Wireless Sensor Network Progress

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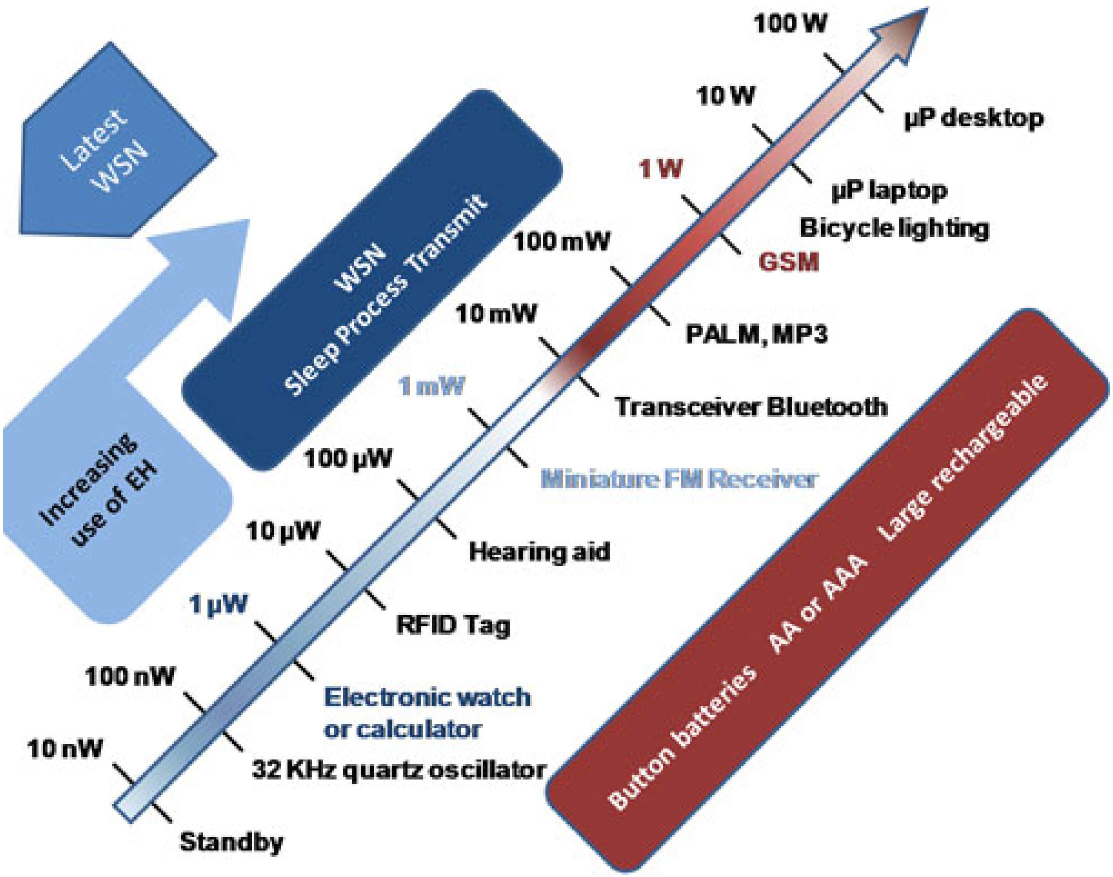
Approximately 100 years after Michael Faraday came Nikola Tesla, another European electrical theory giant who parted his hair down the middle. Faraday brought us the DC motor and much more; Tesla brought us the AC motor and likewise. In 1905, Tesla also foretold that we would globally communicate with hand-held phones. Another 100 years onward and we are progressing towards even bigger dreams.

Yet it is only a step toward small devices communicating without human involvement, along with those radio masts, and their vulnerable cabling. Remember when all those cell phones went down during the Haiti earthquake? Anyone or anything—even power outages from a volcano or earthquake—can take down your systems. They are vulnerable, including the Internet and its hard-wired infrastructure.

Mimicking the way a message is passed through a crowd, so-called ad hoc networking of radio signals is gaining in popularity. In its most general form, it is like mesh, in which anything can communicate provided it is nearby and ready. Like people talking, mesh networking devices both receive and transmit without infrastructure.



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After three decades of development, tens of millions of utility meters from buildings communicate via mesh networks using the ZigBee protocol and derivatives. Similarly, Meraki Networks connects 400,000 San Francisco residents to the Internet via free ad hoc networking, and others additionally aim to replace the tangle of wires.

The Good News & the Bad News

Wireless sensor networks are machine-to-machine mesh networks that operate like the Internet in that they are self-organizing, self-calibrating and self-healing. Furthermore, if a node fails, messages still get through. As with people passing on a message in a crowded room, however, there are problems maintaining such nodes if they are to be there for long. Batteries must survive and remain charged, or something better must be used, for instance.

Additionally, there are severe interference problems and garbled messages, but mathematicians, standards writers and systems analysts are working on it. Nevertheless, wireless bandwidth is a constrained resource, knowing node location is troublesome, coping with moving nodes is difficult, etc. Therefore, wireless sensor networks are a compromise: In real-time communication, these networks frequently encounter delayed messaging. The message only passes when another node comes within range and power is available.

Thus, there is now a trend towards putting two or even three different kinds of harvester in each node. Alternatively, a lithium-thionyl chloride primary battery can last 20 years in the node, but its use may have to be minimal—not too many message transmissions and not for too long.

So far, the packets of data are small with all wireless sensor networks, but Twitter has shown us that small packets of data can achieve a great deal. So has EnOcean radio-emitting light switches and other controls (which are active in more than 100,000 buildings), some of which are two-way, but not yet meshed. Like a miniature version of a bicycle dynamo capturing movement, EnOcean controls rely on energy harvesting through electrodynamics—thank you, Faraday. They also use photovoltaics and thermoelectrics. Then add piezoelectrics, and all lead to a battery-less wireless sensor network, though we are not there yet ... or it’s not used in volume anyway.

In that crowded room, sending a message is easier if people have strong voices and listening skills. The electrical equivalent is chips that use less power in the wireless sensor network node. Some wireless sensor networks act as gas guzzlers; some even discharge their batteries in only a few weeks. If rechargeable batteries must rely on energy harvesting, it should be recognized that none are guaranteed for even 10 years.

The good news is that some companies now have wireless sensor network routing nodes absorbing a mere 90 to 300 microwatts and leaf nodes at the edge of the network functioning on 30 microwatts. Such figures match those of traditional active radio frequency identification, which is much more primitive in capability. Tiny broadband vibration harvesters, transparent film photovoltaics and many other forms of harvesting become suddenly enabled.

In due course, printed electronics—a revolution as significant as the microchip 40 years ago—may offer the prospect of memristor electronics mimicking human brain synapses, which could mean consuming even less power. As a result, harvesting may be achieved at a low cost.

It is certain that there will be other major breakthroughs that we cannot currently envision, including perhaps, by a third genius. Maybe that genius will also part his or her hair down the middle ... like Faraday and Tesla. Then tradition would haunt technology as much as wireless sensor networks promise to haunt the future industrial and commercial landscape.

For more information, please visit www.idtechex.com [1].

Links:
[1] http://www.idtechex.com/