Wireless Widens the View

A wider window into the plant is now possible as previously difficult-to-access field data becomes easier to collect and transmit with the latest wireless technology. By *Jonas Berge*.

The practical and economical barriers to collecting more information from the plant floor and surrounding areas have been dramatically lowered by the emergence of reliable wireless field communications systems. The technology of transmitting information from stand-alone instruments can be put to use today, even in plants with legacy control systems.

Information that was previously difficult or impossible to access in the past is now easily collected and transmitted from wireless devices to the plant control system. As a result, incremental asset health and process status data is delivered quickly and continuously to the right individuals, producing:

- Improvements in asset maintenance
- Greater equipment reliability
- Reductions in plant downtime
- Improved process control
- Better safety
- More certain compliance with environmental regulations
- Lower installation cost than most hard-wired systems can deliver

The most advanced of these wireless systems coexist with, and complement, other wireless networks operating in the typical plant environment. For example, existing IEEE 802.11 Wi-Fi broadband wireless Ethernet and TCP/IP standards are already built into thousands of products used in and around industrial plants.

Using industrial-grade Wi-Fi infrastructure, new solutions can be found, and new work practices can be adopted. Workers in the field easily access desktop applications and perform tasks from a tablet PC – including viewing and responding to alarms, observing the process, and retrieving work orders. The personal communications methods enable workers to be more productive in checking on equipment while away from the control room.

Challenge of change

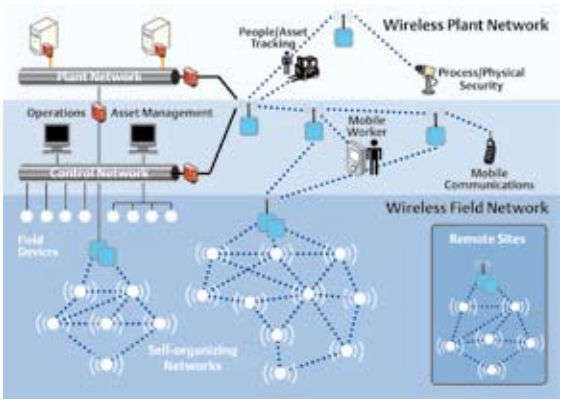
Control requirements and circumstances change over time, which calls for existing control systems to change and/or assimilate much more information than may have been required originally.

For instance, new or more stringent regulations for Health, Safety, and the Environment (HSE) are now enforced in many countries. This may require continuous monitoring of safety showers around the plant so that help can be dispatched if needed. Likewise, there may be a need to know the status of manually operated valves to be sure they are in the correct position to avoid accidents due to false assumptions. And safety relief valves may need to be monitored to detect venting.

Manpower reductions or the need for more frequent updates may make it impossible to rely on operators walking the plant floor with a clipboard to take visual readings. Or it may be desirable to reduce manual measurements in the field where there is possibility of error or risk of personal injury.

To reduce downtime, it may also be wise to continuously monitor assets like pumps and motors for leading indicators of wear-and-tear versus periodic manual checks.

All of these things can be accomplished with field instrumentation reporting to the control room. However, installing wired transmitters to perform new functions is usually phenomenally expensive. In many cases, plants have run out of spare signal wire pairs, spare tray space, spare DCS I/O points, and adding them is not easy. Even



Out in the field, the self-organizing ability of wireless mesh networks, such as used in WirelessHart, moves into action when an established signal path is blocked.

in new plants, there are many remote locations that cannot be reached economically with wire or cable.

Furthermore, the need to resolve problems faster requires more information be delivered to the control room regarding plant-level functions. Consequently, thousands of plants will be relying on new wireless infrastructures to address these challenges and more.

Interestingly, in many applications, it is about replacing non-wired devices with wireless. For example, pressure and temperature gauges, variable area flow meters, and level sight glasses that are not wired to any system and must be read manually no matter where they are installed can now be connected wirelessly.

Wireless plant systems are already delivering impressive business results, including new solutions to problems and fast deployment. Table 1 (overleaf) summarizes some of the latest, innovative wireless solutions being deployed by users.

Hart makes a start

While wireless transmitters are relatively new, a standard covering their manufacture and use is already in effect. WirelessHart is an all-digital wireless protocol that was approved as a controls industry standard in 2007. This assures that companies wanting to incorporate wireless technology won't have to rely on a limited number of products provided by a single manufacturer. Devices from several suppliers can work together easily because they are built to this standard.

WirelessHart transmitters utilize the IEEE 802.15.4 standard ensuring it can coexist and share the same airspace as Wi-Fi. The same IEC 61158 application layer as for wired Hart devices is used on top of this, ensuring easy integration with existing device management software.

It is worth noting here that IEEE 802.15.4 is often used synonymously with ZigBee but this is incorrect. ZigBee is just one of several network and application layer protocols using IEEE 802.15.4 physical layer and data link layer protocols. WirelessHart uses IEEE 802.15.4 but is different from ZigBee. Bluetooth is IEEE 802.15.1 and is not used by wireless field networks because it requires more power than ZigBee, operates over short distances and has no mesh topology.

Devices adhering to WirelessHart standard are capable of supporting any kind of sensor, so they will work with nearly any industrial application, whether for control or monitoring, just like all Hart products do today. A number of leading manufacturers have announced they will supply transmitters and gateways meeting the WirelessHart standard.

Infrastructure decisions

Whether wireless is deployed in a new plant or an old one being updated, the wireless infrastructure can remain in place for many years, so making a decision about wireless is very important, much like deciding on a control system. Reliability and security are the main considerations for an industrial wireless network, and both are addressed by WirelessHart.

A unique characteristic of WirelessHart is the self-organizing mesh-based network that provides transmission reliability by dynamically routing messages around signal obstructions as they occur. It is capable of "working around" communications problems that frequently occur in a plant, so it cannot be impacted by them. The protocol always includes "status and value" data in addition to any kind of configuration data. This gives users insight into the validity of their measurements with the assurance that values are correct as reported.

The self-organizing ability of wireless mesh networks pays off when obstacles such as sky lifts and scaffolding appear, or even when trucks temporarily block the established signal path. The network simply finds an alternate path for the signals to reach the gateway. Mesh networks are therefore more robust.

Plant Challenge	Old Solution	Old Problem	New Solution	New Advantage
Temperature measurement on rotating kiln	4-20 mA transmitter and slip-ring	Slip-ring wear and tear cause signal failure	Wireless temperature transmitter	No wear and tear and thus reliable signal
Temperature measurement in coal pile	Wired probe	Very laborious and dirty moving the wires around	Wireless temperature transmitter	Less labor intensive
Many backup measurements not connected to control system	Operator walks around with clipboard to take readings from pressure and temperature gauges, level sight glasses, and variable area flow meters	Update once per shift; Inaccurate, unreliable due to lack of diagnostics	Wireless pressure, temperature, level, and flow transmitters	Up-to-the-minute data, less labor intensive, and more accurate and validated data; Safer; No additional wiring required
Don't know the actual position/status of manually operated valves	Blind	Operator required to walk to physically check	Wireless valve position transmitter	Information available when required, enabling better and faster decisions
Don't know the actual position or health of control valves	No feedback	Failures go undetected until process is affected	Add wireless adapter on existing positioner	Faster response to failures; Evasive action taken before process is affected
Temperature measurement on rail cars	Operators with probe climb rail cars containing hazardous chemicals in adverse weather conditions	Dangerous, infrequent updates	Wireless temperature transmitters	Safer, timely, and more accurate
Safety shower monitoring	Blind	A person using a safety shower got no assistance	Wireless discrete input	Operations is alerted if somebody uses a safety shower and may need help
Temporary trials and evaluations	Wired data acquisition systems	Very laborious and time consuming	Wireless pressure and temperature transmitters	Faster setup and disassembly
Measure pH in inaccessible places	Running new wires	High cost and time consuming	Wireless pH transmitter	Fast deployment

Table 1: Recently deployed wireless solutions.

The mesh protocol also reduces the number of gateways (transmission receivers) required because every device acts as a transceiver, capable of relaying messages from other devices which are not in the line-of-sight of the gateway. This makes wireless field networks easy to deploy, since the site surveys commonly required for line-of-sight communications systems are eliminated.

Measures used to combat channel noise include channel hopping, black listing noisy channels, and using "spread spectrum" transmission. Security measures include encryption, connection authentication, and message verification.

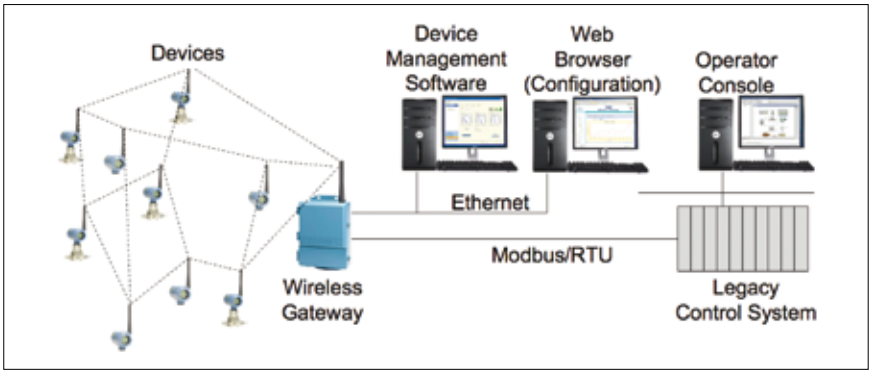
Most plants use a mix of protocols such as wired Hart for safety devices, Foundation fieldbus for control instrumentation, and Profibus-DP for motor starters and drives. These integrate into control and device management systems, enabling all devices to deliver accurate, actionable information to the right person in time to make a difference. Since wireless instrumentation is new, different requirements apply to the wireless field network, and these must be defined when engineering a new system or upgrade.

Legacy potential

At first glance, that distributed control system (DCS) in the plant may appear too old to support wireless. But this apparent stumbling block can b overcome through the use of "wireless gateways" – field devices that can be integrated with the existing system, whether new or old. In fact, a WirelessHart gateway can be added to a control system not supporting WirelessHart.

Because the wireless gateway supports Modbus/RTU, Modbus/TCP, and optionally OPC, it can be connected to legacy control systems while providing process variables from wireless transmitters despite the lack of native wireless support. In addition, an HTTP Web server embedded in a wireless gateway enables setup of the WirelessHart network from a regular Web browser without support from the control system.

Intelligent device management software can be deployed alongside the legacy control system with all device-related information efficiently passing between the field instruments and the device management software. Thus, older plants can enjoy the benefits of wireless and device management.



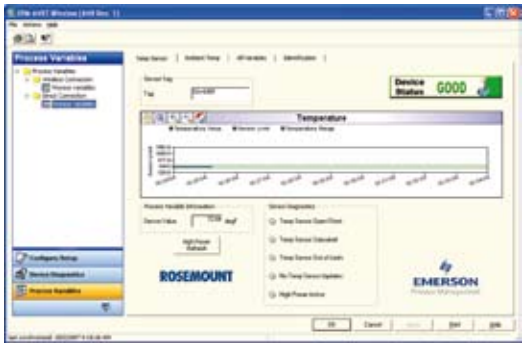
A wireless gateway enables legacy control systems to receive process variables from wireless transmitters.

Wired Hart devices will also soon be able to be enhanced with wireless. Thousands of plants use wired Hart devices, but their control systems lack Hart interfaces. Wired transmitters and valve positioners will be able to be fitted with "wireless adapters", so their diagnostics can be accessed by device management software and remotely configured. By incorporating this capability into daily work practices, the life and value of existing assets is enhanced and extended.

Consider also the aging of the wireless infrastructure, which can have a lifetime of 15 years, much like a control system. How can device management software purchased today configure and diagnose different types and new versions of wireless devices that come into the plant in the future?

This compatibility is ensured through the use of the IEC 61804-3 standard Electronic Device Description Language (EDDL), just as for wired Hart, Foundation fieldbus, and Profibus devices (see *Control Engineering Asia*, September 2007).

Each time a new wireless transmitter or version comes into the plant, the software is kept current by copying the device's EDDL file onto the system. The file enables the device management software to render the user (HMI) display exactly as intended by the device manufacturer, and provides access to know-how in the form of help text and context-sensitive images.



Wireless device management.

First steps and beyond

A wireless infrastructure can be easily installed now for use with existing devices and control system. Many plants start small with a wireless field network of a few devices communicating with a single gateway.

The first wireless point is inevitably the most expensive, because to deploy one transmitter it is also necessary to install the gateway, computer, and software, etc. However, once this infrastructure is in place, installing each subsequent transmitter will cost very little more than the device itself, because one gateway supports many transmitters.

As soon as that first wireless network begins to function, operations and maintenance people will find numerous other applications around the plant, fulfilling long-held desires for asset monitoring and process data collection. Look for applications in your plant by listing the measurements that are currently collected manually – or not at all. Monitoring applications offer a good opportunity to evaluate the technology with little or no risk.

Obtain a wireless starter kit through your maintenance budget. Use the kit to try out wireless and involve all departments – engineering, operations, maintenance, etc, to give everyone a chance to see how this rapidly emerging technology can enhance equipment reliability, reduce plant downtime, improve process control, and result in a safer workplace.

Jonas Berge is Senior Manager, PlantWeb Consulting, at Emerson Process Management Asia Pacific.