Exercise Sensor Networks

Lecture 6: MAC in radio networks

Exercise 6.1: Aloha with preamble sampling

A sender wants to transmit a packet to exactly one receiver via unicast (in contrast to broadcast). On the MAC layer Aloha with preamble sampling is implemented.

a) Why is transmitting a packet in this situation (unnecessarily) energy consuming both for the sender and the receiver?

b) How could the protocol be improved with regard to the problems identified in a) without having to synchronize the nodes? In other words: The solution should be able to work without a synchronized watch.

Exercise 6.2: S-MAC

Ye, Heidemann and Estrin describe in their paper „An Energy-Efficient MAC-Protocol for Wireless Sensor Networks“ their S-MAC approach. Therefor nodes have to synchronize themselves from time to time. Otherwise their sleep- and listen periods would diverge too much.

Some nodes may adopt more than one schedule, the one of their own cluster and one or more of neighboring clusters. The authors only describe how the schedule is synchronized within one's own cluster.

a) What is special about nodes that store more than one schedule and which know about the existence of more than one cluster, especially with regard to the synchronization?

b) The authors do not address the problem from a). How could it be solved?

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Exercise 6.3: Hidden- and exposed station problem

Six stations are grouped around a mountain in a chain topology. Each station is able to hear the next and the previous neighbor in the chain. Station 6 and station 1 can also hear one another. Stations optimize their behavior in order to avoid collisions if possible. We consider only single packets which means that no RTS/CTS is used.

a) Station 2 is sending to station 1 already. Station 3 wants to address station 4. Is 3 allowed to send a packet and will it do so? Where does the collision occur?

b) Station 3 sends to station 2 and 5 would like to send a packet to station 4. Will station 5 start sending and should it?

c) Station 1 and 2 are sending. Which stations belief that they can send and which ones are actually allowed to do so?

d) Station 1 and 4 send. Which stations belief that they can send and which ones are actually allowed to do so?