UNIVERSITY COLLEGE DUBLIN

NATIONAL UNIVERSITY OF IRELAND, DUBLIN

An Colaiste Ollscoile Baile Atha Cliath

Ollscoil na hEireann, Baile Atha Cliath

WINTER EXAMINATIONS 2005

SCHDF0018 - HIGHER DIPLOMA IN COMPUTER SCIENCE EXAMINATION
ARBDF0015 – THIRD YEAR ARTS EXAMINATION
SCBDF003 / SCBDF0015 – THIRD YEAR SCIENCE & B.Sc. (GENERAL) DEGREE EXAMINATION

COMPUTER SCIENCE

COMPP303: Networks and Internet Systems
COMP3616: Networks and Internet Systems
COMP 3008: Networks and Internet Systems

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

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) An important architectural principle for computer network software is the concept of ***distributed scripts***. Briefly explain this concept as it applies to layered network architectures.

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

(1-c) Suppose that a transmitter operating at 10 Mbps (equivalently: 10,000,000 bps) is connected to one end of a 500 km length of coaxial cable. The signal propagation speed in coaxial cable can be taken to be 250,000 km/sec. If packet-switching is used with a packet length of 10,000 bits, how many ***packets*** have been transmitted and are propagating along the cable when the first bit reaches the other end?

(1-d) Briefly describe the principle of ***least-cost routing*** in packet-switched networks, and mention some possible link costs that could be used.

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:

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

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

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

Question 3

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

1. In Ethernet, each node's physical address is guaranteed to be globally unique.

2. The General Parity Check error-handling scheme, in which the receiver takes the closest valid codeword (in Hamming distance) to the received word to be the transmitted codeword, can detect any combination of bit errors.

3. In any flow control scheme, if the receiver cannot handle the sender's current transmission rate it must send an explicit "slow down" signal to the sender.

(3-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. Using this formula, state and explain the effect on Ethernet throughput of the following changes:

1. the length of the channel is decreased (everything else held constant);

2. the average frame length is increased (everything else held constant).

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.

o O o