UNIVERSITY COLLEGE DUBLIN

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An Colaiste Ollscoile Baile Atha Cliath

Ollscoil na hEireann, Baile Atha Cliath

AUTUMN EXAMINATIONS 2002

ARBDF0015 – THIRD YEAR ARTS EXAMINATION

COMPUTER SCIENCE

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) Two important architectural principles for computer network software are ***hierarchical modularity*** and ***distributed scripts***. Briefly explain these principles in the context of layered computer network architectures.

(1-b) Briefly describe the principal differences between UDP and TCP.

(1-c) 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.

(1-d) 100 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 2,500 bits. The transmission rate at each node is 100 Mbps (where 1 Mbps = 1,000,000 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 = 200 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 = 0.02

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:

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

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

If you want to ensure an average packet throughput of at least 4,500 packets/second, which of these ARQ schemes could you use? Justify your answers mathematically.

(2-b) Draw timing diagrams to show how a Go-back-n ARQ scheme copes with

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

Question 3

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

$$\textbf{throughput} = 1/(\textbf{TRANSF} + 5.4 \cdot \textbf{PROP})$$

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 node transmission rate is increased (everything else held constant);
2. the average frame length is decreased (everything else held constant).

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

1. In Ethernet, a node wishing to transmit might never be allowed to access the channel.
2. The reason for a minimum Ethernet frame length is to ensure a minimum level of efficiency.
3. Token Ring efficiency cannot approach 100% under any conditions.
4. In a Token Bus, each node connected to the bus (whether it is in the logical ring or not) receives each frame transmitted on the bus.

Question 4

(4-a) Briefly describe the principle of ***least-cost routing*** in packet-switching networks, mentioning some possible link costs.

(4-b) The two most common routing algorithms in practice are ***distance-vector*** and ***link-state***. Briefly describe their operation, mentioning the information exchanged between routers in each algorithm.

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 4 kB. The receiver's advertised window is initially 24 kB. The first transmission attempt is numbered 0, and all transmission attempts are successful **except** for Timeouts on attempt number 4. In the ACKs for transmission attempt number 9 and subsequently, the receiver's advertised window is **reset** to 20 kB.

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

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

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