

**Q1 (4 points).** Consider the wireless network in Fig. 1 where nodes use the MACA protocol and the Binary Exponential Backoff for accessing the channel. Describe a scenario in which one of the two connections,  $S_1$  or  $S_2$ , would be able to send a series of packets while the other connection no one. Assume that  $B_1$  and  $B_2$  always have packets to transmit.



Figure 1

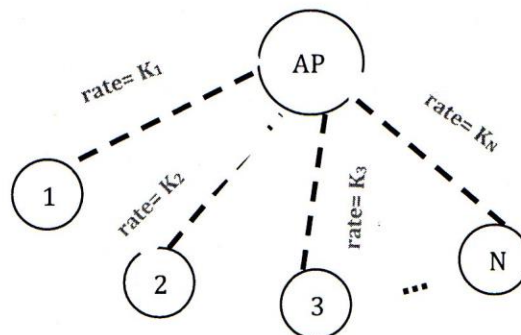
**Q2 (4 points).** Wi-Fi (IEEE 802.11) adapted the binary exponential backoff (BEB) algorithm from Ethernet (IEEE 802.3). Do you see any issues with this choice? How would you address them? Justify your answers.

**Q3 (4 points).** What are the key differences between WiFi and Bluetooth? What are the reasons behind these differences?

**Q4 (4 points).** Illustrate with a simple example the difference in path computation between DSR and AODV.

**Q5 (6 points).** Rate control

Consider the network illustrated below, consisting of  $N$  IEEE 802.11 clients associated to a single AP. All clients are in each other's range and are transmitting as fast as possible packets of size  $M$  bits to the access points. The access point itself has no packets to send. A particular client  $i$  transmits to the access point at  $K_i$  bits per second and the rate never changes.



1. Give an expression of the average throughput of the system, i.e., the average bits per second arriving at the AP, as function of  $K$ ,  $M$  and  $N$ . Ignore all overhead, including channel access time, ACK, RTS/CTS, etc.
2. Adapt the expression computed above assuming all nodes are using the Opportunistic Auto-Rate algorithm.



Q1 (4 points) Consider the wireless network in Fig. 1 where nodes use the MACA protocol and the Binary Exponential Backoff for accessing the channel. Describe a scenario in which one of the two connections,  $S_1$  or  $S_2$ , would be able to send a series of packets. Is the other connection able to send a packet? Justify your answer. (4 points)

Q2 (4 points) With IEEE 802.11, explain the binary exponential backoff (BEB) algorithm from CSMA/CD (IEEE 802.3). Do you see any issues with this choice? How do you address them? Justify your answer.

Q3 (4 points) What are the key differences between WiFi and Bluetooth? What are the reasons behind these differences?

Q4 (4 points) Illustrate with a simple example the difference in path computation between the two.

Q5 (4 points) Rate control: Consider the network illustrated below, consisting of  $M$  IEEE 802.11 clients associated to a single AP. All clients have each their own congestion control algorithm and are configured to a network bandwidth of size  $M$  bits per second. The network bandwidth is  $K$  bits per second. A particular client  $i$  transmits at the source point at  $K_i$  bits per second. How does the rate control algorithm work?

