Exercise Sensor Networks (till March 3, 2008)

Lecture 1: Motivation

Exercise 1.1: Estimation of a node's lifetime

The following data about a sensor node is known:

Consumption in sleep-mode:	50 uA = 0,05mA [1u = 10^(-6)]
Consumption while CPU running (for doing calculations):	8mA
Additional consumption for sending (via radio):	10mA
Additional consumption for receiving (via radio):	6mA

The battery provides an amount of energy of 1800 mAh. The node is driven with the voltage provided by the battery. The measurements above are also based on this voltage.

How long can a node be driven if a measurement has to take place every 200ms but sending is required only once per second? We assume that each attempt to send a packet requires to receive one as well and that a node knows exactly when an incoming packet will arrive. Each packet consists of 200 bytes of data. The wireless radio connection has a throughput of 9600 bits/s. A single measurement takes 5ms.

(1) How long can a node be driven?
(2) To which extend does the lifetime decrease if a node does not know when a packet of another node arrives and thus has to listen to the radio channel all the time?
(3) A couple of influences have not been taken into account in the above calculation. Find some of them and quote why they shorten or prolong a node's lifetime.

Exercise 1.2: Antenna length

The length of a full phase of a wave (think of a sine wave between 0 and 2xPI) will be denoted with lambda. It is known from communications engineering that a sender's optimal efficiency is achieved if lambda is 1/4 of the wave length. Note that the signal travels approx. at the speed of light (300000 km/s). How long should the antenna of the sensor node be if it sends at a frequency of 868 MHz?