

Real-time data acquisition goes WirelessHART at a major US power company. The BULLET proves a budget saver – it's the only network adapter with multidrop support for up to eight devices.

A major power company in the United States serves 7.2 million customers with approximately 57,700 megawatts of generating capacity. In order to better serve its customers, an internal SWAT team called Performance Testing is dedicated to stamping out inefficiency. Managed by Dick Fletcher, Performance Testing consists of six engineers and technicians who keep plant equipment and systems running smoothly by traveling from plant to plant, testing, troubleshooting and verifying performance standards on new and upgraded equipment.

Performance Testing serves the utility's 35,000 MW of fossil generation located in six states across the Southeast and Midwest that reach the company's 7.2 million customers. The group often splits into teams of two to more efficiently perform testing that supplements each plant's individual efforts to ensure peak efficiency and output.

Testing in the field requires portable data acquisition systems that can collect data from multiple process instruments located throughout a facility. The test typically records time-stamped data through a gateway and into a spreadsheet-type application on a laptop PC.

Test equipment must be portable and flexible enough to operate with a fluctuating number of instruments and scan rates.

The Problem with Hard Wires

Performance Testing maintains more than 250 transmitters primarily used for temperature and pressure measurements along with some flow measurements. These transmitters have been traditionally hard-wired to HART multiplexers with long cables to accommodate runs across facilities to conduct tests; in some cases, this means running cables over streets. Testing required time-consuming set-up and tear-down that could last for days and involved hard-wired network multiplexers that would occasionally fail from wear and tear. Problems with wiring damage also occurred as cables were reused from site to site to connect up to 100 instruments.

The advent of the *Wireless*HART protocol and the commercial availability of network *Wireless*HART adapters conforming to the standard allowed the group to install a new wireless system that would replace its aging test equipment and streamline the testing process (see Figure 1).

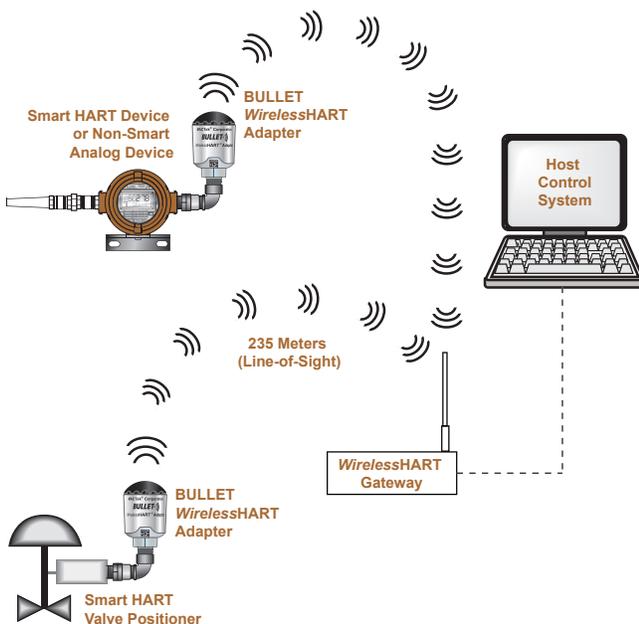
"Both traveling test groups had a major investment in our existing HART Smart Transmitters," Fletcher said. "The logical thing to do was get a common data acquisition system to be shared across the system by Performance Testing."

Fletcher set short-term goals for a new system. It needed to be flexible enough to handle a variety of instruments interfacing with a variety of protocols, with an emphasis on high-accuracy pressure and temperature transmitters. The system also had to be easy to configure since every plant requires a different configuration. He also set long-term goals to use the system to both broaden the scope of testing and achieve a remote data flow over the corporate wide-area network (WAN) for remote testing and analysis. But the group first had to establish a new system as a proof of concept.

Project Objectives

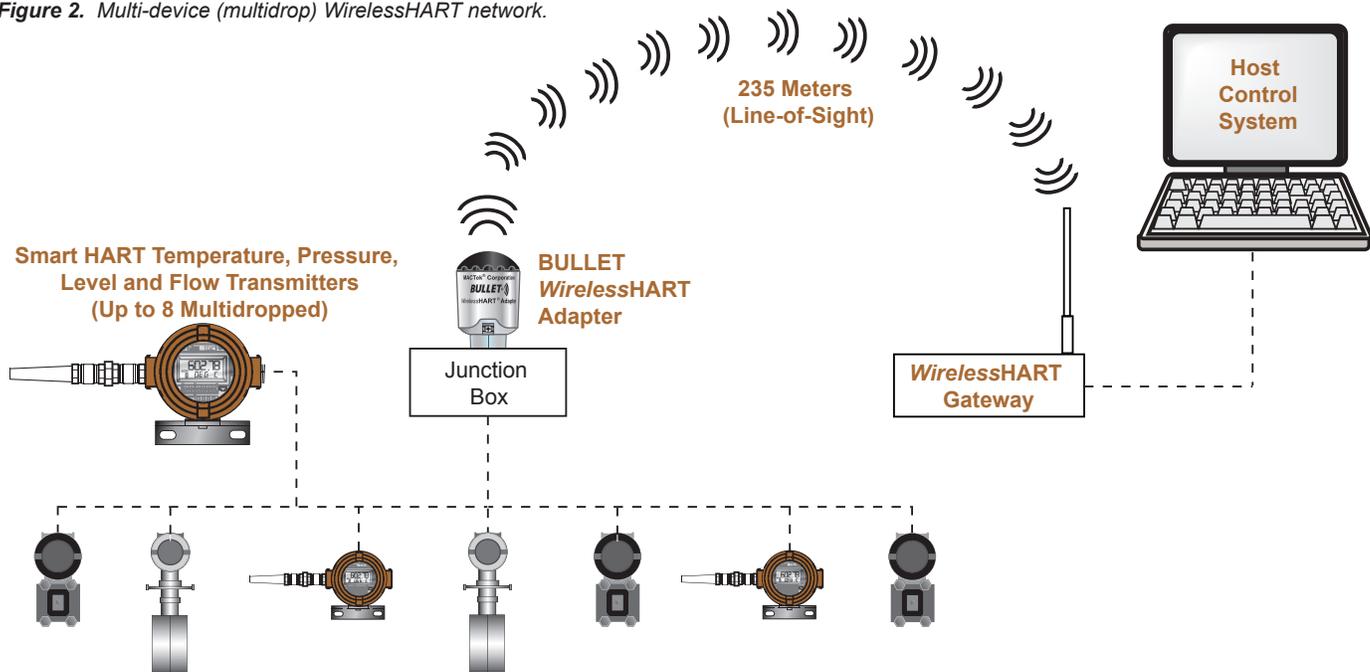
The relatively recent implementation of *Wireless*HART in industrial products, particularly network adapters that bring in HART transmitter data, had improved the speed and ease of test setup. The BULLET adapter provided Performance Testing with the advantage of connecting up to eight existing HART-enabled devices in a digital

Figure 1. Simple two device *Wireless*HART network.



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Figure 2. Multi-device (multidrop) WirelessHART network.



multidrop network mode (see Figure 2). This allowed Performance Testing to approach the development of their wireless system with five specific objectives:

- Create a common field data acquisition system for the testing group to use across the company.
- Allow the sharing of equipment across the system to minimize the company's inventory.
- Take advantage of the capabilities of HART to collect digital data in multidrop mode.
- Ease the installation of the test equipment in order to minimize time and effort.
- Benefit from a system that is flexible, easily expandable and easily configurable.

"The focus of the project in the research phase was mainly on wired multiplexer-based systems because the wireless equipment we were initially aware of was expected to be out of our financial reach," Fletcher said.

A big financial issue was the number of adapters that were required. The wireless solutions initially researched by Performance Testing were only able to connect one HART transmitter to an adapter.

"The realities of the economy meant that we needed to get the best bang for our buck and maintain compatibility with our existing investment in HART-enabled transmitters," Fletcher said. "As we were planning our purchase, we became aware that MACTek had working prototypes of the BULLET."

This prototype was introduced in 2009 and offered the capability to support up to six HART transmitters in a field-proven HART multidrop mode. The version currently used by Performance Testing supports up to eight HART transmitters.

"The multidrop capability meant that a Wireless Gateway could replace failing multiplexers and that far fewer cables needed to be deployed for our temporary test transmitter installations," Fletcher said. "The economics of a hybrid wireless-wired HART system became much more feasible for us to consider."

Implementing the Wireless Solution

Performance Testing's wireless solution makes use of pre-existing Rosemount Smart HART transmitters and the following key pieces of new equipment:

- MACTek BULLETs
- MACTek HART modems
- Siemens Simatic PDM software
- Emerson Smart Wireless Gateways
- 24Vdc power Supplies from Acopian
- Weather proof electrical enclosures
- Transmitter cables from The Mody Co. (3-conductor with Neutrix 3 pin XLR connectors and 5-conductor RTD cables with Neutrix 5 pin XLR connectors).

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The resulting system uses the BULLETS to send the HART data (including PVs) through the Emerson gateway and into a laptop PC, where the data is imported to an Excel spreadsheet using Matrikon Analytics' OPC plug-in Excel Reporter.

Before its implementation, the BULLETS and *Wireless*HART protocol passed an IT security review in compliance with NERC-CIP (North American Electric Reliability Council – Critical Infrastructure Protection) requirements with flying colors.

"While we were able to show no connection to the plant's cyber assets, they were impressed with the security of the encrypted HART protocol," Fletcher said.

Fletcher was concerned about potential range limits and interference with objects between antennas in the wireless network because *Wireless*HART uses the same 2.4GHz frequency band as Wi-Fi but found that in his network, the BULLETS do not necessarily have to be in a direct line-of-sight to establish a network. He also said that while it can take between 10 to 20 minutes to fully establish a *Wireless*HART network with all HART sub-devices reporting, this has more than made up for by the increased reliability of the network and reduced installation times.

Fletcher said that the *Wireless*HART protocol is built for redundancy and reliability. For his testing purposes, he sets-up his transmitters to be polled by the BULLETS every 16 seconds and his gateways to poll at 20 second intervals.

"The *Wireless*HART radio links perform in circumstances that Wi-Fi could not hope to achieve," Fletcher said. "Wi-Fi was designed for speed while *Wireless*HART was designed for reliability of data."

Benefits

The new system utilizing the BULLET had many apparent advantages including lower up-front costs and an increase in the reliability of both Performance Testing's data acquisition system and the sum of the assets throughout their 32 plants.

The BULLET played an important role in the project's success. Whereas some initial solutions investigated were outside the group's "financial reach," Fletcher said the BULLET provided significant cost-savings from the start.

One leading wireless adapter provided the similar wireless capabilities as the BULLET but each adapter handled only one transmitter at a time. The cost of using such wireless network adapters on the 240 transmitters maintained by the performance group was quoted at around \$180,000. The mulitdrop capability of the BULLETS was the main financial reason the product was approved. By handling eight devices each, significantly fewer BULLETS were needed. The total cost of the BULLETS was \$22,000 at list price, a saving of around \$158,000 over the other wireless adapter.

The first outing with the new system was a large test using 114 instruments connected to 17 BULLETS at the power company's Crystal River, Fla., generating facility. The labor savings were evident immediately.

"I estimate that we saved 100 to 150 man-hours on this large test," Fletcher said. "On a small test where we tried the BULLET, we saved about six man-hours on a setup that took approximately ten total man-hours to setup using the wired networks. We do an average of 15 tests each year. If we save 33 hours of labor during each test, this works out to \$20,000 in savings per year."

Fletcher said the multi-vendor test system has been very reliable, from the "rock solid" Emerson gateways to the BULLETS, which he lauded for their "remarkable performance and reliability for a new design."

"Beyond up-front savings, the new system significantly reduces cables, as the use of radio links eliminates situations that placed cables at risk of damage," Fletcher said. "There will definitely be savings over time. The test still takes as long as it must, but set-up and tear-down are much faster, and the group can better focus on its job. Along with the streamlined process for data acquisition, we get a better picture in real time of how our test equipment is performing and communicating."

Fletcher said that they've also found the BULLET extremely valuable in the testing of combined cycle plants. There are typically two or more steam generators that can be several hundred feet apart with access roads between them and the steam turbine is also set apart.

"Not only does the BULLET save us a lot of time in this situation due to not having to run and protect long runs of cable, we don't have issues with loss of data due to damaged cables as a result of traffic as well as minimizing tripping hazards to the plant staff," Fletcher said.

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Performance Testing has also found that using the BULLET means that the time spent in planning the placement of devices has fallen dramatically.

“About all we need do is to place the BULLET in a somewhat open area to give the signal a chance to get out and bounce around, particularly when we have the BULLET on a different elevation than the gateway,” Fletcher said. “In the plant situation we do get a lot of signal ‘bounce’ from the equipment and most of our wireless connections to the gateway are not on a direct line-of-sight. Even with only one or two BULLETS in a direct line-of-sight to the gateway, most other BULLETS will find an indirect connection to the gateway through another BULLET in close proximity that is part of the mesh network, which is standard in *WirelessHART* systems.”

Future Potential

Performance Testing continues to explore the benefits and features of its new wireless solution. For example, Fletcher may switch some BULLETS over to battery power for added flexibility in short-term equipment deployments.

Performance Testing has also modified some BULLET units for use with non-HART instruments by using the instrument to drive a 4-20mA loop through the BULLET and send that data back to the gateway. This has greatly reduced the amount of manual data needed for certain tests. Fletcher said they are currently only doing this for ultrasonic flow meters but the process could be used in the future for any non-HART device with a 4-20mA output.

The system’s productivity gains are leading Fletcher to consider expanding the scope of testing from thermal performance to additional tests and diagnostic capabilities.

“For instance, we are currently looking at adapting our dye dilution flow testing to the new system,” Fletcher said. “Now that the team can work more quickly, there’s more time for more comprehensive testing applications.”

With the test system serving as a wireless proof-of-concept, Fletcher’s group is in discussions with plant personnel to consider permanently installing BULLETS in key locations. If remote access is granted, this can yield benefits at the plant level and beyond.

“The web interface built into the wireless gateways give us good diagnostics and data on the BULLETS and the HART devices they are supporting,” Fletcher said. “If we can link the gateways to our corporate Wide Area Network (WAN), we’ll see even more benefits. Connecting to the corporate WAN instead of the laptop allows engineers to evaluate data from any plant immediately from any location. This would also allow additional, in-depth evaluation by Performance Testing or others in the company at any time.”



How far can you take the BULLET bus?

While HART is a hybrid analog/digital specification, wireless data transmission is all-digital. This allows HART technology to transcend its heritage as a diagnostic tool and enter the world of digital bus functionality.

The application flexibility of *WirelessHART* combined with the capabilities of the BULLET may come as something of a revelation to the uninitiated. In wireless multidrop mode, the analog signal is not used. Instruments use the 4-20mA signals for power, but process variables are transmitted digitally from tags to diagnostics to process variable measurements. So in a sense, the technology may open the door new applications previously thought to be the sole domain of digital fieldbus networks such as condition monitoring and asset management. A BULLET can transmit data from eight multi-dropped instruments to higher levels once every eight seconds (1 second per device) making real-time data acquisition possibility.

Fletcher notes that the protocol is built for redundancy and reliability. For his testing purposes, he sets-up his transmitters to be polled by the MACTek BULLETS every 16 seconds; and his gateways to poll at 20-second intervals.

Moore Industries is the official exclusive global reseller of the BULLET *WirelessHART*® Adapter by MACTek.

The data sheet is available at:
<http://www.miinet.com/BULLET>



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