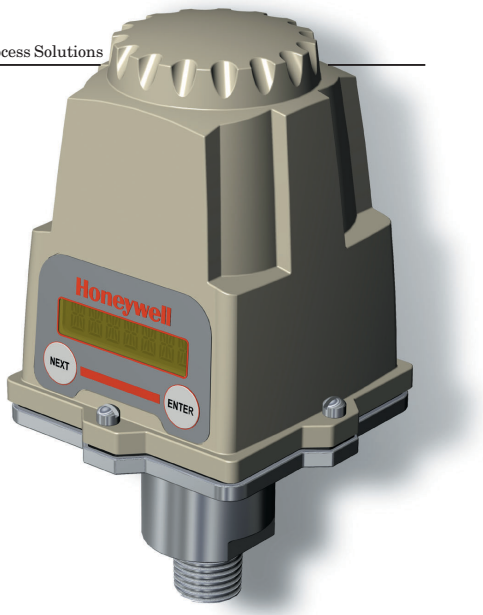
PRACTICALLY WIRELESS

These systems can be as reliable and secure as hard-wired systems — in some cases, even more so. Yet, the proof isn't in how they have replaced, but rather how they have extended, wired-in networks



Honeywell Process Solutions

The XYR 5000 family of wireless transmitters offers a long battery life (3 to 5 years) and a low-battery alarm

Both acclaim and skepticism have resonated loudly since wireless instrumentation technology — signal communication by radio signals instead of hard wires — became a topic of discussion in the chemical process industries (CPI). Naysayers question the reliability and security of wireless networks, while enthusiasts champion the reduced cost of installation and improved profitability that wireless technology can bring.

The voice of reason reckons that wireless systems are suitable for industrial applications except those that require high data rates and fast response times. Wireless can make asset management data more useful, streamline the supply chain and enhance process-control functionality and reliability. CPI companies from petrochemical refiners to pigment producers are proving this to be the case.

In a nod to wireless' ability to "reduce process upsets, lower energy consumption, reduce emissions, and enhance competitiveness," the U.S. Dept. of Energy (DOE; Washington, D.C.; doe.gov) will provide 50% cost-share funding for a $10-million demonstration and test of wireless sensor networking systems in a power-plant environment. The project will focus on wireless network technologies for industrial environments, including innovative sensor technologies for sampling and analyzing gaseous and liquid process streams. Partners in the three-year effort, which is expected to get underway in 2004, include Honeywell International (Morristown, N.J.), the University of Illinois at Urbana-Champaign (uiuc.edu), Caviton, Inc. (Champaign, Ill.; caviton.com), Axonn LLC (New Orleans, La.; axonn.net), Ember Corp. (Boston, Mass.), the Electric Power Research Institute (EPRI; Palo Alto, Calif.; epri.com), and iAculum (Santa Cruz, Calif.).

Newsfront edited by
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Understanding wireless

What separates wireless success stories from the failures is the knowledge on which they are based. Graham Moss, general manager, Elpro Technologies Pty Ltd, (Brisbane, Australia), compares the situation to one of today's common process instruments. If you look at something like flowmeters, he says, there are probably 10–20 types of technologies out there. The CPI clearly understand that difference, but not the difference in wireless technologies.

The biggest limitation with any wireless equipment is how far it will transmit reliably among the towers, steelwork and buildings of an industrial facility — a factor influenced greatly by radio frequency phenomena (RF, see box, p. 20). If the chosen band is not robust, and the distance from the receiver (or repeater) is too far, the signal will be more vulnerable to interference or interruptions.

On a recent visit to a petrochemical facility, Moss was brought in to address such problems. His diagnosis for the facility was simple, "With your hydrocracker, you wouldn't use an air-conditioning thermostat to control the temperature, yet you've used a wireless technology that was intended for a commercial application, and it isn't fit for an industrial environment."

To get around the physical barriers of an industrial environment, Ember Corp. uses a wireless-mesh-network architecture, where every transmitting device — such as tank-level sensors, pressure gages, valves, pumps and temperature sensors — also has the ability to act as a router, by receiving and then passing along any data transmitted to it (CE, May 2003, pp. 73–77). If the quality of the data-transmission link between individual devices is bad, says Ember founder and vice-president Andrew Wheeler, then the transmitting device is able to contact a neighboring device, to reroute its signals around any interference.

Other claimed problems with wireless can be dispelled by one clarification: wireless is not intended to replace the CPI's fast, hard-wired process control systems. John Tillotson, product manager for Honeywell Process Solutions' mobile productivity tools, doesn't even see the early adopters willing to consider wireless as a primary element in their quick-response, closed-loop process controls.

"For any control loop where the response speed needs to be faster than three seconds," says Elpro's Moss, "wireless would be too slow." Such would be the case with a steam boiler. But in a furnace, where you can't change the temperature very fast any-

Instruwatch is powered by a sealed, lead-acid, gel-cell bettery with a solar panel to ensure a continuous charge

way, he adds, wireless would be okay.

Even as wireless transmission rates improve, Moss does not expect short-term wireless interruptions to be alleviated. Presumably, proliferation of wireless devices — and therefore radio-band congestion — will also increase. Here again, delays come into play. "To account for congestion on a radio band," Moss says, "you have to assume that there can be up to 2 seconds of interruptions."

Since the need for continuous data transmission in wireless applications is rare, Honeywell and other vendors are looking to sleeper modes to extend battery life. "The last thing users want to do is create a frequent maintenance cycle to replace batteries in these units," says Honeywell's Tillotson. Indeed, Siemens Energy and Automation's (Spring House, Pa.) Instruwatch is powered by a sealed, lead-acid, gel-cell battery with a solar panel to ensure a continuous charge (photo, above).

Given the limitations of wireless, contemporaries believe that the true calling for wireless is the retrieval of non-critical data that can't affordably be tapped via hard wire, but nevertheless promises added profitability for the CPI users who transmit it automatically.

More information for less

In its production of intermediates for plastic additives, for instance, Atofina Chemicals, Inc. (Philadelphia, Pa.; atofina.com) recently installed a wireless infrastructure to combine several operational functions at its Mobile, Ala., plant. Using Elpro wireless infrastructure, the facility integrated multiple control rooms into one and automated numerous field readings that previously had to be recorded manually, says Guy Miller, the plant's process control engineer. Field readings consisted of both discrete (motor start and stop) and analog (temperature and pressure) values on equipment such as chillers and air compressors.

The cost to bring in these inputs over hard wires was in the range of $80,000, Miller says, whereas the facility spent only $25,000 to do it with wireless instruments. The wireless bill included a one-time charge of $5,000 for the modus interface to the facility's control system, which is the major component of the infrastructure. "Now that the wireless backbone is in place and operational," he says, "adding additional points can be done very inexpensively."

Although Atofina's wireless data doesn't have minute-to-minute importance, centralized data collection is invaluable as far as asset management is concerned. Consider a fully manual scenario, says Honeywell's Tillotson. Data are recorded on a sheet that goes into a data-entry person's inbox. Assuming that those data actually get keyed into a database, there's still the question of whether the database is connected to an asset management system. The point, says Tillotson, "is that if the data's just sitting there, it's not being used."

DuPont Corp.'s (Wilmington, Del.; dupont.com) DeLisle titanium dioxide facility in Pass Christian, Miss., employs Elpro wireless transmitters for supply chain management. Joe Moffett, project manager, passes data between his facility and a vendor that delivers raw materials via pipeline. He says the cost of either hard wires or remote input/output (I/O) was a prohibitive one — to the tune of $75,000 more than the wireless system.

Procurement and installation costs aside, there are other financial incentives to wireless. For instance, one U.S. Gulf-Coast petroleum refiner has saved over $500,000 to date by replacing leased phone lines with wireless links for remote data acquisition.

Also, the sheer time saved is often enough to justify a wireless solution. Infraserv Höchst (Frankfurt; infraserv.com), expects to save at least 4,500 manhours per year with its implementation of SAP's (Walldorf, Germany) mobile asset-management application, mySAP Mobile Business. The system automatically generates a maintenance order directly to the designated technician's mobile device and verifies when each critical component is examined.

A number of vendors are catering to this intermediary step, as it appeals to facilities that may not be able to justify a wireless sensor. In these cases, operators still collect the data manually, but more quickly, via wireless handhelds or pocket PCs.

To serve this niche, Honeywell has teamed its Experion PKS process knowledge systems with SAT Corp.'s (Houston; sat-corp.com) IntelaTrac software, to offer wireless process control in a handheld device. Honeywell estimates that the entry and wireless transfer to corporate databases through the new system, called IntelaTrac PKS, saves at least 30% of the

FREQUENCY AND DISTANCE

The two common license-free radio bands are 900 MHz and 2.4 GHz. Both bands use spread spectrum technology (that is, continually changing the frequency within the band).

The common radio standards (box, p. 23) use the 2.4-GHz band for two reasons:

- Its wider bandwidth allows much higher data throughput
- It is a worldwide band, whereas 900 MHz is unique to North America. In other words, 2.4-GHz products will sell globally, but 900 MHz will only sell in the U.S. and Canada.

The disadvantage of 2.4 GHz in an industrial environment is radio distance. In offices, the environment for which the 802.11 and Bluetooth standards were intended, the radio distances are not large, and the radio paths are not heavily obstructed by steelwork, vessels or reinforced walls. Elpro's Moss says a lack of understanding on this topic has been the culprit for nearly every problem encountered with wireless installations in process plants.

Adding to the confusion, suppliers rarely present the related specifications in context. On most product data sheets, you will see a radio-distance specification expressed as X miles line-of-sight. But there are few line-of-sight paths in a process plant. A 2.4-GHz product can achieve over 20 miles line-of-sight by mounting the antennas on high masts, but it still only achieves 100–300 ft in an industrial environment — quite a big difference.

The 900-MHz band has much better propagation performance in industrial plants, simply because it operates at a lower frequency. The comparison between 900 MHz and 2.4 GHz for line-of-sight is around 2:1, says Moss, but when you introduce steelwork, as in a process plant, then the comparison becomes 10:1. That is, 900 MHz penetrates 10 times the distance of 2.4 GHz. The "median" distance achieved with 900 MHz in an industrial environment is 3,000 ft. In other words, 50% of all possible radio paths will work at 3,000 ft. Most radio paths (over 85%) work at over 1,000 ft. ❐

time required by traditional methods. An ancillary benefit is the reduced field exposure of the personnel who would be collecting the data.

More reliable

Much of the static over the reliability of wireless has been cleared up. Atofina's wireless system has not experienced any reliability problems, according to Miller. Nevertheless, he envisions, "even if we lost a signal on an input once every hour or two, the frequency would be much better than one reading taken by an operator every four hours."

Given the relatively low cost of wireless equipment and installation, more vendors are actually using the technology to improve plant reliability. For example, higher levels of redundancy can be obtained from sensors, when more of them can be deployed, says Ember's Wheeler. If one measurement is significantly different from the others, the control room can be notified of the abnormal reading.

At one point, Flint Ink's (Ann Arbor, Mich.; flintink.com) CDR Pigments plant in Holland, Mich., had a wired system in place to meet state reporting requirements for wastewater flow, pH and temperature. After lightning took out some expensive controllers, says Mark Nyboer, the company installed an Elpro wireless system that has taken care of the problem at relatively little expense.

BS&B Pressure Safety Management, LLC (Tulsa, Okla.) has recently introduced a system that brings affordable communications technology to pressure-relief devices. With the SmartDisk wireless sensor and monitoring system, the control room can be immediately notified when an overpressure, flow or other pressure event occurs.

More secure

The thought of a competitor — or worse, a terrorist — either stealing data while its in the air or hacking into the network and shutting down some operations, for example, makes CPI companies understandably nervous. The truth is, quite simply, if the wired information goes outside your premises, explains Moss, then you would be less vulnerable with wireless.

In the first place, hard-wired systems aren't exactly impervious. U.S. corporations lost over $70 million in theft of proprietary information this year, according to the Computer Security Institute's (CSI; San Francisco; gocsi.com) 2003 Computer Crime and Security Survey, conducted with the participation of the Federal Bureau of Investigation's Computer Intrusion Squad, based in San Francisco.

In addition to encryption technologies borrowed from hard wire systems, wireless technology naturally changes frequency within its designated frequency band. "Anyone who wants to hop on to that signal has to change frequency in the exact manner that you do," explains Elpro's Moss, "so you are able to get a much higher security than you do on the Internet."

It's also important to keep in mind that wireless transmitters, such as Honeywell's recently commercialized XYR 5000, (photo, p. 19) are often sending only one data point at a time, says Honeywell's Tillotson. So intercepting that one data point won't really disclose much. "You can't really tell from a temperature reading what product is passing through," he says. Even if a hacker could get past your security measures, far from 100% of your plant data would be found. And even if all data were embezzled, he speculates, putting the whole puzzle together would be extremely difficult. ■

Rebekkah Marshall

WIRELESS RESOURCES

For more on wireless networking and wirelessly enabled instrumentation, visit these and other notable websites:

Accutech	***savewithaccutech.com***
Bentek Systems Ltd.	***scadalink.com***
BS&B Pressure Safety Management, LLC	***bsbsmartdisk.com***
Cirronet	***cirronet.com***
Elpro Technologies	***elprotech.com***
Ember Corp.	***ember.com***
Honeywell Process Solutions	***honeywell.com***
Millennial Net	***millennial.net***
MSA	***msagasdetection.com***
Omnex Control Systems Inc.	***omnexcontrols.com***
Pacific Crest Corp.	***paccrst.com***
Phoenix Contact GmbH	***phoenixcontact.com***
RAE Systems	***raesystems.com***
SAP	***sap.com***
Siemens Energy & Automation	***siemens.com***
Wilcoxon Research	***wilcoxon.com***

RADIO STANDARDS

Most of the wireless products specifically designed for industrial applications do not conform to a standard — they have proprietary protocols and functionality. Such equipment falls into the following categories:

- Wireless I/O — replaces signal wiring
- Radio modems — replaces data wiring
- Wireless gateways, or wireless protocol converters — again replaces data wiring but also allows different data highways to interconnect

The main characteristics that distinguish these proprietary designs from the following standards are a 900-MHz frequency, (for more on frequency, see box, p. 20) better operating-temperature specifications and different networking functionality.

802.11 WiFi

This is the standard for wireless LAN equipment. It uses 2.4 GHz and can transmit Ethernet data at very high rates (>10 Mb/s). Since it was developed for the office environment, WiFi suffers badly in industrial environments from its short distance range (around 100 ft) and RF interference.

Bluetooth

Developed to interconnect PC peripherals and cellular telephones, Bluetooth uses 2.4 GHz and has lower data rates than 802.11, but is less vulnerable to interference. Equipment following this standard also suffers in industrial environments from short distances (again, around 100 ft).

Zigbee

Zigbee was developed for applications in heating, ventilation and air conditioning (HVAC) as an alternative to Bluetooth for imbedding in transducers. It is designed for very low power consumption — so it can run on an imbedded battery for long periods — and better temperature specs than Bluetooth. Zigbee exhibits better protection against RF interference than either Bluetooth or 802.11. While it can use either 900 MHz or 2.4 GHz, its low RF transmit power limits the distance range to 100–300 ft. ❐