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Department of Computer Science and Engineering

CSE 3213: Computer Networks I (Summer 2008)

Quiz III

Date: July 24, 2008

Name:_____

Student number:_____

Instructions:

- Examination time: 45 minutes.
- Write your name and student number in the above provided space.
- You are not allowed to use laptop, textbook, cell phone and any kind of electronic devices during the quiz **except calculator**.
- Ensure that this quiz has 4 pages (including cover page) and 5 questions.
- Answer the questions in the provided spaces. If you run out of room for an answer, continue on the back of the page.
- Good Luck!

1. Suppose two nodes start to transmit at the same time a packet of length L over a broadcast channel of rate R. Denote the propagation delay between the two nodes at t_{prop}. Will there be a collision if t_{prop} is less than L/R? (2 marks)

There will be a collision in the sense that while a node is transmitting it will start to receive a packet from the other node.

2. The following is a list of desirable characteristics of a broadcast channel of a rate R bit per second (bps)
    a. When only one node has data to send, that node has a throughput of R bps
    b. When M nodes have data to send, each of these nodes has a throughput of R/M bps. This need node necessarily imply that each of the M nodes always has an instantaneous rate of R/M, but rather that each node should have an average transmission rate of R/M over some suitably defined interval of time.
    c. The protocol is decentralized; that is, there are no master nodes that can fail and bring down the entire system.
    d. The protocol is simple, so that it is inexpensive to implement.

    2.1 Which of these characteristics does slotted ALOHA have? (2 marks)

    Slotted Aloha: a, b and d (slotted ALOHA is only partially decentralized, since it requires the clocks in all nodes to be synchronized).

    2.2. Which of these characteristics does token passing have? (2 marks)

    Token ring: a, b, c, d.

3. Using 5-bit sequence number, what is the maximum size of the send and receive windows for Selective-Repeat ARQ? (2 marks)

Send window size = 32/2 = 16, Receive window size = 32/2 = 16

4. Why would the token-ring protocol with Single-Frame operation be inefficient if a LAN had a very large perimeter? (2 marks)

When a node transmits a frame, the node has to wait for the frame to propagate around the entire ring before the node can release the token. Thus, if L/R is small as compared to t_{prop}, then the protocol will be inefficient.

5. Would CSMA/CD have the same efficiency in a WAN environment as in a LAN? Justify your answer from the given formula (see Hint). (5 marks)

Hint: efficiency of CSMA/CD is given by 1/(1+6.4a) and a = t_{prop} * R/L which is a ratio between delay-bandwidth product and frame length. t_{prop} = d/v where d is a distance in meters and c is a speed of light ($3x10^8$ m/sec). Assume that in a LAN d is approximately 100 meters and in a WAN d is approximately 100 KM. Also assume that an average frame length is 1500 bytes.

In a LAN environment, the end-to-end distance is around 100m and the transmission rates are typically 10Mbps, 100Mbps and 1Gbps. An Ethernet frame has a maximum length of 1500 bytes = 12,000 bits.

The table shows the efficiency of CSMA-CD at various transmission rate. Assume *L* = 12,000 bits and propagation speed of 3×10^8.

	a	Efficiency
10 Mbps	3×10^{-4}	0.998
100 Mbps	3×10^{-3}	0.981
1 Gbps	3×10^{-2}	0.839

Note however that if shorter frame sizes predominate, e.g. 64 byte frames, then *a* increases by a factor of about 20. According to the above formula the efficiency of CSMA-CD at 1 Gbps then drops to about 0.7. The situation however is worse in that the minimum frame size at 1 Gbps needs to be extended to 512 bytes, as discussed in page 436 of the text.

In a WAN environment *d* is larger. Assuming 100 Km, *a* is larger by a factor of 10^3 resulting in an efficiency of 0.36, 0.05, and 0.005 respectively for 10 Mbps, 100 Mbps, and 1 Gbps transmission rates. In the case of 10 Mbps transmission rate the efficiency of CSMA-CD is close to the efficiency of ALOHA but in the other two cases it is much less than ALOHA.