

Wireless Sensor Technology

New wireless sensor technology facilitates unprecedented energy savings, waste reduction, and cost benefits.

Creating a New Market

New sensor technology developed with cost-shared funding from the Industrial Technologies Program (ITP) is immediately useful in a variety of industrial equipment and processes. Wireless sensors can be installed in places that were impractical for wired devices. The technology is proving as transformational for manufacturing as the Internet was for information distribution.

Industry is just beginning to explore potential uses for industrial wireless technology. The initial focus area is *Condition-Based Monitoring*, in which wireless sensing systems track the status of the manufacturing infrastructure to uncover wasted energy. Many plants already monitor their large motors continuously using wired sensors. *Mechanical Engineering* editor Paul Sharke noted that for motors, "...wiring in plants is expensive—mainly because of

"The DOE ITP Wireless Program kick-started a worldwide effort to address the energy-savings and operational improvements that large, energy-intensive industries were requesting. This has directly led to hundreds of companies and thousands of technology-related jobs being created within the past five years—and this is with the market just emerging."

Hesh Kagan, Chair
Wireless Industrial
Networking Alliance (WINA)



DOE's wireless sensor research partners, including Eaton, GE, and Honeywell, have converted their technology advances into commercial products, such as the wireless sensor unit above, shown at an industrial installation.

the high cost of labor—and falls between \$160 and \$4,000 a foot... Wireless mesh networks are the latest hope in eliminating this costly barrier to abundant information."

ITP Role

The Industrial Technologies Program has facilitated the development and use of wireless sensors to boost industrial energy efficiency, as demonstrated by the following activities.

- **Conducted pioneering R&D** using the expertise of Oak Ridge National Laboratory to demonstrate the promise of wireless sensing in 1999.
- **Sponsored development of a "Wireless Vision"** by bringing together suppliers and end users to set high-level goals for developing wireless sensors for industry. The resulting *Industrial Wireless Technology for the 21st Century* continues to guide development of industrial wireless technology.
- **Provided cost-shared R&D support** to three leading companies to pursue initial systems.
- **Catalyzed the formation of an industry association**, the Wireless Industrial Networking Alliance (WINA), to facilitate wireless deployment in industry.

- **Provided support for development of ISA 100 standard.** Global standards promote market acceptance and accelerate deployment to save energy.

A Wave of Wireless Technology Advances

ITP's research partners completely redesigned a previously existing wireless system. Their advances produced a technology that can:

- Coexist with other wireless systems (such as wireless telephones) via automatic smart channel selection.
- Provide robust service through redundant data transmission and tight time synchronization with all network sensors.
- Deliver multi-year operation through low power, low data rate, wireless connectivity.
- Heal itself by automatically rerouting data and re-establishing synchronization in case of failure.
- Transmit securely through use of NIST's Advanced Encryption Standard.
- Assure timeliness of transmitted data throughout the network via use of a robust protocol to guarantee data delivery within tight time constraints.

Why Wireless?

Industrial wireless technology is now improving industrial production efficiency by 10%, depending on the application. Potential benefits of wireless technology include:

- **Reduce costs:** Eliminate the need for wiring (\$50-\$2,000 per foot) and reduce maintenance costs for motors and other plant equipment. (See cost-benefit analysis below.)
- **Increase productivity:** Enable faster, real-time identification and repair of poorly performing motors, to save energy. Make it possible for facility staff to easily install sensors anywhere in a plant, eliminating the need for manual equipment checks and reducing product waste.
- **Improve knowledge management:** Help manage large quantities of information and increase the accuracy of system data.

Potential Barriers to Market Adoption

Key barriers to commercialization of wireless technology include the following:

- Lack of technical standards
- Data security concerns
- Perceived reliability issues

These barriers have been addressed by ITP industry partners as part of the technology development process. (The table below highlights selected approaches.)

Bottom Line

Wireless technology is creating new markets. Wireless system suppliers are finding that industry will purchase wireless systems because they make excellent business sense. The potential energy and cost benefits to the companies that use these systems—and to the nation—are impressive.

Sample Application:

Compressed Air Systems

Sensors to monitor and optimize the performance of compressed air systems can help industrial facilities operate at peak efficiency. Until now, the high cost of running wires from sensors to a central monitoring station made this application impractical.

Low-cost, wireless sensors were recently used in a paper mill to capture performance data in three compressors. The technology so impressed the mill management that it installed seven more wireless flow meters in less than a day. The ease of deployment and immediate benefits (documented energy savings of 30%) prompted the installation of five additional wireless sensors at key locations.

Wired vs. Wireless*

Wired Automation Investment	Initial \$	Annual \$
Wired Installation	385,000	
Wired Inspections	70,000	70,000
Wired Total	455,000	70,000
Wireless Automation Investment	Initial \$	Annual \$
Sensors and Wireless System	121,000	
Average Annual Maintenance	14,000	14,000
Wireless Total	135,000	14,000

* Based on analysis by Honeywell

Addressing Barriers to Commercialization

Issue	Solution
Lack of Wireless Standards	ITP actively supported efforts by supplier and end-user communities to unite behind a single wireless sensor standard fostering multi-supplier interoperability and facilitating industry adoption.
Issue	Solution
Data Security and Interference Concerns	ITP partners created a “frequency-agile” hybrid transmission system, which improved security, performance, and coexistence with other wireless systems.
Issue	Solution
Reliability/Ease-of-Use	ITP’s R&D activities emphasized use of the technology in rugged environments, ease of implementation, and extended battery life (5+ years).

For additional information, please visit www.industry.energy.gov.

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