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Remote Sensing with WirelessHART Process Transmitters

Wireless remote sensing cuts implementation time, saves money, and reduces maintenance costs as compared to wired alternatives.

» *By Haitham Madian, MEA Solutions Architect, Emerson Process Management*

Oil & gas companies must constantly monitor production and injection wellheads, and react quickly when conditions change. Relying on manual readings and corresponding outdated information isn't acceptable as it may take weeks to spot a trend or realize there's a problem.

Automated wellhead monitoring with wireless sensors (**Figure 1**) allow companies to safely monitor production to ensure product flows continue uninterrupted in a safe manner. They also help guard against over injection, which wastes energy and resources, and possible damage to the well. Remote monitoring also minimizes under injection, which can cause production loss.

Recent developments in wireless systems make it possible to bring needed measurements from remote areas to central control rooms, where the data can be analyzed and quickly acted upon.

Figure 1: WirelessHART transmitters are used to obtain pressure, level, flow, temperature, and other data from remote facilities, such as offshore platforms and wellheads. All Photo Credit: Emerson Process Management

WIRELESS REMOTE MONITORING ANYWHERE

Flow, level, pressure, temperature, and other transmitters traditionally used a wired 4-20 mA output signal representing the process variable. In the mid-1980s, the HART (Highway Addressable Remote Transducer) protocol created a standard whereby digital information was imposed on the 4-20 mA signal, allowing control and monitoring systems to obtain data in addition to the process variable, such as device status and diagnostic information. In 2004, WirelessHART was developed, allowing HART signals from process instruments to be transmitted wirelessly.

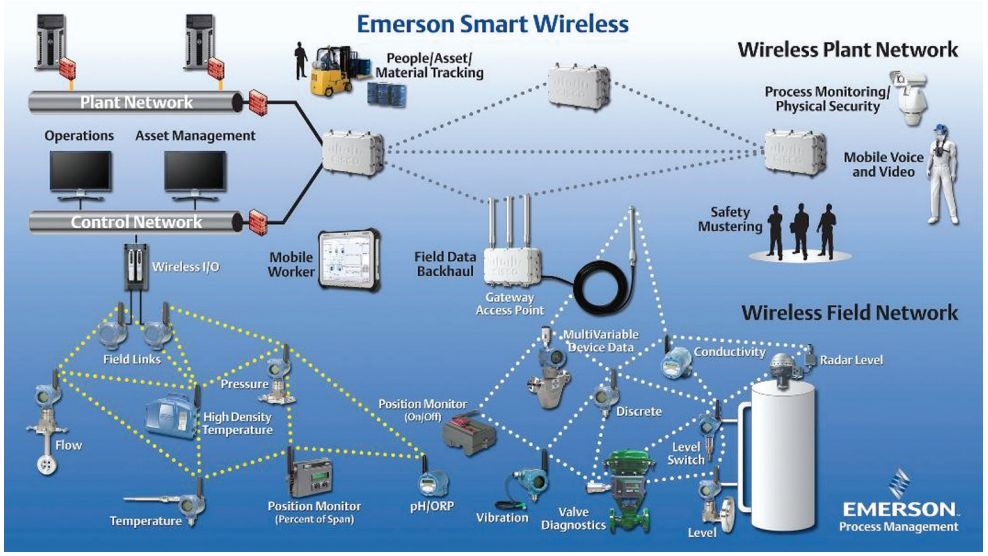

Figure 2: A WirelessHART network has field devices that connect wirelessly to local gateways via a mesh network.

WirelessHART is a global IEC-approved standard (IEC 62591) specifying an interoperable, self-organizing mesh technology in which field devices form wireless networks. This architecture creates a cost-effective network that does not require wiring and other supporting infrastructure.

In the traditional "wired" world of process sensors, a transmitter sends data through twisted-pair wiring to a distributed control system or other host. With a wireless solution, a radio and antenna convert electronic signals from the transmitter into radio waves, and another antenna and radio at the host convert the waves back into usable information.

Wired transmitters require a power source, cable, a collection point (marshalling cabinet), a data acquisition system to gather data from multiple transmitters, and a wired means to send the data back to a control system. The cost of such a system prohibits wired transmitters from being used in many remote applications. Battery-powered wireless transmitters, on the other hand, can be quickly and inexpensively installed anywhere, such as on an offshore platform.

HOW WIRELESSHART WORKS

The WirelessHART protocol conforms to IEEE 802.15.4, and operates in the 2,400-2,483.5 MHz license-free ISM band with a data rate up to 250 kbits/sec. Radios employ direct-sequence spread spectrum technology and channel hopping for communication security and reliability, as well as time division multiple access to ensure latency-controlled communications among devices on the network.

Each device in the self-organizing mesh network can serve as a router for messages from other devices. This extends the range of the network and provides redundant communication routes to increase data reliability to 99.9 percent.

Each WirelessHART network (**Figure 2**) includes two main elements:

1. Multiple wireless field devices connected to process or plant equipment.
2. A WirelessHART Gateway, which enables communications between these devices and the control system.

If the gateway is far from the control system but in the same plant, it collects data from its mesh network and sends it wirelessly through Wi-Fi to the control system. If the gateway is far away — as on an offshore platform — it connects to the control system via Wi-Fi, satellite, or cellular, depending on the distance. If the gateway is close to the plant's existing industrial wired communications network, it sends data over this network.

OFFSHORE WELLHEAD MONITORING

On an offshore wellhead platform, the data needed is far from the control system, and supplying power is a big issue. Wired transmitters are usually impractical in such situations, so Petróleos Mexicanos (PEMEX) used WirelessHART technology to improve safety and extend production of its 30-year-old Cantarell offshore oilfield in the Gulf of Mexico.

PEMEX's Cantarell operations consist of about 200 production wells on more than 50 platforms with limited or non-existent instrument power available. Many of the platforms also lack communication wiring to transmit data back to the onshore operations facility.

Previously, employees were sent each day by boat to platforms up to 50 miles from shore to gather data. This approach was costly, subject to unfavorable weather conditions, delayed important decision-making, and created safety risks.

The solution was to install battery-powered wireless sensors and instrumentation to obtain pressure, temperature, and valve position data. The instrumentation on each platform sends wireless data to a local gateway, which transmits the data via satellite to the control system.

The remote wireless monitoring system was created without additional wiring infrastructure, long implementation periods, or high maintenance costs.

TANK FARM MONITORING

Many tank farms use wireless transmitters, and distances are short enough to permit wireless communications back to the control system through a local gateway installed at the tank farm.

Figure 3: Tank farms cover large areas that are remote from a refinery's control system, but near enough for wireless transmitters to reach the control system.

A Swedish refinery was using wireless instruments to monitor and control its remote tank farm (**Figure 3**), but there was no direct Wi-Fi access from the refinery's main control room to the tank farm gateway. To monitor the wireless network status and configure devices, instrument technicians had to go into the field, and work permits and keys were required for entering the locked facility.

To improve operator and maintenance technician access to the remote wireless network, the refinery added a Wi-Fi based wireless plant network (WPN) from Emerson Process Management.

The WPN system includes three industrial hotspot units that extend the local network, and each of these is connected to a remotely-installed outdoor antenna. In addition, the WPN has an integrated antenna to create a Wi-Fi zone. This enables an operator to access the wireless network from any place in the control room or throughout the facility via a laptop equipped with Emerson's AMS wireless configurator, AMS wireless Snap-On, or TankMaster software.

REMOTE WIRELESS MONITORING BENEFITS

- *Eliminates unnecessary travel to remote sites*
- *Quicker data delivery*
- *Reduced power consumption*
- *Improved operations & safety*
- *Improved maintenance responsiveness to process problems*
- *Minimized engineering time and installation cost*
- *Quick and easy installation*
- *Reduced maintenance*

Figure 4: One oil producer added more than 3,500 WirelessHART devices to wellheads without needing additional power at the sites.

MONITORING WELLS

A major onshore oil producer has widely distributed wells with long distances between the wells and the main control center. The producer wanted to eliminate manual well inspections and unnecessary operator visits, collect real-time data to trend production efficiencies, and adjust for changing well conditions. The producer also wanted prompt identification of well shut-in conditions.

The difficulty was the sheer number of measurements necessary on the wellheads, each of which had limited power available. Battery-operated wireless process transmitters were the solution.

The producer implemented a mixture of wired and WirelessHART devices to monitor and control 80+ wells, while only using existing wellhead power systems.

More than 3,500 WirelessHART points were integrated through wireless gateways into a SCADA host via Modbus TCP/IP. Rosemount wireless temperature transmitters monitored temperature on each of the wellheads (**Figure 4**), while Rosemount wireless pressure transmitters were installed to monitor casing pressures on each of the 80+ wells.

THE WIRELESS WORLD

Remote wireless monitoring provides a host of benefits as listed in the table and as described in this article. WirelessHART is a widely accepted standard for implementing remote wireless monitoring systems because it provides benefits reliably with much lower implementation and maintenance costs than wired alternatives. **WDD**