# Unlocking stranded information

## The ABB WirelessHART™ upgrade adapter

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**In today's economic climate, maximizing plant assets and reducing unplanned plant shutdowns has become a focus for reducing costs and maximizing productivity. Currently, potentially valuable information acquired by process instruments is often left stranded in the field. This information could be monitored if a communications pathway back to the host control system were created. Typically existing instruments have a built-in HART communication protocol, used normally during instrument commissioning. The arrival of wireless standards, such as WirelessHART™, has allowed ABB to develop an upgrade wireless adapter, which can be fitted to existing HART instruments, providing a cost-effective and secure communication pathway back to remote condition monitoring applications, such as ABB's Asset Vision Professional.**

The HART (Highway Addressable Remote Transducer) communication protocol is used by process instruments to digitally communicate process measurements and diagnostic information to intelligent hosts such as a distributed control system (DCS) or a HART handheld tool. The HART digital protocol is implemented as a frequency shift-key (FSK) that is superimposed on top of a 4 to 20 mA signal. Wired HART devices can connect with 4 to 20 mA analog I/O modules as part of a control system, which may or may not be able to communicate via HART. Today, HART is the dominant instrument communications protocol, with some 30 million 4 to 20 mA HART instruments installed worldwide. Its dominance is partially due to its ability to coexist with the 4 to 20 mA signal. Its position as market leader has remained despite the arrival of more sophisticated digital-only buses, which are often perceived as complex 1.

## Valuable information stranded

HART communication is often used during the commissioning of field instruments; typically a HART handheld tool is connected directly to the field instrument where parameters such as range and transducer type can be set. Once the handheld tool is disconnected, all the remaining instrument information is left stranded within the instrument unless a pathway back to the host is available.

It has been estimated that only 10 percent of the 30 million HART instruments installed since 1989 have a pathway back to the host.[1)] This remote access would allow operations and maintenance to take full advantage of this stranded instrument information for functions that include:

### Process monitoring

Some instruments such as flow meters often measure other process data such as totalizers, density or temperature, all of which are useful for process monitoring.

### Condition monitoring

Process connection issues (eg, plugged impulse-line detection for differential pressure flow or control valve condition monitoring by signature analysis) and instrument issues (eg, analyzer consumable usage or analyzer probe condition) allow the condition of a process to be monitored.

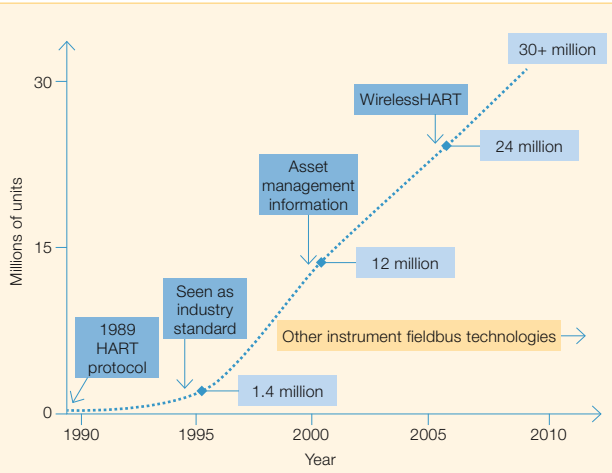
### Configuration database

This database is used to manage instrument configuration and maintenance checking.

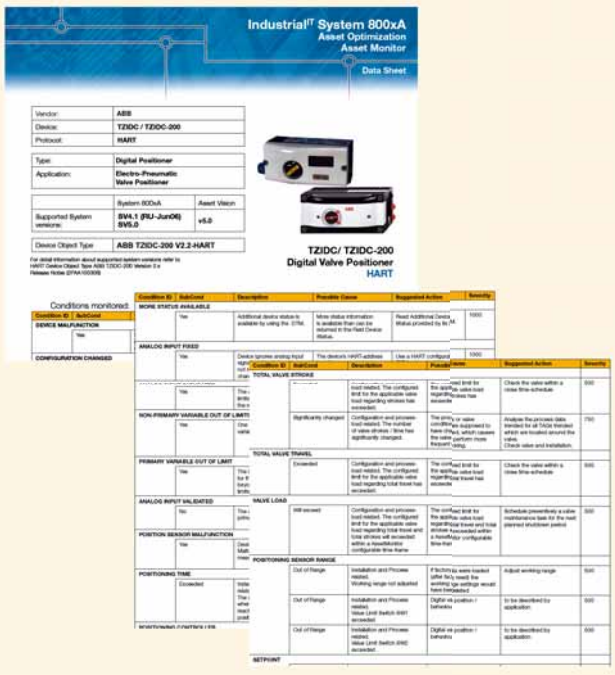
The value of the information stranded within the instrument will largely depend upon the asset it is measuring or controlling and also upon the capabilities of the instrument itself. Some analyzers, for example, contain buffer fluids to allow periodic calibration; these buffer tanks will need refilling and this requires a maintenance alert. Other plant assets with moving components (eg, drives or valves) would also have the ability to predict maintenance requirements based upon activity 2.

With industries struggling to cope with the current economic downturn, attention is focused upon the timely maintenance of assets in the field. Methods must be found by which to unlock the information stranded within instruments in an economical and low-risk way to maximize plant availability.

1 Growth of HART and major milestones




2 Example of detectable conditions for control valve positioner




Identified maintenance conditions monitored by the ABB valve positioner (part identication TZIDC)

It has been estimated that only 10 percent of the 30 million HART instruments installed since 1989 have a pathway back to the host.

## Unlocking the information

A traditional 4 to 20 mA control system would contain a programmable logic controller (PLC) with I/O modules wired through a marshalling cabinet via multi-core cable to the field 3. The marshalling cabinet would contain

**Footnote**

1) It is estimated that 75 percent of intelligent instruments use HART – 90 percent of these do not have remote access.

relevant power supplies and barriers or isolators. Access to HART data can be achieved by retrofitting a HART multiplexing unit with a serial link to the host system. The best location for the multiplexer would be in the marshalling cabinet where each instrument signal would be connected in turn.

The addition of a HART multiplexer to an existing installation is possible; however, there are issues to be aware of, eg:

- The most recent panel wiring diagram should be correct and available.
- Adequate space should be available in the marshalling cabinet.
- During installation each loop should be opened to connect to the multiplexer.
- It may be necessary to wait for a plant to shutdown.

Another option would be to add a wireless network to transmit the HART information from each instrument back to the host system for appropriate monitoring. A wireless adapter would be added to each instrument so that valuable information could be passed on 4. The adapter could be powered via the 4 to 20 mA loop or via another source (eg, battery, local power, solar). Such a solution would provide a low-cost point-by-point addition of instruments to a wireless network, communicating back to an asset management system such as the ABB Asset Vision Professional (AVP).

A wireless adapter would be added to each instrument so that information could be passed on to an asset management system such as the ABB Asset Vision Professional.

The addition of remote access point-by-point is cost effective with phased installation, and there is no need for rewiring of marshalling cabinets or reliance upon wiring diagrams, providing lower-risk installation.

### So shall we use WiFi?

Using an existing wireless network such as WiFi sounds like the best way to proceed; however, with a little thought it is clear that such a solution has too many problems. WiFi is a good solution for transferring large files, networking PC's and peripherals in an office or at home, but industry requirements are much more vigorous and are particularly vulnerable to security and reliability issues 5.

- Is WiFi secure enough?
- Can WiFi coexist with other wireless networks?
- Can WiFi adapt to changing environments?
- Will I need new tools to support it?

Often people's experience of WiFi is frustrating, especially when other networks are nearby. On an industrial site we know that the radio environment will change often (sometimes daily) as vehicles move through the plant or the infrastructure changes (eg, erecting scaffolding, adding new equipment). The conclusion is that to simply send HART over wireless (WiFi) does not provide an industrial-strength solution.[2)]

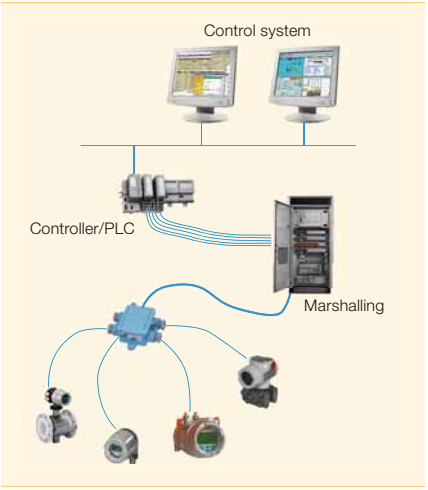
WirelessHART is the next evolutionary step for HART as the industry standard.

WirelessHART™ provides the solution by building in multiple levels of security, data authentication and redundant pathways back to the host. These functions are built in to the standard so that compliant devices can exchange data in a reliable and secure way through a WirelessHART network. Building a wireless solution upon HART is also cost effective as the engineering tools remain unchanged; you need only update the HART DD (device description) / DTM (device type manager) for the new devices.

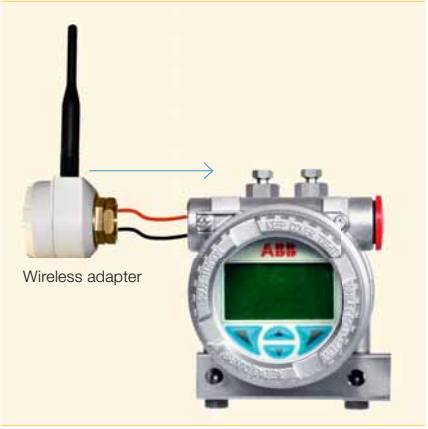
### WirelessHART™ for instrumentation

The process industry is conservative and reliant upon standards, which provides lower costs and increased choice. Vendors such as ABB also prefer working with standards and so it is not surprising that WirelessHART has become the first such standard available. WirelessHART is the next evolu-

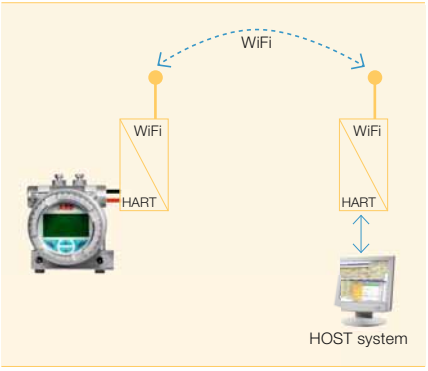
3 Traditional wired control system




4 The ABB WirelessHART upgrade adapter




5 HART over wireless – unsecured and unreliable




**Footnotes**

[2)] Top three end-user requirements:
- Make it secure
- Make it reliable
- Keep it simple

[3)] HART 7 is the most recent version of the HART specification and is fully backward compatible with existing HART instruments and tools. HART 7 includes additional features to support wireless networking.

tionary step for HART as the industry standard and is part of the HART 7 specification[3].

The WirelessHART network is shown in 6. Little has changed for the host system since the HART communications is already built in. There is a high-speed fieldbus backbone to WirelessHART gateways located in the field. The WirelessHART gateway is responsible for building and grooming the wireless mesh, which connects the instruments to the network. A traditional HART handheld tool is used to join new WirelessHART instruments to the network 6. Joining requires entering a join key (encryption key) and network identification. The most secure way to enter these parameters is through a short physical connection via the handheld device.

WirelessHART has several strategies to satisfy the end-user requirements for security, reliability and simplicity. ABB is applying the WirelessHART specification to its instrument range where these strategies are built in.

WirelessHART is intrinsically compatible with the 30 million 4 to 20 mA HART instruments already installed – to use WirelssHART, simply apply a loop-powered plug-in upgrade adapter and use the same traditional HART tools with an updated DD or DTM.

### Reliability

WirelessHART-enabled devices use a mesh network where alternate routes to get the information back to the gateway and the host system are available. If one pathway back is broken then an alternative path is selected automatically.

When coexisting with other neighboring networks the WirelessHART employs the following strategies to make sure it gets the message through with minimal effect on other networks using similar frequency channels:

### Channel hopping

Each message automatically uses a different frequency channel from the previous message to avoid other networks (there are 15 channels from which to select) 7.

### Channel assessment

The transmission channel selected is tested to see if other networks are using it before the data is sent (ie, avoids data collisions).

### Short messages

The WirelessHART message is very short (3 to 4 ms in one 10 ms time slot).

### Security

For WirelessHART devices security is built in and cannot be disabled 8. The main concerns are with data privacy and authentication. A brief view of the features built into WirelessHART, which are used by ABB in its WirelessHART instruments:

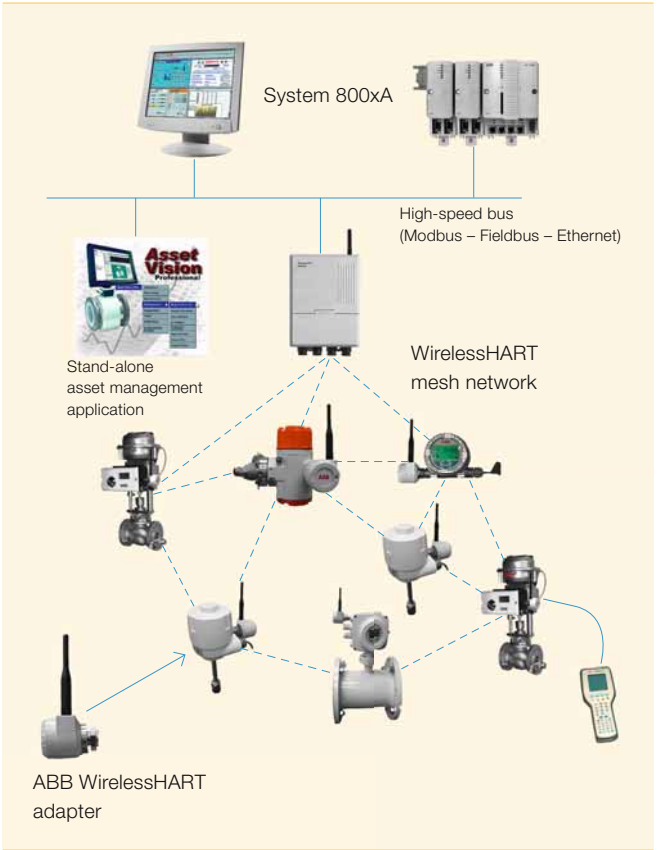
- Data is encrypted with a different encryption key as it hops through the mesh network, providing greater security.
- Data is authenticated to ensure it has not been altered by other agents as it passes through the network.
- Devices are authenticated as they join the network to prevent rogue devices joining.
- Messages are kept short and transmitted on different channels at each hop so that data is hard to find.

ABB has identified an urgent need to train potential users and provides support to the HART Communication Foundation (HCF) to create and run a series of worldwide technical road shows.[4]

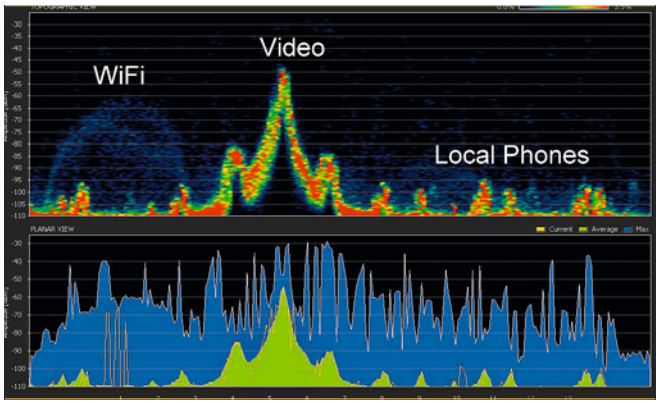
### WirelessHART adapter

The upgrade adapter (NHU200-WL) will be the first ABB WirelessHART device available. This device allows operations and maintenance teams to unlock stranded information 9. The adapter is designed for ease

6 WirelessHART network




7 An example of on-site wireless activity




**Footnote**

[4] To find out when the next road show will be in your area, go to www.abb.com/instrumentation, register and follow Wireless Instrumentation links on the right.

of use during both installation and operation. This has been achieved by its small size and use of green power (energy scavenging), which means there are no batteries to maintain or replace.

### Commissioning adapters

The adapter can be connected anywhere within the 4 to 20 mA loop used by the instrument. Typically this will be via a spare cable entry gland on the instrument or a T-piece, should only one gland be available. The small size of the adapter makes it easy to fit if there are obstructions nearby, ie, pneumatic connections to valves; in fact the antenna can be removed to make physical installation even easier.

- Connect the adapter in series with the target instrument.
- Connect a traditional HART tool (handheld or Asset Vision) to the 4 to 20 mA loop and set the joining parameters of the adapter (join key – network ID).
- Monitor the join status and disconnect the HART tool when complete.

The adapter will now read information from the target instrument and make it available to the host system.

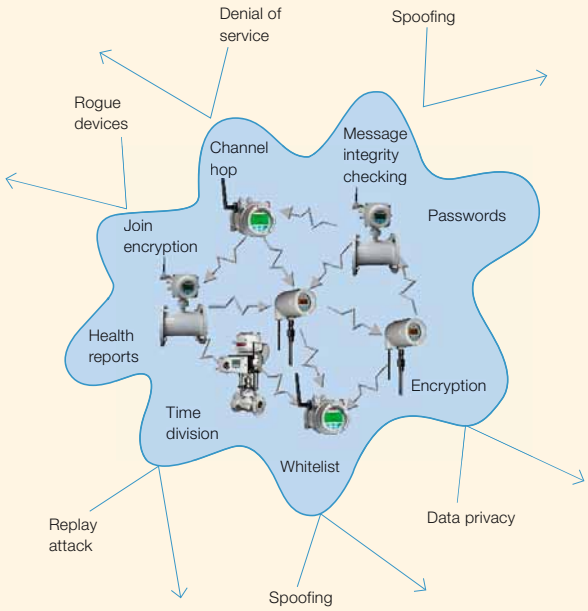
### Using the adapter

The main use of the adapter is in conjunction with asset management tools, such as ABB AVP to monitor instrument maintenance conditions Factbox 1. AVP has built-in asset monitors for HART instruments. These are used to check instrument maintenance conditions and provide additional information to assist with fault finding. These asset monitors can be used without modification with the WirelessHART adapter.

ABB's WirelessHART adapter is designed for ease of use during both installation and operation.

Once installed the adapter will route requests for information from the asset management system to the target instrument and then send back the reply 10.

8 WirelessHART security




Factbox 1 Adapter benefits

- Small size makes it easy to fit in challenging conditions
- Rotating housing allows you to obtain the best antenna direction thus simplifying installation
- Green energy means there is no battery to maintain, reducing operating costs
- Low power requirements allow the adapter to be installed at the end of long cable runs increasing its suitability
- WirelessHART built in allows the adapter to join existing WirelessHART networks with other third-party vendor equipment, reducing costs and increasing flexibility
- Provides access to all the information (process data and maintenance information) in an existing installed 4 to 20 mA instrument
- When coupled with AVP (or other asset management applications) the adapter provides full remote access to instrument information (process and maintenance)
- Designed for use with ABB and other instruments

### WirelessHART tests

WirelessHART devices such as the ABB adapter will be part of a networked system so it is important that all devices are tested to comply with the written HCF specification. All ABB WirelessHART devices will be certified to work in multi-vendor networks with built-in features for reliability and security.

The HCF test kit used to certify WirelessHART devices became available mid-2009, which means certified devices are not expected to be available until the beginning of 2010, since it will take time to test and solve any problems found.

### Trial site – BASF

BASF has joined together with NAMUR[5] to ask if WirelessHART provides the single standard for wireless process measurement and control devices. To gather information and answer this question, BASF Ludwigshafen in Germany was chosen as the trial site to install and test several WirelessHART networks with devices from multiple vendors, including ABB.

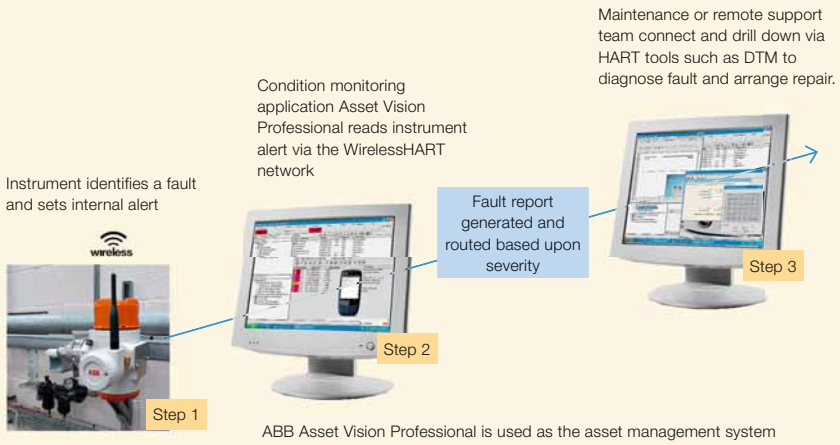
The trial at BASF started in July 2009 with precertified and prototype devices from ABB, Emerson, Endress & Hauser, MacTek, Pepperl & Fuchs and

9 ABB NHU200-WL WirelessHART upgrade adapter


**Footnote**

[5] An international user association of automation technology in process industries

10 Information flow between the adapter and the asset management system




Siemens. These were connected to host systems from ABB and Emerson. NAMUR has produced recommendation NE124 entitled "Requirements for Wireless Automation," which will form a basis for some of the testing. ABB has assisted with site installation and commissioning Factbox 2.

The trial has two phases.

Phase 1: The laboratory test focuses on interoperability, usability and response times. Other tests will include coexistence with other radio standards such as 802.11b/g/n (used for example with WiFi).

Phase 2: Application tests focus upon installation and operational performance at several production plants at BASF's Ludwigshafen site. This phase will serve to validate the laboratory phase.

WirelessHART has been developed to complement wired networks for situations where installation is difficult and costs are high or when a second maintenance network is beneficial.

The results of these tests will be available during the fourth quarter of 2009.

In this context the NAMUR study represents a catalyst for both manufacturers and standardization bodies to prepare the ground for a joint and unique IEC standard for wireless sensor networks. Such a uniform wireless standard will help manufacturers and end users implement wireless applications quickly to harness the potential of this new technology.

The NAMUR technological study is not limited to the WirelessHART standard. The intention is to counteract the emerging competition between the different standards at an early stage and to combine the advantages of the current WirelessHART and ISA SP100 initiatives.

**Let's use wireless everywhere!**

Wireless at the instrument level is not intended to replace wired 4 to 20 mA or any other digital-only fieldbuses. WirelessHART has been developed to complement wired networks for situations where installation is difficult and costs are high or when a second maintenance network is beneficial. ABB continues to monitor the development in wireless standards and will provide products based upon market demands.

This article has dealt with the case for wireless adapter use, where existing instruments are upgraded by the addition of a wireless network for condition monitoring or process monitoring in some cases. Wireless-only devices (battery powered instruments with only wireless connectivity) would be the subject of another article; however, the performance of such devices and wireless networks falls short of the requirements for critical process control and interlocking.[6] Wireless-only instruments (battery powered) would have an energy budget to deal with and so process refresh rates (although variable) are usually in the range of 30 s or several minutes.

Wireless for instrumentation has its place alongside wired versions and should be considered with care and perhaps supported by vendors such as ABB and the trial site reports of NAMUR or HCF.

Factbox 2 ABB Wireless Service

- Site assessment identifies potential site wireless issues and design solutions
- Installation and planning guidance
- Local support provides site visits and maintenance checking
- Remote support for distant locations surveys instrument maintenance conditions and advises about the action to take

Adapter installed on-site

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**Footnote**

[6] This is where a process value is used as part of a control sequence.