Indian Institute of Technology Kharagpur
Dept. of Computer Science & Engineering

Mid-Semester Examination, Spring 2022-23

Subject No.: CS31204/CS31006 **Subject Name: Computer Networks**
Time: 2 Hours **Full Marks: 60**

Answer ALL five questions

4. (a) Explain how a frame is sent by a node in a system using CSMA/CA system, including how collisions are detected and handled. (6)

2 marks for checking for line idle/busy, waiting for IFS etc.
1 mark for waiting for random time even after waiting for IFS time
1 mark for stopping wait timer during the random time wait if line is sensed busy
1 mark for collision detection (given only if you have written that detected by no acknowledgment received)
1 mark for collision handling (given only if you have said anything about changing random time to wait for the next time using exponential backoff)

RTS/CTS are optional and not in basic CSMA/CA. Ok if you have written, no marks deducted, but no marks for that.
Marks for collision handling is given only if you have explicitly said the above; just saying earlier binary exponential random time wait is not sufficient as it does not say where is the time changed.

(b) Suppose that two machines A and B want to communicate with each other in a CSMA/CD scheme using p-persistent CSMA, with p = 0.4. If both machines sense the medium to be free at the same time at beginning of time slot 0, what is the probability that exactly one process will transmit in time slot 0? Assume that a machine gives up after 3 collisions and the time for sensing the channel, detecting collision, processing etc. is negligible compared to the slot time. Show all calculations with justifications. (8)

Lets take only A transmits case. Case for B is symmetrical so can be just doubled.

- *No collision case: A transmits at slot 0, B does not, so 0.4x0.6 = 0.24*

- *One collision case: Here, after collision, machines will choose from {0, 1) slots to wait (binary exponential backoff). So A transmits if: both A and B transmits in slot 0 (so collision), and ((A chooses 0 slots to wait and B chooses 1 slot to wait and A transmits) OR (A chooses 0 slots to wait and B chooses 0 slot to wait and A transmits and B does not transmit)) = 0.4x0.4x (0.5x0.5x0.4) + (0.5x0.5x0.4x0.6))*
- *Two collision case: Similar, just that no. of slots to wait for will be chosen from {0, 1, 2, 3}, so A still has to choose 0 but B can choose any of 1, 2, 3.*

4 marks for no collision case (3 if you forgot to multiply 0.24 by 2)
2 marks for handling collision cases (even if you do not consider that slots to wait for will change with number of collisions; given 1 or 2 depending on how clearly written)
2 marks for handling changing the number of slots to wait for with different number of collisions

5. (a) Explain clearly why there is no collision in a full-duplex switched Ethernet. (4)

2 marks for writing how collision between distinct pairs (say A to B and C to D) are prevented (basically writing how a switch works, 1 or 2 given based on what you wrote), 1 mark for noting 2 separate cables because of full duplex (prevents collision when A has to both transmit and receive), 1 mark for saying buffer inside switch (prevents collision when both A and B send to C).

(b) Explain step-by-step how an Ethernet packet is processed by a receiver in a TCP/IP network. (5)

The purpose of mentioning TCP/IP here is just to see if you remember that in TCP/IP, Ethernet always means Ethernet-2, not 802.3. An Ethernet packet is processed only at the Ethernet layer, rest of the layers process the data part of the Ethernet packet, not relevant. Still given 1 if you wrote things about layering and IP processing etc. only.

1 marks for talking about all fields in Ethernet header (showing or implicitly while discussing)
1 mark for CRC check (this should be done first or 0.5 deduced. If CRC is wrong, no point checking anything else at all)
2 marks for checking destination address (DA) field: 1 deducted if you have not explicitly said broadcast address is also accepted. No marks if you brought in DSAP etc. of LLC which is not there in Ethernet-2.
1 mark for processing Type field. No marks if you said Length etc.

As stated in class, preamble handling is not considered a part of Ethernet frame processing, as you us it to get out the frame as a frame. Ok if you have written it, no marks deducted, just no marks for that.

(c) Suppose you are given five 8-port switches. What is the maximum number of machines you can connect with them? Justify briefly. (3)

2 marks for stating the correct answer (32), 1 mark for arguing why is this maximum. For example, if you have shown one configuration to show 32 machines can be connected, you get 2 because you have not justified why no other configuration can give you more. The max. comes easily from the simple graph fact that to connect 5 nodes you need at least 4 edges, now each edge takes away 2 ports (one at each end) from the total ports (over all switches), so ports remaining free to connect machines is 5x8 – 4x2 = 32.

(d) Can you do reliable communication across a link using Ethernet? Justify. (2)

2 marks for saying no, 0 for saying yes. Ethernet does not have any error control, only error detection, frames can still get dropped due to corruption or switch buffer overflow.

Many of you have written Yes with justification that higher layers can make it reliable, still get 0, that is not the issue at all, you can always add layers above to make any unreliable protocol reliable, that will not be Ethernet anymore. Also, the question asks for communication across a link, so not relevant for end-to-end communication like IP, TCP etc. anyway.

An exception where you got 2 even with saying yes is if you have explicitly said that by Ethernet, you are considering 802.3 and so 802.2 LLC can do this.