

Wireless Sensor Networks Come of Age

The adoption of wireless sensor networks, or mesh networks, has struggled over the years to live up to its hype in commercialized applications and deployments. However, says Martin Hanssmann, with the recent advent of new commercially viable standards, this technology is now proving itself.

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The earliest 802.15.4-based standard for Wireless Sensor Networking (WSN) to be introduced to the market was ZigBee, with the stated goal of becoming a common standard for industrial, commercial, residential, and other applications. WirelessHART, released in late 2007, is a standard that specifically targets the well-established *wired* HART market to provide a secondary wireless data link to its very popular industrial communications bus. Within the context of process monitoring, this standard should find a successful niche for wireless sensor networks that require 30-50 devices with sampling periods of greater than one second.

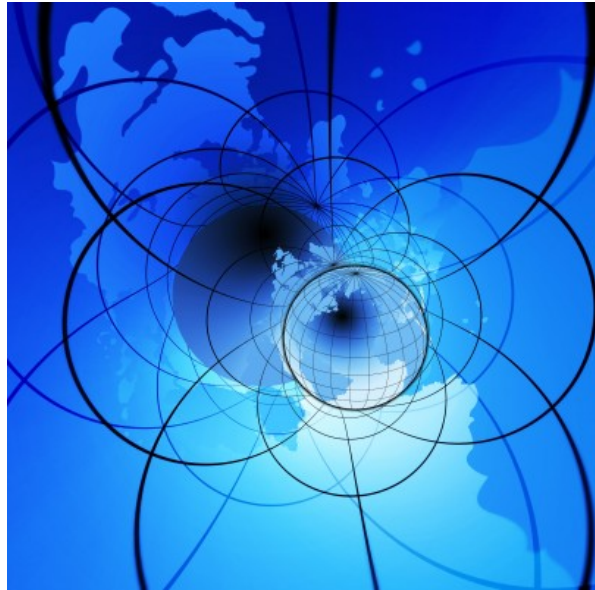
Following closely on the heels of WirelessHART is the ISA100.11a standard. In its first instantiation, ISA100.11a is also intended to address process monitoring applications, including those with a broader perspective than WirelessHART (particularly in its gateway and network manager integration within industrial automation schemes). Yet another player in the market is Z-Wave, which focuses primarily on residential markets.

A simple heuristic equation formulated by Millennial Net postulates that an overall mesh network performance (Q) can be seen as the sum of Reliability (R), Low Power and Low Latency (P), Range (L), Scalability (C), Data Rate (D), Network Topology (T), and Security (S).

Essentially, this equation states that the overall network performance (Q) can be considered a constant for all 802.15.4-based solutions; maximizing parameters such as Data Rate (D) and Network Topology (T) can come only at the expense of other parameters such as Reliability (R) or Scalability (C).

Maximizing Reliability and Security

Each of the standards serves a different market; characteristics of these markets drive the parameters that are most essential to meet the needs of the intended applications. WirelessHART, for example, has taken a TDMA approach that maximizes reliability and security



but sacrifices data rate, latency, and scalability. ZigBee, in its earlier releases, took a CSMA approach with a fairly uniform focus on all of the variables. It demonstrated a potential fit for almost any application but was insufficiently optimized to address particular market needs. The new ZigBee Pro standard, although still early in its deployment, appears to be optimized more for the home area network market, much like Z-Wave.

These approaches currently leave two significant holes in the coverage of WSN standards: there remains a need to address the discrete automation segment (where extremely low latencies of sub-10 milliseconds are required) and a need to address the complex commercial buildings market. Organizations such as ISA SP100 (which has formed a Factory Automation Study Group) and the Profibus User Organization (PNO) are now focusing their attentions on the former.

The latter segment includes larger buildings of more than 50,000 square feet and accounts for over 50 percent of total building square footage in the US today. Wireless Sensor Networking in such buildings can be an extremely appealing alternative for secondary monitoring and control, including demand and response. However, any solution must robustly address the simultaneous

need for 150+ sensors and 10+ hops with reliability, range, bi-directional communication, and sub-second latency. This need is currently being met with proprietary protocols by Millennial Net's MeshScape, now in its fifth generation. Millennial Net's MeshScape protocol is based on a Time Adaptive CSMA approach specifically optimized to meet the complex building market needs. With over 40,000 nodes deployed, the MeshScape protocol is reliable, robust, and highly scalable.

An increased understanding of the specific characteristics each WSN standard brings to its market segments leads to successful deployment. With positive user experience, wireless sensor networks are coming of age; yet despite the new standards, there remain market characteristics not fully met by standards. To avoid disappointing results, it is increasingly important that users diligently analyze their needs before choosing a solution.

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