Title: Energy in Wireless Sensor Networks

Energy usage is one of the main issues in WSNs. A depleted node affects the whole of the WSN; it reduces the sensor data collected as it no longer generates data. In addition, it affects the rest of the nodes, since it cannot forward data from other nodes. The result may be a higher forwarding load on other nodes affecting their lifetime, and at worst, a partitioning of the network. Generally, the main energy consuming part of the nodes is the radio. During operation, the radio switches between different states such as receiving, transmitting, idle and sleep. The amount of energy consumed varies with the radio state. Sleeping consumes substantially less energy than the other states. To reduce the energy consumption, the nodes should therefore switch to sleep state as often as possible. A broad range of approaches suggested in the literature are focused on the radio states, and how to increase the time that nodes are sleeping. The approaches suggested mainly belong to the MAC layer as it manages the different states of the nodes.

The MAC layer energy reduction methods do not preclude the impact of the solutions suggested at other layers. At the network layer, the routing protocols play an essential role, for instance to balance the energy in the network. Balancing the energy consumption prevents early depletion of nodes, and it is especially important to prevent early depletion of key-nodes. Key-nodes are the nodes that cause network partitioning since they forward data for other, more remote nodes.

The focus of this tutorial is MAC and network layers solutions to reduce energy consumption in WSNs. At the MAC layer the primary investigation is on Low Power Listening (LPL) as a sleep protocol, where the nodes periodically wake up to listen for activity. Nodes that have data to send, use a preamble packet to signal the transmission. The preamble informs the nodes to stay awake to receive the data packet. At the network layer, the focus ison balancing the energy consumption between routing path. For instance, a node with several potential successor nodes should choose the node with the currently highest amount of residual energy. In addition, since the transmission range is decided by the transmitter, one of the main energy-consuming parts of the nodes, topology control protocols are briefly discussed.