Today's advanced wireless devices and robust mesh networks can provide a range of operational, environmental and financial advantages for operators.

Industrial Wireless – *changing the landscape* in plant operations

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For operators throughout the worldwide chemical process industries, knowledge is power, and that knowledge comes from the widespread use of monitoring devices and instruments to gather real-time data related to pressure, temperature, level, flowrate, emissions, turbidity, pH, vibration and other key operating and environmental parameters. When process operators are armed with real-time operating insight, they are better able to detect previously undetectable problems and to plan their maintenance and repair activities in the most cost-effective way.

Considering that the typical chemical, petrochemical plant, petroleum refinery, pharmaceutical production facility, power plant and other complex industrial facility typically has hundreds or even thousands of sensors and controllers in place to monitor ongoing operations and track potential sources of emissions, the costs associated with hard-wiring all of these field devices can add up very quickly. Particularly costly is the time and labor required to install conduit and mount the cable trays over long distances and through complex process environments, pull the wires, generate work permits and hazard-proof the entire installation. Typically, these installations must be done around existing equipment, structures and access points, and this requires holes and tunnels to be cut.

According to published reports, regular industrial wiring can cost $82-131/m while explosion-proof or intrinsically safe wiring can cost about $262-328/m or even more. Highly specialized wiring that is required for nuclear power plants can cost up to $3,280/m. In fact, according to some industry estimates, it's not uncommon for the cost of the monitoring device itself to represent just 10% of the overall project cost, with wiring and installation costs making up the balance.

As a result, process operators who rely on traditional hard-wired field devices are often forced to skip monitoring devices that are seen as being too costly to justify.

Wireless: a cheaper alternative

Wireless monitoring devices and instruments rely on the bi-directional transmission of radio frequency (RF) signals between intelligent field instruments and host systems such as distributed control systems (DCS), programmable logic controllers (PLCs), asset-management systems, safety systems and handheld devices. Wireless devices require no hard-wired connections to either bring power to the device, or to transmit process data from the device to the control system.

In addition to eliminating the need for – and cost of – hard-wiring, the use of wireless devices allows facilities to cost-effectively monitor a greater number of plant assets. Armed with more real-time operating data, operators are then able to improve overall operations, personnel safety and environmental compliance, and reduce unscheduled downtime for maintenance and repairs.

Wireless monitoring devices are not only less costly to install and operate, but they can be installed more quickly (and relocated easily), and used more widely throughout the facility. This lets operators collect data from more locations – especially those that were previously thought to be cost-prohibitive.

For instance, since the battery lifetimes on today's wireless devices generally last 3–5 years, they are particularly ideal for gathering data from un-

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manned or only partially supervised pumping and compressor stations and remote tank farms. Wireless devices are also well-suited for hazardous environments, to eliminate the need for manual data collection (which not only puts technicians at risk, but can be inherently error-prone).

"Applied strategically, the benefits of industrial wireless extend far beyond the cost savings of fewer wires to run," said Jeff Becker, Director of Global Wireless Business for Honeywell Process Solutions (Phoenix, Arizona). For instance, he notes that wireless transmitters in tank farms "can add value to the operation by allowing the company to keep better track of its inventory, more accurately monitor tank levels (and provide high-level alarms to guard against overfilling), and in this way, it can streamline throughput and optimize operations."

Customers using a wireless asset-monitoring system from GE Energy subsidiary Bently Nevada (Minden, Nevada), have documented savings exceeding $1.5 million/year related to reductions in maintenance costs and process interruptions, and return-on-investment exceeding 400% in less than one year.

Similarly, the use of low-cost wireless devices to improve leak detection from pumps and valves can help to both limit pollution and reduce valuable product losses, and helps plant managers to plan maintenance activities more effectively (by scheduling shutdowns at optimal times, and arranging for parts and labor in the most cost-effective manner). And the ability to respond promptly to any leakage of flammable or hazardous materials helps to safeguard workers and reduce potential liability issues.

"In my 39 years in process automation, I have never seen a technology with such compelling, immediate benefits," said John Berra, President of Emerson Process Management (St. Louis, Mo.) in a March 2008 statement. Emerson estimates that in the U.S. alone, the demand for wireless industrial technology will exceed $1 billion by 2012.

Wireless mesh networking

Over the past few years, several advances have helped to make wireless monitoring a viable option for a growing number of complex industrial applications. In the early days, proprietary wireless networks often relied on a relatively simple network configuration – imagine a hub-and-spoke arrangement – 0which required direct line-of-sight connection between the wireless field devices and the central wireless hub or gateway that receives the signals, in order to maximize the potential for a full-strength RF signal.

However, this configuration is inherently limiting for industrial applications because direct line-of-sight conditions are rarely available in congested plant settings, which are typically crowded by steel tanks, reactors, heat

exchangers, piping, structural steel, reinforced concrete and other physical interferences that can either absorb or reflect the wireless signals.
More recently, a newer wireless architecture – called the wireless mesh network – has been widely adopted by today's wireless-device vendors, and it has effectively eliminated this problem. In a wireless mesh network, every transmitting field device – such as wireless pressure gages, temperature and level sensors, and so on – also has the ability to act as a router, by receiving and then passing along any data transmitted to it.
Thus, if data transmission between two individual devices fails because of equipment failure or a physical obstacle, the transmitting device automatically contacts a neighboring device, to find an alternative route around the interference. This rerouting continues automatically until receipt of the data has been confirmed.
By providing multiple data pathways, wireless mesh networks greatly increase the wide range of geographical coverage and provide the redundancy needed to ensure the uninterrupted signal transmission of process data from thousands of wireless sensors that are likely to be used at a typical chemical process or refinery site.
Meanwhile, today's wireless devices must also be immune to potential interference from sources of electromagnetic energy and other RF devices that are commonly found in process plant environments. To meet this challenge, many of today's wireless devices use so-called frequency-hopping spread-spectrum (FHSS) transmission technology (i.e., the use of multiple frequencies), which helps to avoid interference sources that are typically found in process plants and other industrial locations, and ensure the reliable transmission of the wireless data.

Equipment health monitoring

While the use of wireless devices continues to grow throughout the global chemical process industries, today such instruments are still mainly used to gather data from "non-critical" assets, and to provide real-time diagnostic alerts to provide early warning of process or device problems. Because today's industrial wireless devices are not considered by many to be robust enough to be used for "mission critical" applications, many process operators are not yet using them for the closed-loop process control of critical assets (rather, these applications are still traditionally managed using hard-wired solutions). However, many industry observers agree that as wireless technology continues to mature, the base of user experience continues to expand, and users become more comfortable with the reliability and security that today's wireless systems provide, wireless technologies will eventually be adopted for more-demanding control applications.

Standardized communication protocols

A guarantee of seamless, transparent interoperability among devices from competing vendors is critical when developing site-specific instrumentation and control schemes for complex chemical process applications. Fortunately, when it comes to industrial wire-

Picture: Emerson Process Management

Mobile worker monitoring process and plant applications with wireless solutions.

less devices, two sets of emerging standards – which were originally being pursued in parallel – are now in the process of being integrated.

In September 2007, the HART Communication Foundation (HCF; Austin, Tex.) released its HART 7 specification, which includes the WirelessHART standard. WirelessHART defines the way in which messages are communicated between wireless field devices in process applications and the central gateway.

In March 2008, Emerson Process Management became the first company to begin offering WirelessHART-enabled pressure, flow, level, temperature and vibration transmitters and gateways, and the company says that future wireless products will also follow the standard. Many other vendors are also in the process of commercializing WirelessHART-compliant products. “The WirelessHART standard opens the door to confident and broad implementation of wireless throughout the industry,” said Emerson President John Berra at the time of the announcement.

The existing HART communication protocol describes the standard instrumentation grade wire and standard wiring and termination practices that are required to enable communication between hard-wired field devices, monitoring systems and control systems, and today, more than 20 million HART-enabled devices are in use worldwide, according to HCF. The newer WirelessHART protocol “addresses the critical needs of the process industries for simple, reliable and secure wireless communication in real-world industrial plant environments,” says HART Communications Foundation executive director Ron Helson. “It is easy to use, easy to deploy, and fully backward compatible with existing instrumentation and host systems, thereby preserving the investment in HART-enabled devices, tools, training, applications and work procedures that are already in being used today.”

Meanwhile, the Instrumentation, Systems and Automation Society (ISA; Research Triangle Park, N.C.) is currently working on its own ISA100 family of instrumentation and control standards. While the overall ISA100 standards have much broader scope than just the wireless protocols that are specified in WirelessHART, the pending ISA100 standards will also define standards for wireless communication in factory automation and discrete devices, whose requirements are significantly different from those of process devices.

Today, the HCF and ISA are working to accommodate the WirelessHART protocol into the ISA100.11a wireless standards. Both groups have publicly stated their commitment to work together, in order to enable robust and secure wireless communication in real-world industrial plant applications, and to serve the needs of the end user, which include the need for reliable wireless performance, ease of use and broad interoperability among products from competing vendors. ■