Abstract

Almost one decade later, wireless sensor networks (WSNs) still challenge scientists to solve the problem of minimizing energy consumption. Efficient routing algorithms, innovate topologies, radical ideas that go beyond classical models, such as mobile sensors, and most recently the exploitation of alternative forms of energy have been proposed in order to reduce energy consumption in the network. The incomplete dream of the scientific community is to realize a wireless sensor network in which all devices have very small, balanced, energy consumption and lifetime close to infinity.

Simultaneously, at the end of 2007 scientists from university of MIT, presented a paper which proved analytically that it is possible to achieve wireless energy transfer over long distances with efficacy close to 40%. In 2008 they presented a real system that was able to transfer power wirelessly in a distance of 2 meters and efficacy of 45% while later other researchers improved the performance even more. Thus, it seems that the dream of perpetual operation of a wireless sensor network can become true by embedding this technology through a mobile node which acts as a charger which charges the static nodes.

In this work, firstly, every possible known technique is presented which can help to minimize the energy consumption in a WSN. Then, a formal definition is provided for the charging problem, which is proved to be computational hard. In order to better understand the impact that charger's integration into WSNs has, it is assumed that the total initial available energy to the network, E_{total}, is $E_{total} = E_{sensors} + E_{MC}^{init}$ where $E_{sensors}$ is the static sensor's initial energy and E_{MC}^{init} is the energy that is given initially to the charger.

Under this model and using 3 completely different routing protocols, the following are investigated:

- Is it better to equip the mobile charger with a part of the total initial energy, E_{total}, in order to charge the sensors?
- Which charging strategy (partial vs full) maximizes network's lifetime?
- What percentage of the total initial energy, E_{total}, best maximizes network's lifetime?

Last but not least, numerous trajectories of mobile charger which use only local information are studied and compared to a heuristic global knowledge charger in respect to network's lifetime, connectivity, coverage and energy balance.