



WirelessHART™: The Industrial Wireless Standard

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Wireless is unleashing the next wave of industry transformation due to its inherent flexibility, scalability, and efficiency for improvement of distributed sensing and control systems. Proprietary wireless transmitters have existed in plants for many years but always focused on point-to-point cable-replacement applications. Now wireless networking is being realised in industrial process control since WirelessHART™, designed by the leading suppliers of instrumentation for the process control industry, has been recently approved. WirelessHART, the only approved standard, enables standards-based wireless networking for process automation, allowing confident and broad implementation of reliable, secure wireless technology. WirelessHART enables pervasive connectivity among sensors and actuators, with a field-proven reliability greater than 99% and a secure self-organising network. As a highly engineered solution, WirelessHART supports the full range of control and monitoring solutions, allowing process owners and operators to start using the growing set of wireless applications today and scale up as a plant-wide range of traditional and advanced functions are developed and offered by the variety of global instrumentation suppliers.

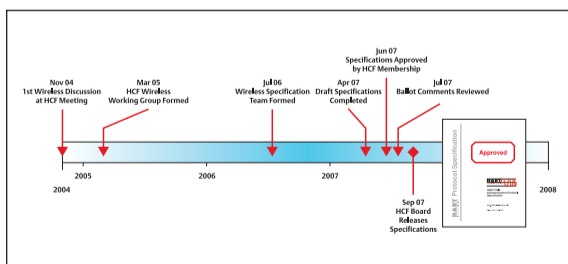
The Genesis of Industrial Wireless Networks

The quest to improve plant efficiency and productivity has motivated the process control industry to innovate on multiple fronts: advanced diagnostic algorithms, new and improved sensor technology, and of course, communications technology including industrial wireless systems among others.

Industrial wireless technology has its origin from the coalition of two major technology developments. The first originated in 1995 from the U.S. Defence Advanced Research Projects Agency. This agency funded several millions of dollars to develop technology to enable highly-reliable, secure and extreme low-power wireless sensor networks for military purposes. The second development occurred in 2003 with the introduction of IEEE802.15.4, the first and only radio communication standard centred on wireless sensor and actuation applications. IEEE802.15.4 was designed by leading industrial and technology provider companies working in a common vision to enable pervasive monitoring and control functionality in a reliable and secure way.

WirelessHART

WirelessHART is the first open and interoperable wireless communication standard designed to address the critical needs of the process industry for reliable, robust and secure wireless communication in real world industrial plant applications. The HART Communication Foundation (HCF) started its wireless efforts in January 2003 and by autumn 2007, WirelessHART, part of the HART 7 specification, was approved following an extensive review and approval process. This release represents the culmination of literally hundreds of man-years of combined process-industry experience coupled with state-of-the-art wireless innovations uniquely suited to industrial deployment.



WirelessHART is the approved standard for industrial process control

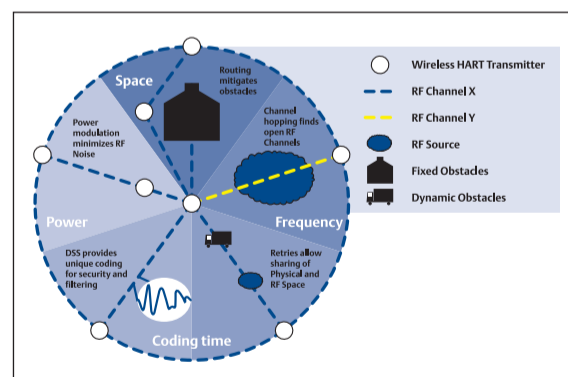
Like wired HART®, WirelessHART supports the full range of process monitoring and control applications, including equipment and process monitoring, environmental monitoring, energy management, asset management, predictive maintenance, advanced diagnostics and

closed-loop control. In addition, WirelessHART was designed to complement the portfolio of wired instrumentation by providing backwards compatibility with legacy systems and a path to scaleable instrumentation growth enabling investment protection.

Emerson, a leading vendor in the process control industry, has started taking orders for WirelessHART products. Other vendors are expected to follow. Moreover, the Fieldbus Foundation (FF) and PROFIBUS Nutzerorganisation (PNO) have signed an agreement with the HART Communication Foundation to develop a specification for a common interface to a wireless gateway. The goal is to ensure complete compatibility with the existing wired versions of each participant's technology.

Industrial-Grade Reliability

WirelessHART uses self-organising wireless mesh networking between field devices, as well as other innovations to provide secure, reliable digital communications that can meet the stringent requirements of the process industry. To achieve reliability higher than 99%, WirelessHART implements a set of advanced techniques called diversity measures:



WirelessHART uses advanced techniques to achieve reliability higher than 99%

Time Diversity

Time diversity is a technique in which data transmission is scheduled intelligently to minimise collisions and recover from losses. WirelessHART achieves time diversity by the use of Synchronised Time Division Multiplexing in which time slots are dynamically managed. The optimising algorithm maximises the packet success rate of any wireless link in the network by avoiding collisions.

Coding Diversity

The coding diversity technique allows effective use of the radio spectrum while enhancing reliability. With this method, a specific transmission can be easily separated

from the noise of other communications going on at the same time. WirelessHART leverages this technology from the IEEE802.15.4 radio standard.

Frequency Diversity

Frequency diversity is a technique where the wireless devices dynamically choose different channels of operation to avoid jamming and/or mitigate interference from other wireless systems. WirelessHART achieves frequency diversity by the use of channel hopping.

Path Diversity

Path diversity is enabled by the use of mesh networking. The objective is to provide redundant communication paths for the communication between two or more wireless devices. In addition, this technique allows the use of lower power transmissions (enough to be heard by a neighbouring router) which minimises coexistence issues due to power jamming.

Power Diversity

Power diversity is performed by controlling the transmission power of radio links to the minimum level where destination devices can receive the signal, in order to limit the RF pollution against the other users of the spectrum.

Future Outlook

Many initiatives have been undertaken with aspirations to develop communications protocol standards suitable for process control applications. For example, the ZigBee® Alliance has worked to develop a general wireless communications protocol that also leverages the IEEE802.15.4 standard for industrial applications. This effort has not borne fruit. Today, most of the ZigBee Alliance constituency is focused on residential and commercial applications. It is expected that new releases of the ZigBee technology will enter the industrial space, but will be confined to non-critical condition based monitoring.

Similarly, the Bluetooth® organisation has spent many years trying to formulate ways to enter the industrial space. Bluetooth sought to extend their success from the consumer electronics market into new spaces. Due to the inherent limitations of the technology to form networks, Bluetooth participation in the industrial space has been confined to point-to-point I/O communication links. The introduction of a new Bluetooth-based technology called WiBree™ is expected to break through some of the technical challenges, enabling the formation of Wireless Sensor Networks for multiple application spaces.

ISA100 is yet another wireless standards body trying to define a new standard for general industrial applications, although its approach has significant

overlap with the scope covered already by *WirelessHART*. Contrary to the statements of most of the publicity initiatives about ISA100.11a, this standard is at early development phases. According to participants in this standard committee, the ISA100.11a specification is expected to become available sometime in 2009 with actual test and validation to follow.

The ISA100.11a radio technology and common baseline technology are very similar to that of *WirelessHART*. The most notable differences include the concept of "Internet Protocol to the Edge" based on IPv6, including optional mesh and an object-based application layer. Unfortunately these features pose several challenges in the power consumption of the expected network devices since they require a few months of battery operation. Further, there are major communications security concerns derived from the native internet connectivity. Moreover, the complexity of this initiative might pose reliability challenges.

At the time of preparation of this article, the ISA100 committee is working diligently to adopt *WirelessHART*

as part of the family of standards that ISA is sponsoring. This will allow the needed communication among different technology factors to work toward the definition of convergence standards. This adoption is a work-in-progress initiative.

Conclusions

WirelessHART™ is the only open and interoperable wireless communication standard designed specifically to support the requirements of industrial process automation applications. With countless man-years of combined process-industry experience and a reliability of more than 99% proven in actual field deployments, the *WirelessHART* standard provides the needed performance to fulfil all field instrumentation communications needs.

The products and knowledge are in place and the value clear for starting wireless now. By picking an application - even a small one - engineers can join early innovators that are enjoying the satisfaction of application improvements they could only imagine



Wireless enabled instrumentation is available now

before wireless. Wireless technology is set to make broad inroads industry-wide because of the significant improvements in efficiency and performance it delivers. *WirelessHART* is the industrial wireless standard.