No more batteries

After cordless phones and wireless Internet there is a third wireless wave coming: wireless sense and control networks, connecting all kind of equipment in our homes from freezers to light switches, from consumer electronics (TV, DVD-player) and remote controls to sensors, for detection or protection, and to central door locking and window locking (as we are used to in our cars). Actually the IEEE 802.15.4/ZigBee is going to be the driving standard to make this improvement of comfort and opportunity of energy management a practical reality in a not too distant future. Unfortunately, all these sensors and controls are going to use significant quantities of batteries creating environmental concerns as well as a serious maintenance problem (continuously exchanging batteries). Therefore energy harvesting (or scavenging) is such an exciting opportunity in technology development, where the energy that is available in the environment is used instead of batteries.

Unfortunately there is a lot of hype going on in the world of energy harvesting that needs to be separated from the reality. Energy harvesters can usually be divided in two categories: the "tricklers" and the "bursters". The most well known energy trickler is the solar cell, where certain varieties of solar cell can even pull energy from the limited light that is available indoor. To be usable for sense and control networks it is important that the energy is stored and also that the usage of the energy is controlled: a task (eg. a data transmission) is only started when there is enough energy to finish it (eg. receive the acknowledgement). Solar cells have a big advantage: they are relatively cheap, and they have a serious drawback: they only work when there is light…, and that is not very good news, when networks need to be reliable independent from lighting conditions (as most networks do).

Another trickler energy harvester is a peltier element that taps into the energy stream that comes into existence when two sides of one object have a different temperature, eg. a wall of a house, where the outside temperature is different compared to the inside temperature. Usually a temperature difference of 5 degrees Celsius gives enough usable energy. Unfortunately also the dependability of peltier elements is limited because of the fact that temperature differences usually cannot be controlled, and… contrary to solar cells, peltier elements are relatively expensive.
The mostly used energy "burster" is the dynamo, a sort of reverse step engine, where instead of energy being used to create motion, motion is used to create energy. Actually this form of energy creation is quite crude as usually once set into motion the amount of energy that becomes available is way beyond the requirements of a sensor networks and need to be burnt off. Unfortunately this type of energy harvesting is also quite expensive.

Another "energy burster" is the piezo element, where energy is created from mechanical torsion. Also here the amounts of energy are relatively large, however – piezo elements are quite sensitive to wear and tear and making these piezo elements reliable and durable makes them also quite expensive.

Taking a look over the energy harvesting field the conclusion can be that this technology is still a major challenge despite the steps that are being made. No cheap and high volume solutions are in sight, with exception of the solar cell. Actually solar cells are the only energy harvesters that are producing in high volume and low cost as required by sense and control networks, but to overcome its "dark shortcomings" the assistance by small batteries is still required. The good news is that this way at least the growing stream of batteries is somewhat reduced, but not eliminated.

Interesting developments are going on, the most recent one that was announced was the energy harvesting from trees (by putting an element between the tree and the ground and tapping energy from the difference in the electrical charge – and available 24 hours per day). It would be a nice step forward to get it in our homes and out of plants as well, but that maybe still a while to go, and then changing the batteries is eliminated by watering the plants…

Anyhow, no more batteries will continue to be quite a dream for a while…, but with solar cells at least a step can be made!

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