Cairo University	Computer Networks 1
Faculty of Engineering	CMPN405/CMP405
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Sheet 5

Part1: Static channel allocation

1. For the two static channel allocation techniques FDM and TDM answer the following
   a. Draw and show how the channel can be shared for N=4 stations evenly.
   b. Show how the number of joining stations can affect the performance of these two techniques.
2. Suppose a TDM channel allocation technique is used in a channel while the frame transmission time = 2 ms, the propagation delay = 2 ms and the channel bandwidth = 6 Mbps.
   a. Find the channel efficiency
   b. Find the effective bandwidth of the channel.
   c. If number of stations sharing this channel is N=200 stations, what is the maximum transmission rate of each station.
3. In which situation is TDM with polling considered an enhancement for ordinary TDM and in what situation it is considered not.

Part2: Pure ALOHA and Slotted ALOHA

4. Consider pure ALOHA channel allocation technique and answer the following :
   a. Is it a collision avoidance or collision detection technique? If it is a collision detection technique how it reacts in case of a collision?
   b. What is the vulnerability period for this technique?
   c. Given that Probability (k Packets are generated in t frame time) = $(\mathrm{T}\boldsymbol{G})^{\boldsymbol{K}} * \boldsymbol{e}^{-\boldsymbol{GT}} / !\,\mathbf{K}$ get the maximum throughput of this technique.
5. Repeat question 4 for slotted ALOHA technique.
6. In which situation is Slotted ALOHA considered an enhancement for Pure ALOHA and in what situation it is considered not.
7. A group of N stations shares 100 Kbps slotted ALOHA channel. Each station outputs a 500 bits frame on an average of 5000 ms even if previous one has not been sent. What is the required value of N stations so that maximum throughput can be reached?
8. Repeat 7 for pure ALOHA.
9. Consider the delay (time before successful transmission) of pure ALOHA versus slotted ALOHA. Which one is less at low and high number of stations? Explain your answer.

Part3: carrier sense multiple access protocols

10. Consider the three CSMA protocols (1-persistent CSMA , p-persistent CSMA and non-Persistent CSMA) and answer the following :
    a. Are they collision free algorithms? If not, in which cases a collision may happen?
    b. If a station senses the channel is busy before sending, when it can send its frame? With which probability of sending?
11. a. In what way p-persistent CSMA is an improvement of non-persistent CSMA?
11. b. In what way CSMA/CD is an improvement of non-persistent CSMA?

12. For how long a station using a channel with CSMA/CD should at least wait before it detects successful transmission operation?
13. For a channel with CSMA/CD, if the round trip delay is 4 ms and the channel bandwidth is 20Kbps, calculate the minimum frame length.
14. For question 13 if the maximum number of collisions before any first success of frame transmission is 13 ,calculate the channel efficiency

Part4: collision free protocols

15. In the binary countdown protocol, explain how a lower-numbered station may be starved from sending a packet.
16. Consider 3 stations A, B and C that share the same medium and apply bit-map protocol. The following table shows the contention window number where each frame is ready to be sent.

Frames	Arrival windows
A0, A1, A2	0, 3, 7
B0,B1	0,4
C0,C1,C2	3,5,7

Apply the bit-map protocol (show your steps) and find the order of the frames to be sent.

17. Solve the previous question with binary countdown protocol using the following addresses: C=10, B=01, A=00, give the priority to the highest address.
18. What is the advantage of Binary Countdown protocols over Bit-map ones?