Wireless Sensor Networks:

ALL In ONE

WirelessHART represents a standard that supports a plant's wireless devices, eliminating the need for multiple communication protocols and gateways.
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Engineers across different industries are adding value to their plants by using instrumentation based on the international IEC-approved WirelessHART standard. This is in applications to lower automation cost, improve plant performance, and lower operation and maintenance costs. This article takes a look at the enablers of the underlying technology and how some of these early practitioners have overcome plant challenges with innovative solutions that are based on the standard.

The standard is designed for process applications, which is different from other wireless protocols for power grid, factory, building, or home automation. The standard was designed specifically for process industry needs, based on requirements defined by end-users in 2004 and afterwards verified by the

Standardisation Association For Measurement And Control In Chemical Industries (NAMUR) at a multi-vendor test at the BASF Ludwigshafen plant in 2009. This is why instrumentation and control suppliers are rapidly developing products based on the standard, and plants are applying these in their processes.

International Standards In Interoperability

WirelessHART is an international standard for wireless sensor networking for process applications and is known as IEC 62591. By specifying devices conforming to IEC 62591, plants are assured that these devices will interoperate with each other, forming the self-organising mesh network and providing access to complete device functionality.

A single network infrastructure supports all the plant's wireless measurement needs, eliminating the need for multiple communication protocols and gateways. Many manufacturers provide a selection of the standard's transmitters for flow, level, valve position, pH, conductivity, discrete, vibration, temperature, multiple temperature points, and pressure. Level switch and valve position monitoring as well as wireless adapters for hardwired devices are also available.

New applications become possible as more manufacturers release products. These devices can be mixed in the same network to meet different process application needs based on this common standard.

An unmanned offshore platform in India required remote position indication for the Emergency Shut-Down (ESD) blow down valves. Laying new cable and installing additional field junction boxes for hardwired devices on this operating platform would have been costly and risked damaging existing equipment and cabling.

Position transmitters (as well as temperature transmitters for other purposes) were installed sharing the same gateway. As a result, operators receive confirmation of valve action at a fraction of the cost of a wired solution. In the future, additional devices can share the same network infrastructure.

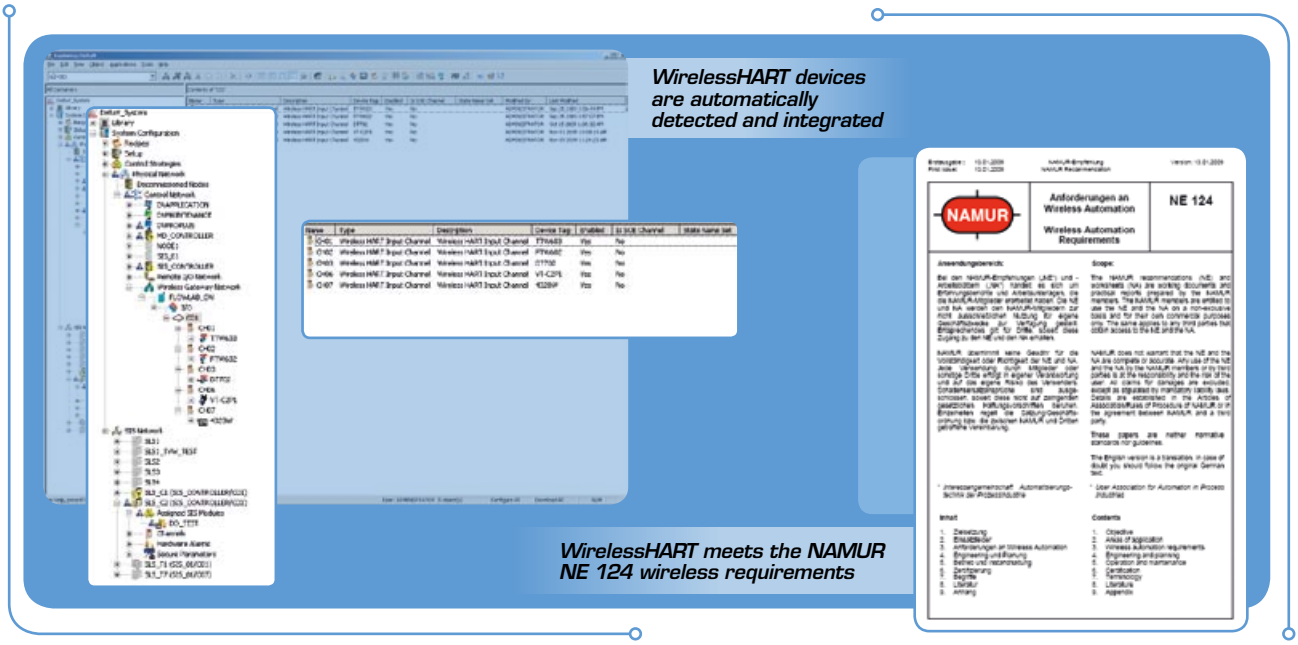
All of the standard's devices use the same commands (which are also the same as wired HART); IEC 61784-1 CPF 9 / IEC 61158 Type 20. This means that there is no need to integrate gateways and drivers for multiple protocols. Automation systems with native WirelessHART support eliminate the need for gateway and data mapping altogether. This is a clean and seamless solution that is easy to deploy and maintain, and provides a base-level of interchangeability in addition to interoperability.

The standard uses the same commands that have been used in wired HART devices. These include commands for access to the Process Variable (PV), identification, commissioning, calibration, setup, and diagnostics with which technicians are already familiar. There is no need to learn the different ways to integrate the PVs, identify, commission, calibrate, setup, and troubleshoot devices.

An important difference from hardwired HART, is that WirelessHART uses scheduled burst mode to communicate measurements in real-time, not poll-response.

Plants can mix and match the devices from different manufacturers for different functions – and be assured that the devices will mesh network with each other, integrate with the system and software, and be operated and maintained in the same basic way. This provides freedom in choosing from manufacturers and device types, independent of gateway.

With the standard commands, old or new hardwired HART devices can be fitted with a simple wireless adapter to join a WirelessHART network without arduous configuration. The intelligent device



management software part of asset management solutions can now access the device for setup, calibration, and diagnostics etc.

Many wired HART instruments have rich diagnostics and process data, yet this valuable information goes unused because older legacy systems are not equipped to receive HART communications. While it is often too expensive and complicated to access this data through traditional wired means, upgrading devices with a wireless adapter is an easy and cost-effective way to 'see' the diagnostic and process information.

A tyre factory in India required radar level transmitters in their utilities unit. Signal wires could not be run but local power was available at the measurement point. WirelessHART adapters were fitted on the transmitters instantly giving access to the measurement as well as all internal intelligence enabling remote setup and diagnostics. Running signal wires would have been far more expensive.

Easy Maintenance

All of the standard's devices have a wired HART port, compatible with wired HART tools. Existing handheld field communicators or common HART interface and laptop software which technicians are already familiar with, can temporarily be connected to the maintenance port for local setup and device management at the time of commissioning or maintenance. Documenting field calibrators are also able to connect through the hardwired port.

A chemical plant in Australia has a rotating reactor. The earlier solution using hardwired transmitters and slip-ring connections was prone to frequent failure. The standard's transmitters provided a more reliable solution, resulting in higher quality product and greater productivity.

To commission a WirelessHART device, the network ID and join key (password) are assigned through the wired HART maintenance port available on all devices, not using wireless communication. This ensures that an outsider cannot 'overhear' and use the join key (password). This is a secure way of commissioning wireless devices. The technician uses the same handheld field communicator or laptop software to commission all their wireless and wired HART devices.

A company in India performs turbine performance analysis, going from plant to plant on a periodic basis. In the past, time was lost due to the need to wire the temperature and pressure sensors to the data acquisition system. Using the standard completely eliminated this time consuming and error-prone step, resulting in reduced testing time and improved productivity.

Self-Organising Deployment

In a full mesh network topology, all devices are capable of data packet routing, thereby ensuring multiple redundant data paths from remote sensors all the way to the gateway. A multitude of powered wireless access points need not be installed throughout the plant – a single (or redundant) gateway will do. Since multiple 'hops' are possible, data can be relayed long distances. If one of the paths is obstructed, interfered with, or otherwise fails, data simply follows another path.

WirelessHART network management automatically establishes and maintains the routing path and backup between devices. No manual configuration is required when adding a device. In addition to reliability, this makes

it easy to add new devices 'at will' or to replace devices.

A jetty at a bitumen loading terminal in Australia had problems with cold spots along a 900 metre long heated pipeline, which caused the bitumen to solidify and stop flowing. Transmitters were installed along the pier to measure and relay data back to the operators. This resulted in catching potential problems before blockage occurred. Hardwired devices and cable trays along the jetty would have been more expensive due to the difficulty of laying the cable.

Just like hardwired HART and other fieldbus devices, WirelessHART devices do not have an Internet Protocol (IP) address, making them more secure as well as independent of the IT department. Since the standard uses IEEE 802.15.4 radio, the gateway does not necessarily use Wi-Fi (IEEE 802.11) radio and has no direct IP addressing.

Therefore, the instrumentation and engineering responsibility is clearly segregated from IT responsibility. The Instrumentation and Electrical (I&E) department can deploy new devices and extend the network at will without liaising with the IT department. Conversely, the IT department can independently control the requirements for Wi-Fi and IP equipment according to their standards.

Not having direct IP addressing also has a security benefit since data is not routed between the upper and lower levels in the network hierarchy.

The standard IEEE 802.15.4 radio that is used by WirelessHART employs Direct Sequence Spread Spectrum (DSSS) technology – which in conjunction with channel hopping and optional channel black listing, makes communication tolerant of interference and does not create interference with other radios. The radios used have low power consumption which enables batteries to last for several years. Some devices use intrinsically safe 'power modules' that can be placed in a hazardous area.

Flow and pressure of production wells in Brunei had to be monitored remotely. A WirelessHART sensor network was deployed with a Wi-Fi long-distance backhaul network. The two networks coexist and complement each other for a lower cost than an all-hardwired or partially hardwired solutions.

Interoperability: Application Profile

Just like hardwired HART devices, all the wireless standard's devices have common communication settings: always Time Division, Multiple-Access (TDMA), 10 ms time slot, security on, network manager in gateway, and so on. There is no need for plant personnel to make all these advanced settings. This minimises the possibility of configuring devices incorrectly. It is therefore easy to enable such devices to work together – just assign network ID and join key (password).

An ore beneficiation plant in India required monitoring of a 1.2 km long conveyor belt to detect pull, sway, and swing. WirelessHART solved the application at half the price, and increased productivity by its ability to pinpoint the exact location causing the problem, thereby shortening the problem resolution process.

Security measures like encryption, key rotation, authentication, access control list, and sequence number, are only effective when turned on within a system. For WirelessHART, all these security features cannot be turned off; they are constantly on for protection. There is no possibility of inadvertently leaving the security off and the system open for intrusion.

Going Beyond The P&IDs

WirelessHART lowers project cost, increases quality and throughput, reduces downtime, lowers operations and maintenance costs. It also reduces the cost of Health/Safety/Environmental (HSE) compliance, reduces energy consumption, and cuts down waste and rework. It is another example of a digital plant architecture that uses the power of field intelligence to improve plant performance.

In most projects, the type and quantity of field devices are still being evaluated when engineers begin the detail automation designs. The standard's devices and networks add flexibility to projects. It simplifies many design activities by eliminating wires, including cabinets, wiring, terminations, cable tray design, fusing, and installation drawings.

It also accommodates changes – device additions, or location changes – easier than with wired devices. Modifications to wireless instrumentation can continue until late in a project. Including the standard as an integral part of the automation design can protect projects from delays and their accompanying cost overruns.

For many new projects everything on the Piping and Instrumentation Diagrams (P&IDs) is currently being wired, but plants are now 'going beyond the P&IDs' using the standard. For instance, vibration monitoring of small critical assets such as pumps, motor winding temperature, and position monitoring on hand-operated gate valves – which normally are not connected to the distributed control system.

These incremental measurements lend themselves well to wireless monitoring. Most plants are designed with the minimum amount of wired instrumentation required to run. But to operate the plant with increased attention to improved reliability, increased energy efficiency and improved turnaround planning requires additional measurements.

These are not required to go into the DCS since they are not part of the control strategy, but they are needed to automate asset optimisation. For these areas, WirelessHART is ideal. Plants also deploy the infrastructure to get the 'add at will' ability for wireless devices for unforeseen future applications.

While it is often too expensive and complicated to access this data through traditional wired means, upgrading devices with a wireless adapter is an easy and cost-effective way to 'see' the valuable diagnostic and process information.

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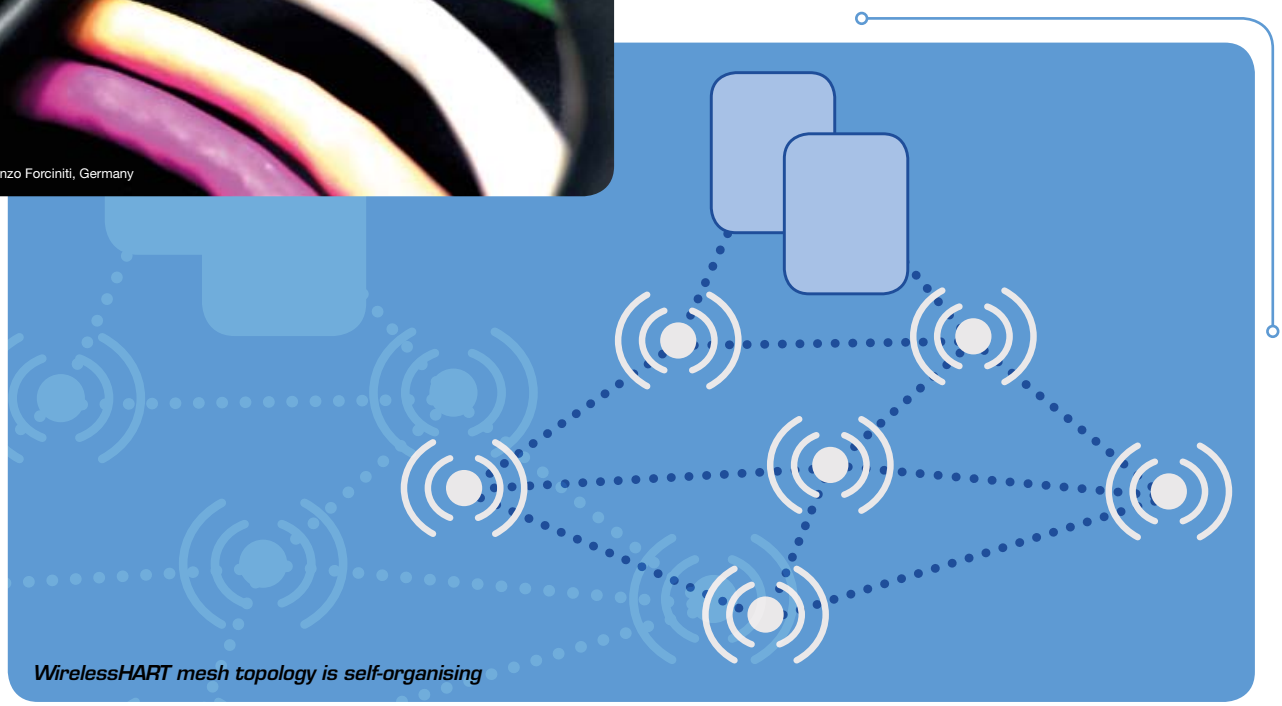

WirelessHART mesh topology is self-organising