Wireless Telemetry For Industrial Applications

Wireless Telemetry Architecture will be Developed to Provide Building Blocks for Intelligent Industrial Process Control Systems

Robust wireless telemetry technology that provides building blocks and technology underpinnings for the deployment of intelligent industrial process control systems will promote the long-term goal of increased energy efficiency in the industrial sectors. To this end, a wireless telemetry architecture (integrating principle) will be developed that addresses the following needs: reliable communications and networks, environmentally robust systems packaging, easily deployable and costeffective infrastructure, and standardized communication protocols and structures. Additionally, this activity will address the critical needs of the energy-intensive industries by integrating sensor and control suppliers into the commercialization process.

The emerging technology will integrate sensors with signal conditioning, digitization, and intelligent processing and with communication electronics, all on the same silicon substrate. This holds the potential to provide a new generation of sensors that will perform better while costing less to purchase, deploy, and upgrade than conventional wired sensors. With wiring costs ranging from $40 to $2,000 per foot in industrial applications, the potential market size is significant for wireless solutions, both for new applications as well as upgrades and retrofits for legacy systems.

Wireless sensor on a chip

Benefits for Our Industry and Our Nation

- Nonproprietary, wireless-network architecture allowing integration of third party components and hardware
- Dynamic reconfiguration and adaptability to meet many specific industry needs
- Reduced cost through integrating signal sensing, conditioning, and processing with communication electronics as well as through elimination of wiring costs
- Reliable communications and networks, with standardized communication protocols and data structures
- Robust performance in difficult industrial environments
- Easy deployment
- Increased operational and production efficiencies
- Improved process and personnel safety
- Lowered energy use and reduced emissions

Project Description

Goal: Develop a nonproprietary, dynamically reconfigurable, wireless-network architecture that provides standardized communication protocols and data structures for robust performance in industrial environments.

An architecture specification document has been developed that details communication protocols, data formats, hardware configurations, software formats, power management strategies, and standards development, allowing multiple commercial suppliers to manufacture compatible devices for the prescribed network of intelligent, multifunctional wireless sensors. During FY 1999, the first prototype, including a single-sensor node with master transceiver, was designed and tested to demonstrate bi-directional communication, outboard data acquisition/transmission, and data reception in a predetermined industry test site.

Further development was carried out in the second year to demonstrate incremental enhancements such as intelligent, spread-spectrum, wireless, multisensor-compatible application-specific integrated circuits (ASICs) in the 915-MHz ISM band. These enhancements were specifically configured for industry applications such as emissions control, condition-based maintenance, material-flow management, energy utilization, and waste-stream monitoring. The focus was to develop a standardized front end for integration with various sensors so that the integrated systems could be broadly applicable and also able to meet individual application needs.

In subsequent years, work focuses on the development of prototypes that demonstrate comprehensive functionality across multiple application environments. These units supporting a standards-based, dynamically reconfigurable, wireless network architecture will be demonstrated in extended mill trials for features such as multi-point, bi-directional communication, robust information integrity, and intelligent front ends to accommodate high bandwidth sensors. Work in the final years emphasizes critical issues in broad-scale deployment: open-standards (ISA SP100); end-user partnerships (WINA, Sensors Magazine), and performance qualification testing (the Extreme Measurement Communications Center at ORNL).

Progress and Milestones

Industrial Technology Program participation in this multi-year project began in FY 1999. Key tasks that have been performed or are planned are:

- A functional description and requirements document that identifies key functionality, utility, and operability targets has been developed.
- An architecture specification document that adopts the IEEE-1451 standards as a basis for standardization has been developed.
- Development and demonstration of prototypes will occur in three successive stages:
  1) demonstrate a first-generation prototype system in the plant environment
  2) develop laboratory prototypes that demonstrate evolutionary advancement toward integrated, intelligent wireless systems
  3) demonstrate and quantify performance of pre-production prototypes of miniature, standards-based, intelligent wireless networks with general purpose sensors and compliant with the emerging global industrial wireless automation standard, SP100
- The plant demonstration plan to showcase this technology to prospective users and suppliers will be developed.

Applications in Our Nation's Industry

Wireless telemetry technology provides building blocks to integrate various sensor and control components into deployable systems to meet individual industry application needs, including:

- emissions control
- condition-based management
- energy utilization
- waste-stream monitoring
- monitoring of inventory, mobile assets, manufacturing processes, and final product movements throughout the process

Project Partners

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Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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