Wireless expands M&D to more of the plant

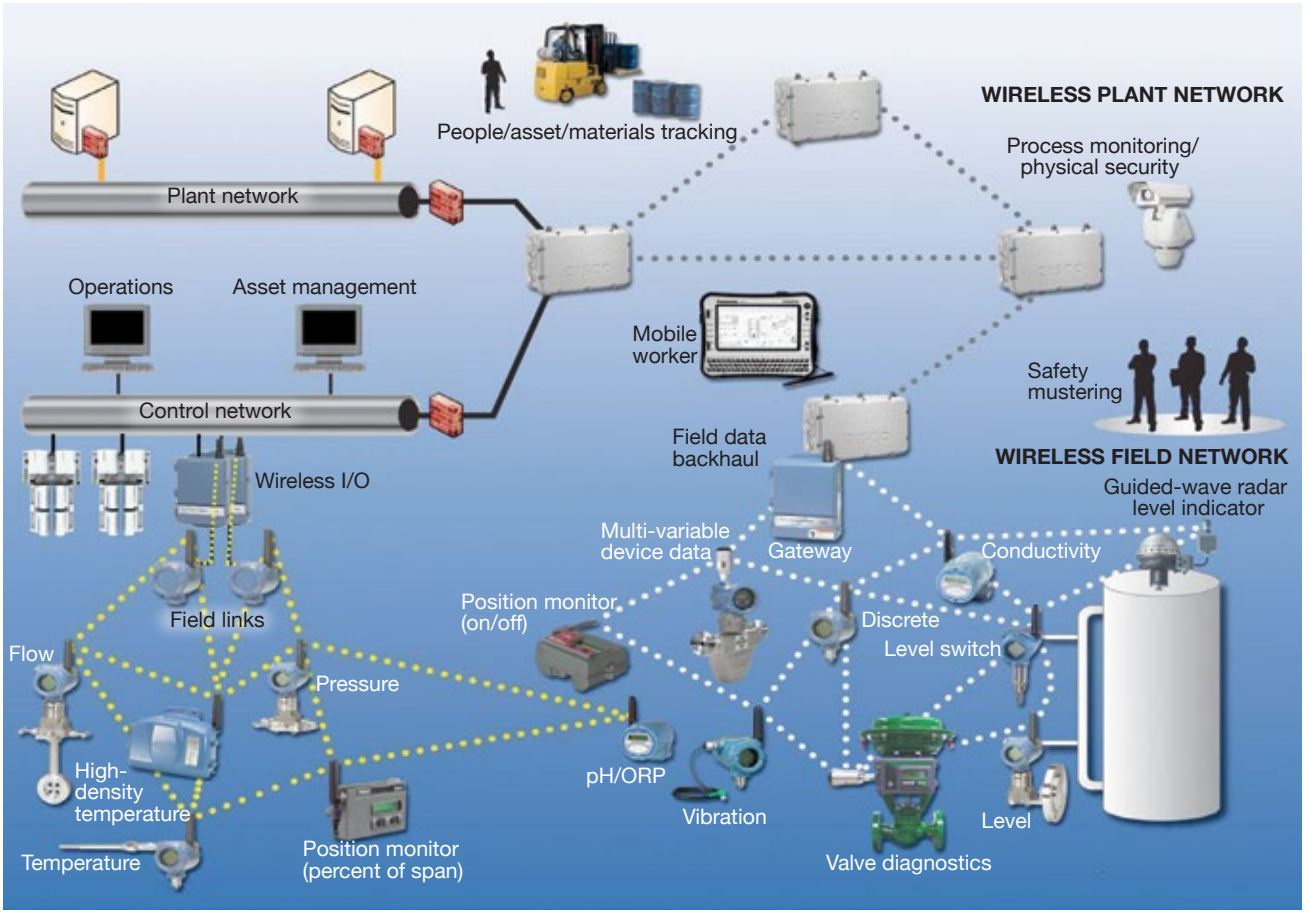
Wireless control devices, sensors, and networks are bringing new M&D capabilities to more of the powerplant footprint, just like cellphones and wireless computing devices have changed the way we live. Use of wireless today, in fact, is probably limited only by imagination, budget, and cybersecurity concerns.

Most anything in M&D that can be hardwired can now be done with wireless (Fig 1), even if plants are not quite ready to give up "the landline." Probably the best way to think about wireless at the plant level is this: You don't have to "make the rounds" to read gages; the gage readings come to you. Of course, the data also can go into the control and automation system as well. That's the point. The data can go anywhere as long as a network can pick up the signals and the transmission is secure.

Virtually all of the plant's performance metrics—safety, productivity, efficiency, environmental compliance, and reliability—can be enhanced by adding wireless M&D at strategic locations. One reason is because wireless M&D brings data to you in real or near-real time, or at the very least much faster than an operator on his/her periodic rounds. Thus operators are able to focus on other things, like conducting maintenance and checking out issues indicated by M&D.

From a practical standpoint, wireless is often an inexpensive way to add M&D capability to an existing facility. Good examples are the cooling-tower area, the water-treatment unit, tanks situated away from the turbines and boilers, and fuel supply pipelines. Just like a security camera gives you "eyes" into different areas of a building, live video and audio feeds for critical process areas can be transmitted wirelessly, too.

At last year's Ovation User's Group (OUG) meeting, Scott Stofan and John Blaney, Emerson Process Management, Power & Water Solutions, gave a "top to bottom" review of wireless applications.



1. All of the typically measured parameters important to control and M&D can be monitored wirelessly with today's technology

The first step is to understand the basics. Wireless is based on sending and receiving signals in the form of waveforms and it takes power in the form of MHz or kHz to send those waves long distances. You use existing unlicensed wave spectra, like the Industrial Scientific and Medical (ISM) spectrum running at standard 2.4 or 5 MHz, or customized licensed spectrum bands.

Think of the wireless "system" in three buckets: The field devices and links, the network infrastructure, and the solutions, or what you actually do with the monitored points. The links and infrastructure (Fig 2) are industrial, ruggedized versions of similar equipment you use at home or in the office.

Each field device has an antenna which transmits a signal through an industrial-grade point accessing a "mesh"—a wireless field in which each signal strengthens every other signal through the use of what's called repeater devices to add communications pathways.

A wireless local area network collects and manages all the signals from the field devices. A wireless-network server provides a system view for radio frequency (RF) planning and management. Security and intrusion prevention are, of course, necessary parts of this system.

The field instruments (Fig 3) available today span the gamut of what every powerplant monitors in real time. It's worth pointing out that even corrosion monitors and gas/flame detectors are included.

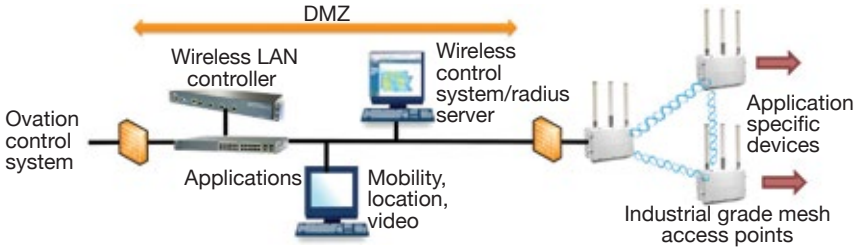
According to Stofan and Blaney, some of the latest elements of a wireless system from Emerson include the following:

- Broad selection of wired and wireless pressure transmitters with different capabilities and functionalities at different price points—that is, more diagnostics deliver higher value but for higher cost.
- Guided wave radar technology for sensing tank levels more accurately, especially when there is stratification of fluids and/or when better overfill protection can enhance safety and reduce environmental risk.
- Smart wireless gateway. It combines (1) wireless HART, based on IEC62591 (a non-routable protocol which allows the process sensor devices to communicate through a mesh network through a gateway to host systems, such as a DCS) with (2) wireless WiFi, based on IEEE 802.11, the global wireless routable Ethernet-based communications standard to connect tablets, laptops, cameras, and RFID tags to plant-wide application standards.

  As a reminder, routable protocols contain a device address and a network address. In theory, this allows information packets to be transmitted anywhere through an open communications system. A non-routable protocol allows information packets to be transmitted only to another device through a closed communications system.
- Distributed remote terminal units (RTU), used to collect data from distant locations—such as a cooling-water intake or distant pipeline metering/supply station.
- Wireless multi-variable transmitter, capable of providing the primary measured parameter (for example, flow) as well as secondary parameters used in the primary-parameter calculation (pressure and temperature, for example).
- Advanced totalizer, a simple connection to a turbine meter measuring average flow and totalized volume.
- Network manager, a logistics coordinator of sorts, which examines the radio spectrum frequencies, monitors strength (dB levels), determines the appropriate communications pathways, and ensures signals get to where they are supposed to go
- Security enhancements ensure the system complies with NERC-CIPS and/or other higher-order security frameworks.

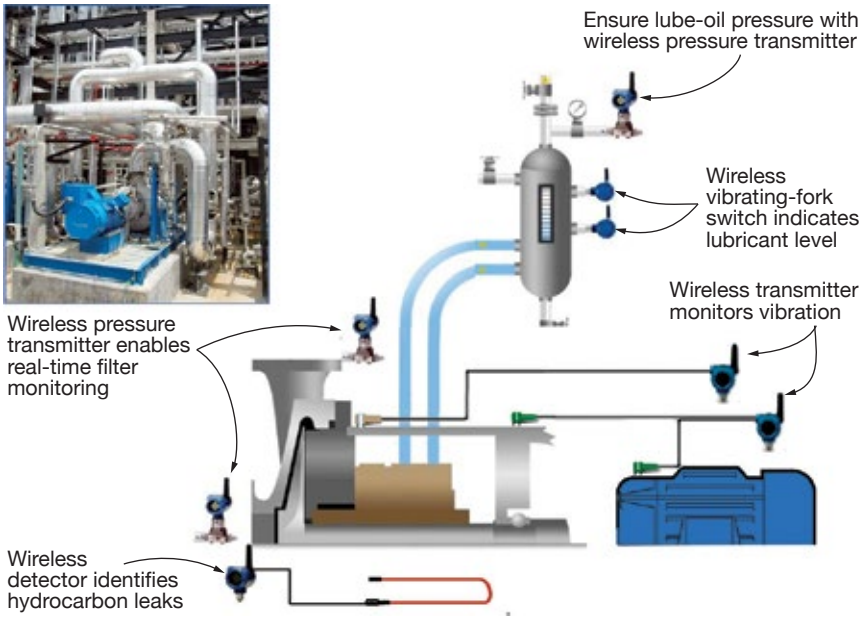
All capabilities available at a stationary human machine interface (HMI) screen can be delivered through mobile devices via remote desktop—including alarms, trends, reports, engineering analysis, and laboratory data.

At the same time, all the wireless



2. The three "buckets" of a wireless system: (1) Field devices/links communicating through a mesh wave field; (2) the infrastructure level, a wireless LAN controller, server, and terminal to collect and manage the data and RF requirements; and (3) the applications

3. The range of wireless M&D available to a powerplant essentially is limited by your imagination (and cybersecurity concerns and budget limits, of course)



4. Wireless M&D options for a single pump include filter monitoring (pressure), leak detection, vibration monitoring, level sensing, and lube-oil pressure

devices and infrastructure can be maintained via Emerson's AMS Suite Intelligent Device Manager. All wired and wireless HART devices can be calibrated, configured, troubleshooted, and documented on the go or from wherever you happen to be (within range of the network).

For example, suppose you have a critical pump, or a non-critical one that isn't well-spared (or not spared at all) or poorly instrumented. Wireless monitoring options (Fig 4) include vibration, lube-oil pressure, filter monitoring, lube-oil supply level, and fluid leak detection.

The cost for adding such monitored points is relatively low. To illustrate: Adding wireless HART to a cooling tower (often a poorly instrumented area of the plant) would cost nominally $25-50K, which would include several field devices, access points, and a mesh network gateway. Recognize that, to actually use the data, the host system has to be configured with a secure connection interface, database, and graphics.

The typical gateway handles up to 100 field devices, so there's plenty of room for expansion. Installation time for the wireless devices and gateway (excluding the physical process connection) generally is not more than a few hours. The physical process involves mechanical changes—for example, the instrument has to be connected to the pipe where the measurement is desired. Connecting the wireless part of the system to the wireless network involves software changes which take little time.

One caution: Wireless monitoring capability must be designed and implemented using a team of instrument specialists, host system administrators, and security experts to ensure compliance with all security protocols.

Wireless capabilities also should be assessed in the context of more predictive capability through "big data" solutions, algorithms which crunch and correlate reams of PI or historian data to predict whether and when a component could fail. On the one hand, more monitored points could feed such real-time analytics. On the other hand, better M&D through direct measurement could lessen any dependence on such analytics.

Beyond the busy plant areas (turbine deck, HRSG area, water treatment building), wireless can be applied for such diverse applications as monitoring inlet cooling water or feedwater flow and return outflow discharge temperatures and flows for regulatory compliance, wastewater treatment basins, cooling towers, air-cooled condensers, materials delivery and inventory, and perimeter security.

Once you get into the guts of the signals, communications protocols and standards, firmware, adapters (used to allow 4-20 mA HART-enabled devices to communicate with wireless networks), gateways (the wireless equivalent of marshalling panels and junction boxes), security details and patch requirements, ports and gateways, and configuring and building points, there are versions and revisions and procedures best left to the I&C and digital specialists.

Keep up with advancements in I&C technology by attending the upcoming Ovation Users Group conference, July 26-30, in Pittsburgh's Westin Convention Center Hotel (users only). CCJ