The ZigBee Umbrella

Trying to be everything for everybody you always run the risk of becoming nothing for nobody. This was somewhat of the trap that ZigBee almost fell into, but a few smart moves on the side of the ZigBee Board have helped to stay away from this risk.
The ZigBee standard was always positioned as the solution for low power (sense- and control) networking. But low power networks come in a variety of flavors and it took some time to recognize and classify them. This growing insight is now formulating these groups as follows: (1) low power, (2) very low power and (3) ultra low power. This is more than a word game, because it is turning out that this leads to a reasonably proper grouping of fields of applications and sources of energy available.

These three groups can be defined for sense- and control nodes as follows:

1. Low power: every transaction (interaction, packet) of the node needs more energy than in the area of 2,000 microJoule; therefore the energy is made available through the mains power or some type of large batteries (for example two AA-batteries, depending on the application power needs), where changing of the batteries is not leading to an overriding maintenance issue. In this situation the node is capable of expanding its functions, like becoming a mesh node and bridge larger areas or a gateway into an IP network.
2. Very low power: in this situation the energy of a node required per transaction is in the range of 200 to 2,000 microJoule and in general is provided through a battery, where the battery life time in general exceeds the lifetime of the (sense or control) node – in other words, can become maintenance free; it is clear that with this limited amount of energy available the node cannot support significant extra functions like meshing.
3. Ultra low power: this is the category of nodes where per transaction less energy is required (or available!) than around 200 microJoule and usually is only available on an intermittent basis, for example through energy harvesting. Although there are burst type of energy harvesters available that produce an abundance of energy to support the category (2), in general it takes for instance a small solar cell a few minutes to make this energy available.

Clearly more can be said about this categorization, as nodes have a very low duty cycle (are asleep most of the time that is 99% of the time or more). So, energy consumption during sleep becomes relevant in the total calculation as well, but in a way these three categories map reasonably well on the three categories in ZigBee that are getting serious market traction.

1. The ZigBee Smart Energy standard operates under the profile of energy being available in (relative) abundance for home energy management applications. This technology can become the backbone for the sensor network and meshing capabilities.
2. The ZigBee RF4CE standard (replacing infra-red with two-way radio frequency for consumer electronics applications) as was adopted from the RF4CE Alliance, fits the life-long battery application profile for remote controls and comparable small devices.

3 The recently announced ZigBee Green Power feature set is targeted at the battery-free, energy harvesting based operating end-nodes like wireless dimmers and switches.

These three standards that all can work worldwide under the 2.4 GHz based IEEE 802.15.4 compliant radio certification (like Bluetooth and Wi-Fi) are forming together a nice family of coexisting ZigBee protocols that can easily be interfaced with the existing and well-known IP networks, say "the Internet". The definition of this interfacing is still ongoing but the emerging picture looks as follows, for the above three categories.

1 Several gateways for ZigBee Smart Energy to Ethernet are under development or already exist today and make ZigBee Smart Energy nodes immediately addressable via the Internet.
2 ZigBee RF4CE devices can be connected to the Internet also via a gateway in the so-called "target" of the ZigBee RF4CE node.
3 The ZigBee Green Power end-nodes present a little more of a challenge as these nodes may not have any power to be talked to. Actually these are nodes that appear sometimes suddenly on the network (when there is energy), but for the rest of the time they are "off-line".

Although this energy based categorization has its limitations, it has proven useful so far in defining the categories of nodes, based on energy availability as it creates a consistent set of definitions under the ZigBee umbrella that helps to make ZigBee the universal standard for sense and control networks for home and building applications worldwide. It does so not by trying to be everything to everyone, but by a careful definition of the different application categories and scale the networking technology solutions accordingly.

Do you have comments or suggestions? I appreciate your feedback!

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