

## ABB Measurement Products

### Wireless technology for instrumentation

#### Taking advantage of wireless in process plants

By Gareth Johnston, ABB

Today's smart field instruments have benefited from the use of more powerful microprocessors with low energy requirements. These instruments can provide much more information than just the measured value in the form of a 4-20 mA analog signal. Instruments now have the ability to diagnose both device and process connection conditions to improve availability. In addition, multivariable smart instruments can provide multiple measured and calculated values with fewer process connections.

About 30 million HART-capable 4-20 mA instruments serve as physical plant assets that perform measurement and control in processing plants worldwide. Plants often employ the HART protocol simply to configure and commission the instruments. Estimates indicate that only 10% of these instruments have a digital pathway back to the host system. They don't take advantage of the existing diagnostic and connection information residing in the field instruments. WirelessHART, as implemented in the latest HART 7 standard, can provide this pathway in a convenient, affordable, secure, and reliable way.

#### WirelessHART takes hold

Virtually all large instrumentation companies now accept and use the WirelessHART standard in their products. Manufacturers are shipping WirelessHART-capable products as well as adapters that fit to existing installed instruments and convert them to WirelessHART. The adapters provide a cost-effective and secure communication pathway back to remote condition monitoring applications, such as ABB's AssetVision or similar functions at the computer control system. Wireless adapters can also be used for process monitoring in the case where there is local power available at the instrument but no connection back to the

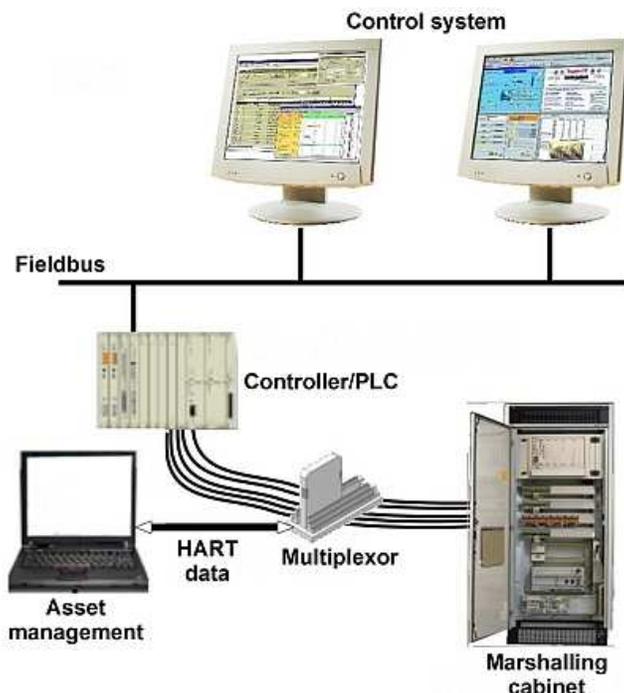


Figure 1. Hard wiring HART-capable field instruments to asset management system.

host system. WirelessHART adapters for field instruments obviously eliminate significant rewiring costs. They offer a good starting point for end users to gain experience with wireless technology while benefiting from new remote access to existing assets in the field.

Of course it's possible to retrofit existing HART instrumentation without resorting to wireless, Figure 1. Plants can add a wired HART multiplexor. A serial link from the multiplexor to the host asset management system would provide access to the instrument HART data. The logical location for the multiplexor in making this series connection to the 4-20 mA signal is the marshalling cabinet. Here installation technicians could connect each instrument signal in turn to the multiplexor.

But this solution depends on:

- availability of an up-to-date and accurate panel wiring diagram
- adequate space in the marshalling cabinet for the multiplexors
- possible necessity to wait for a plant shutdown as each loop requires re-wiring.

WirelessHART avoids these drawbacks, permitting processing plants to facilitate low-cost implementation point by point often without the need for a plant shutdown. In this way they can take full advantage of their field instrument assets, Figure 2. Essentially, wireless can offer dramatically reduced costs in wiring, engineering, installation, and maintenance, combined with increased data gathering flexibility.

Plants can monitor process data via the wireless link using MODBUS TCP. They can use standard instrument integration files for configuration and fault drill down. Additionally, energy harvesting techniques employed by many wireless adaptors avoid the need for batteries. The wireless adapter is often connected at a spare instrument cable gland and becomes part of a mesh network back to a gateway device connected to the host system. With this new knowledge of instrument and connection diagnostics, plants can reduce unplanned shutdowns.

Some common applications for using recovered data include:

- Multivariable process data, such as totalizer, temperature, and density associated with some mass flowmeters.
- Detection of plugged impulse line from differential pressure transmitters.
- Assessment of measured value reliability.
- Communication of status and alarm messages.
- Control valve condition monitoring by signature analysis.
- Feedback from valve and actuator positioners.
- Imminent analyzer calibration requirements.
- Accumulation of instrument over-pressure counts.

Additionally, engineers can remotely access the instrument to alter its configuration or manage a central configuration database. They can modify the instrument's parameter configuration without having to expose wiring or connect test leads in hazardous environments.

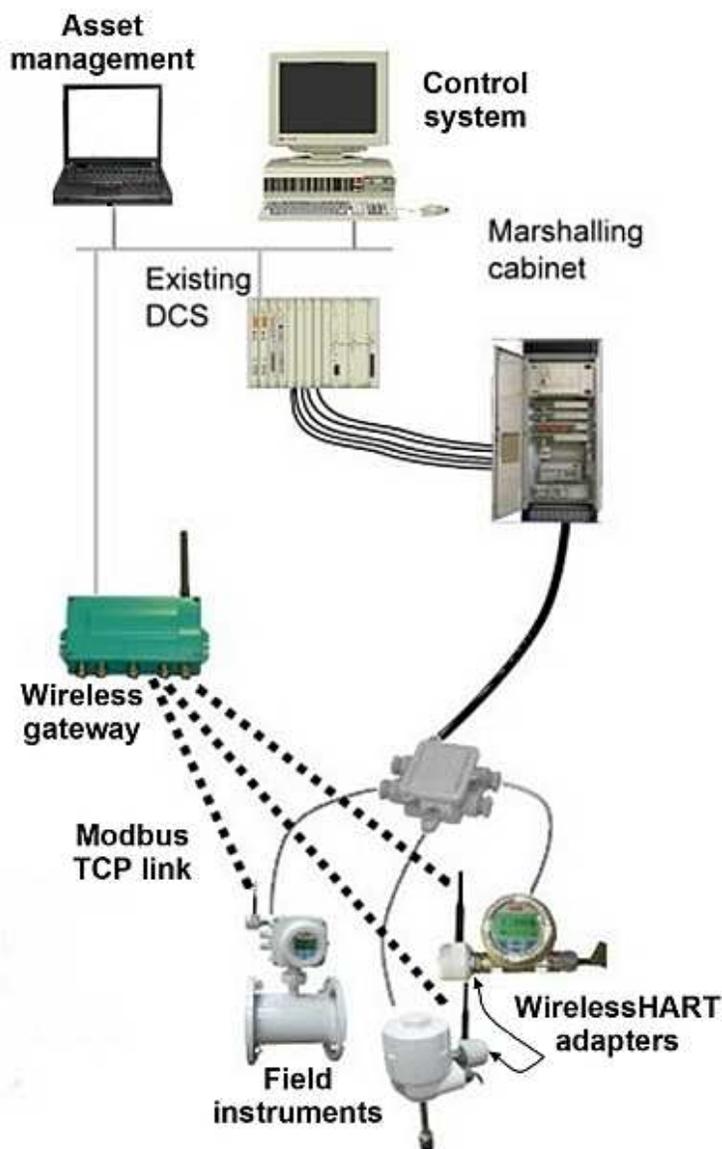


Figure 2. Employing WirelessHART adapters to communicate with asset management.

Wireless communications would improve plant uptime in three steps, Figure 3. Initially, the instrument identifies a fault and sets an internal alert. Then an application that monitors conditions, such as ABB's AssetVision or condition monitors running in ABB System 800xA, reads the instrument alert via the WirelessHART network. The asset management system generates and routes a fault report based upon its severity. Finally the maintenance or remote support team connects to the field instrument and drills down via HART tools such as DTM (Device Type Manager) to diagnose the

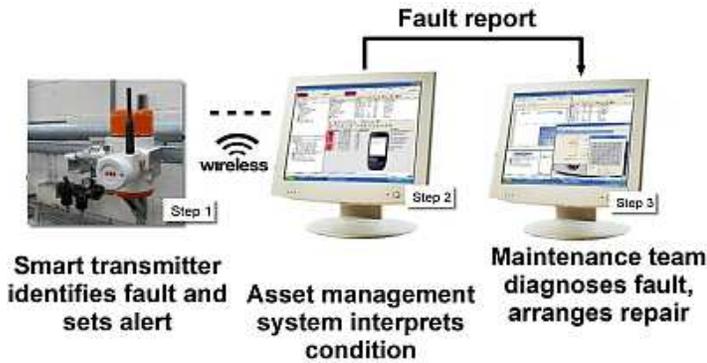


Figure 3. Reporting maintenance alerts and arranging repairs.

fault and arrange repair.

The value of the information recovered from within the instrument will largely depend upon the asset it is measuring or controlling and also upon the capabilities of the instrument itself. Some analyzers, for example, contain buffer fluids to allow periodic calibration; these buffer tanks will need refilling and this requires a maintenance alert. Other plant assets with moving components (for example drives or valves) would also have the ability to predict maintenance requirements based upon activity.

### Understanding WirelessHART

An industrial wireless network at the instrument level must address the concerns of security, reliability, and simplicity of use along with the ability to integrate devices from multiple vendors into the same network using the full feature set.

A standard such as WirelessHART (IEC-62591) provides a good process solution through the use of multiple levels of security and redundant pathways via mesh networking. These functions permit compliant devices to exchange data in a reliable and secure way through the network. With a WirelessHART solution, the engineering tools to integrate the instrument with the host remain unchanged. Plant engineers need only update the HART device description (DD) and device type managers (DTMs) for the field instruments.

Process plants often have dense infrastructures, vehicle movement, large electrical equipment, and numerous sources of RFI and EMI, including other radio communication systems. WirelessHART automatically adjusts the mesh network to changing surroundings

and can hop to unused radio channels to ensure process information is available.

**Network**--The WirelessHART mesh concept provides a robust and self-healing network. The mesh network offers multiple pathways as data travels between the instruments and the host gateway. If one pathway is blocked, the transmission can switch to one of the alternative (redundant) pathways. A network manager (typically software residing in the gateway) maintains the mesh automatically. Switching to a redundant path is automatic with no engineer intervention. As instruments join the mesh, the network manager automatically builds a new graph of redundant pathways.

**Time slot**--WirelessHART employs a fixed time duration (often called a slot) of 10 ms for each transmission. These time slots are configured automatically (based on the data update rate required) to ensure instruments can report timely process data back to the gateway.

**Smart reporting**--To maximize battery life, Wire-

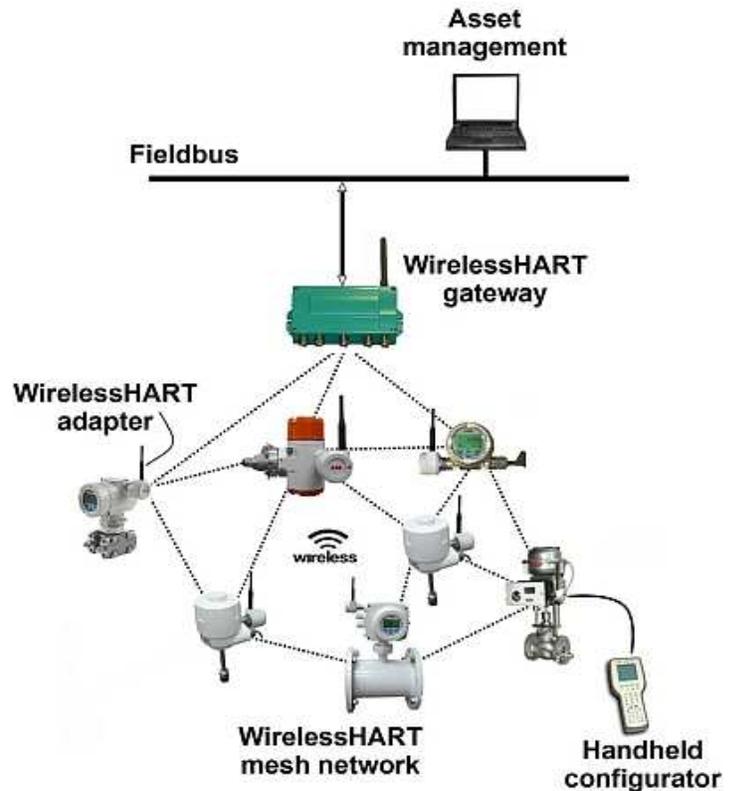


Figure 4. WirelessHART mesh network ensures system reliability.

lessHART can be configured to transmit process data only if it has changed or if an event requires transmission. Smart reporting provides a method to change the data rate based on the process value. The reporting rate can increase if the process variable crosses an alert level, providing more frequent updates. In addition, the transmission can occur only if the process changes by a preset amount (for example, 5%) or if a time period expires (for example, 10 minutes). The process data transmitted has a time and date stamp added by the instrument.

**Wireless co-existence**--WirelessHART uses a radio standard (802.15.4) and an unlicensed frequency band of 15 channels for transmissions (ISM band 2.4GHz). Since anyone can use these channels, the system must minimize collisions to ensure the networks operate at a satisfactory level. WirelessHART uses channel assessment and short message sizes to coexist with neighboring networks. As each message is prepared for sending, the instrument checks the selected channel for usage. If the channel is being used, the instrument waits for the next time slot and hops to a different channel.

**Wireless diagnostics**—These techniques ensure the health of the network and its security status. Diagnostics are built into the HART standard and include indicators of battery life remaining, devices present, network join attempts, and other network management indicators.

**Wireless security**--This is one of the top three wireless requirements (the others are robustness and simplicity). WirelessHART takes advantage of spread spectrum transmissions that greatly improve security and immunity to noise and interference. Originally, spread spectrum systems were designed for the military in World War II with the goals of avoiding data interference and providing security. (Surprisingly, actress Hedy Lamarr is the co-holder of the earliest patent on spread spectrum communications). Encryption adds another layer of security.

WirelessHART contains additional security considerations. The system verifies if a joining instrument has the proper credentials. And wireless messages each contain a unique message integrity code to ensure that the content of the message has not been altered as it passes through the mesh network.

To sum up, wireless networks at the field instrument level may not replace 4-20 mA loops but will complement them where installation is difficult or expensive or where valuable information is left stranded in the field. Wireless adapters can be used to add wireless connectivity to existing or new HART instruments and provide an effective maintenance network back to the host system. Wireless adapters, such as the ABB FieldKey, can be fitted, point by point, and provide full access to the information stranded within the target instrument. The unlocked information can greatly augment the value of a processing plant's asset management systems.

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