

ISA100 Wireless™ Adapter for HART®

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Introduction

The ISA100 Wireless™ architecture provides a user-driven, scalable, global, control-ready and flexible framework, designed to accommodate a variety of legacy applications. This paper describes how legacy HART® devices have been seamlessly adapted into the ISA100 Wireless object-oriented application model, using WCI's ISA100 Wireless Adapter for HART specification.

Benefits include secure and reliable communications of process data; improved asset management and uptime; faster troubleshooting; reduced maintenance costs and savings; safer and more efficient employees.

The ISA100 Wireless Adapter framework and methodology can be applied to other protocols or embedded applications in the future, leveraging the capabilities of ISA100 Wireless as a state of the art platform for industrial monitoring and control.

The ISA100.11a-2011 Standard (IEC 62734)

ISA100 Wireless provides a universal, simple and efficient network with following characteristics:

- One strategic network that supports multiple uses
- Scales from a few field instruments to thousands to get started now but still prepare for future
- Operates in noisy radio frequency environments for reliable communication
- Provides predictable power management to ensure uptime and optimize maintenance
- End-to-end industrial security to protect plant information and ensure safety
- Open architecture and protocol integration to provide choices for standard and cost-effective solutions

The ISA100 standards committee was formed in 2005 to address these key user requirements. The committee comprises over 400 automation professionals from nearly 250 countries around the world, offering their expertise from a variety of industrial backgrounds. As an accredited member organization of the American National Standards Institute, ISA works with standards bodies around the world to develop and hone its standards methodology. The ISA process, and technology, is open so that end users can have the best possible choices for interoperable products.

ISA100 standards are cooperatively designed by the best industrial experts in the world, to ensure that they meet end user needs. ISA has brought together experts in wireless technology, instrumentation,

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security, and a wide range of industrial end use applications— which means that end users can be confident in the reliability, integration, industrial usage, and security of the technologies offered.

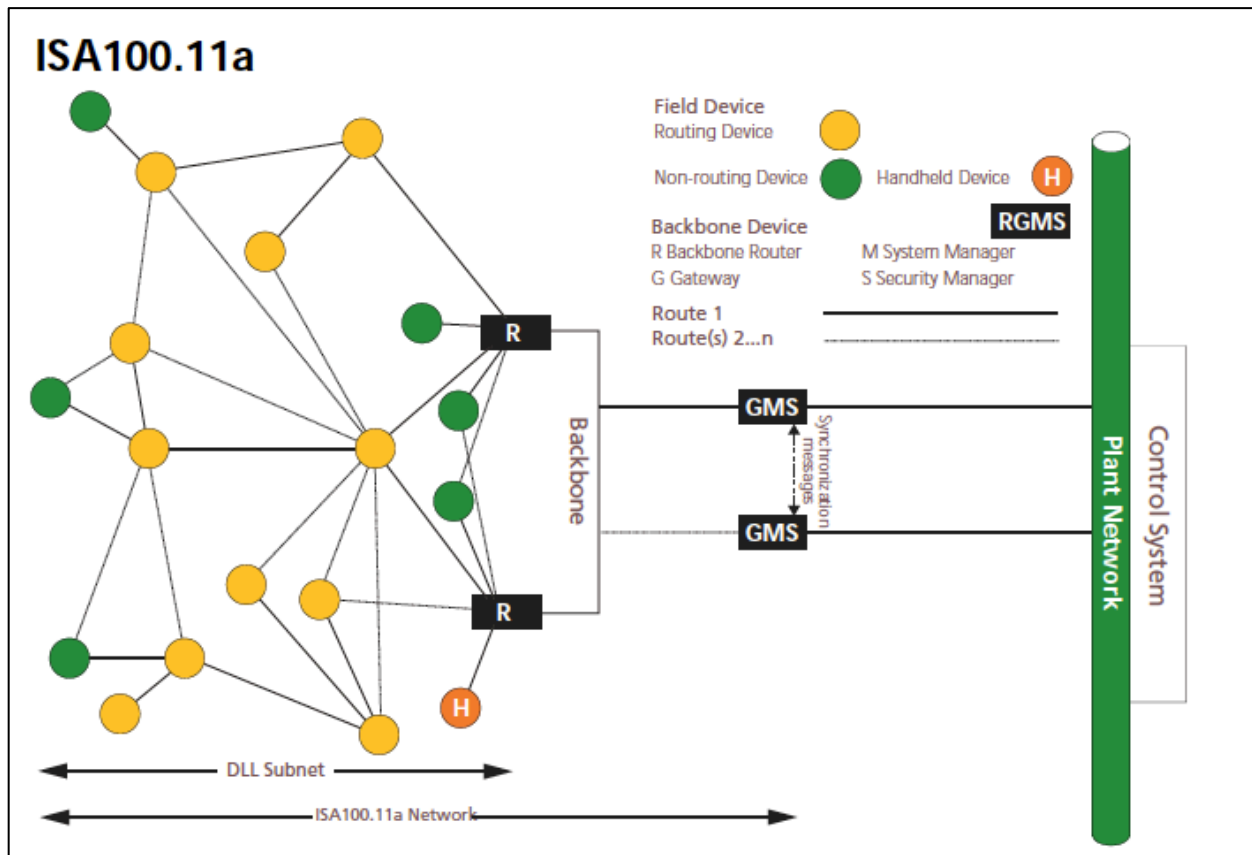


Figure 1: ISA100.11a Industrial Network Architecture

ISA100.11a-2011 (IEC PAS 62734) was the first work product from ISA100. It provides a complete and coherent integration of the entire OSI stack, from radios at Layer 1 to process industry application objects with associated services at Layer 7. The object based application model is extensible, so that a single standard network will simultaneously communicate with many existing application protocols wirelessly throughout the plant, such as HART[®], FOUNDATION[™] Fieldbus, Modbus[®], Profibus[®], Common Industrial Protocol (CIP[™]), and more. ISA100.11a is optimized to support all of these protocols wirelessly, preserving existing protocol investments and protecting future protocol needs. A coherent and flexible architecture results in one technology to learn, maintain, operate, and manage. The world's leading DCS suppliers support ISA100.11a-2011.

The standard is based on IEEE 802.15.4 radios operating in the 2.4 GHz ISM band. ISA100 adds a time-synchronized channel hopping protocol to sidestep RF interference and minimize power consumption. Its adaptive mesh network is self-organizing, automatically adapting to changing conditions for simplified installation. Mesh, star-mesh, and star topologies are supported. Robust security protects all messages with AES-128 ciphers at multiple layers. Its unified application

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interface ensures an open and interoperable application environment, providing a common integration point for multiple-host systems.

ISA100 Wireless Adapters for HART in a Network

ISA100 Wireless is designed to integrate various legacy technologies into one coherent network. One important use case is ISA100 Wireless Adapters for HART, as shown in Figure 2.

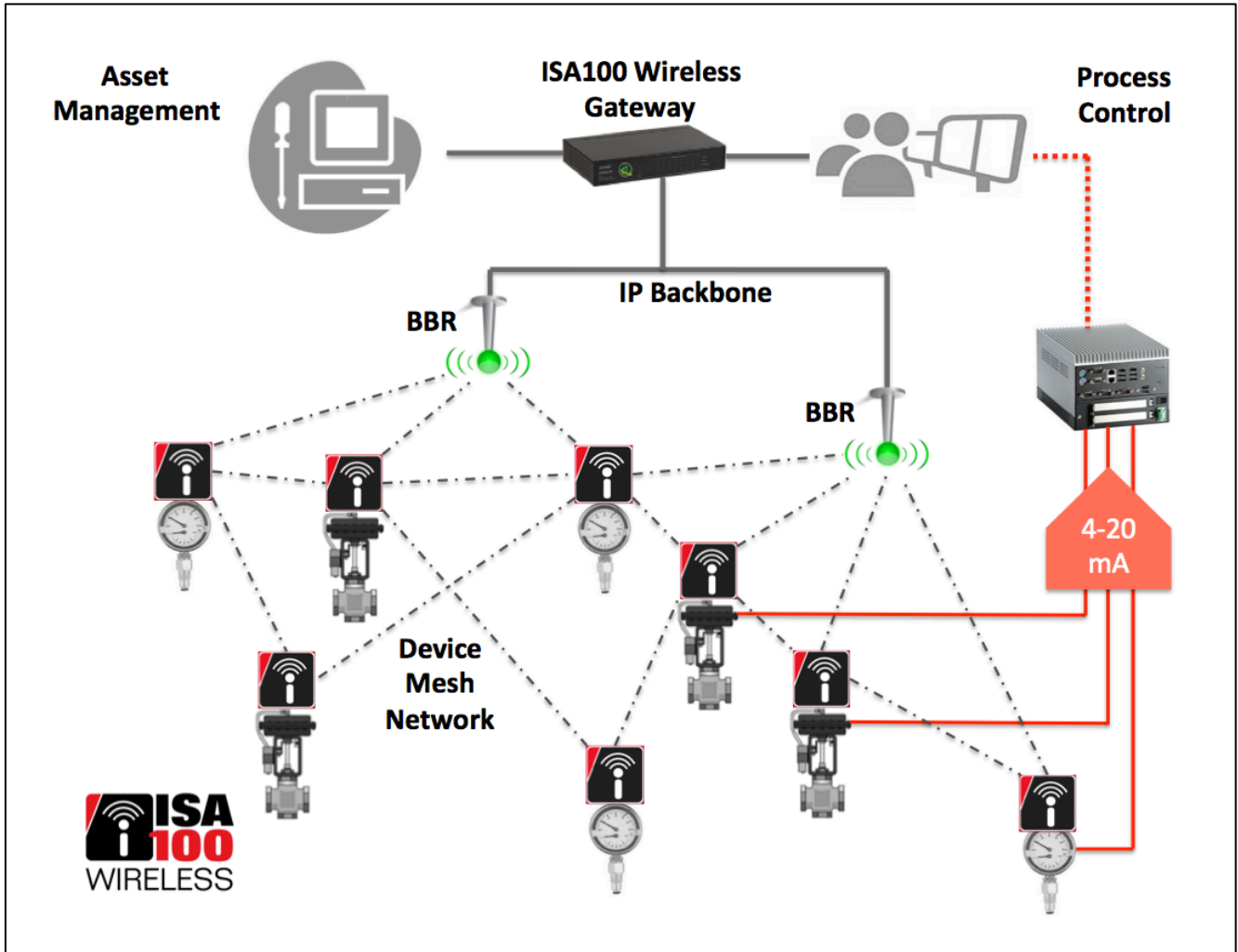


Figure 2: ISA100 Wireless Adapters for HART Adapters in a Mesh Configuration

Figure 2 shows an illustrative mesh configuration of HART adapters in an ISA100 Wireless network.

On the right side of the diagram, three legacy HART devices are shown wired to a controller and reporting a single critical data value through a 4-20 mA interface. That controller might or might not have a connection to a plant-wide process control system, shown as a dotted line.

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An ISA100 Wireless Adapter for HART is connected to each of these three pre-existing devices, so that additional HART digital data can be reported to a process control application. Even if there is no wired connection to plant-wide systems, or in the event that the wired connection is compromised, the wireless connection provides remote access to all of the device's data, functions and interfaces.

A hybrid wired / wireless device is commonly referred to as semi-wireless, with some functions supported via wireless, with other functions supported over dedicated wired interfaces.

A single wireless interface enables remote access to device process data and device maintenance functions.

A variety of other devices are shown that do not use a 4-20 mA connection. These devices communicate wirelessly, without wired interfaces. They may be special-purpose ISA100 Wireless devices, or they may be any HART-enabled device with an ISA100 Wireless Adapter for HART.

Typical system components on an IP backbone are shown on the top of Figure 2. Redundant backbone routers, labeled "BBR", provide high performance IP connections for wireless devices in the ISA100 Wireless mesh network. An Asset Management system and a Process Control system are both shown connected to an ISA100 Wireless Gateway on the IP backbone, as is typical in practice. Integration of system components through an IP backbone provides a state of the art connection to wireless mesh field devices.

The ISA100 Wireless Adapter for HART allows the user to integrate HART devices into an ISA100 Wireless field network, leveraging the standard's meshing technology optimally and automatically. ISA100 Wireless provides a single secure and reliable network for all functions, scaled seamlessly to meet a site's process industry requirements.

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User Benefits

Many process applications are important to plant uptime, yield, and throughput. However, they may not be systematically monitored, resulting in unplanned downtime. With a wireless connection to HART devices, users can efficiently receive early warning of process or product variations to minimize their impact, allowing them to schedule any maintenance ahead of time. This minimizes the impact of servicing the equipment and avoids costly shutdowns. With remote wireless access, a time-consuming trip to a hazardous location becomes a quick online task from the maintenance shop.

With an ISA100 Wireless Adapter for HART hundreds or even thousands of existing HART devices can be integrated into an ISA100 Wireless system. Additional information from those devices, such as stranded diagnostics and secondary process data, becomes visible to applications anywhere in the plant, while the devices continue to perform their original functions. Full benefit is obtained from devices that are already in the plant.

Specialty devices, not yet available in wireless form, can be installed and integrated with a plant-wide ISA100 Wireless system. With an ISA100 Wireless Adapter for HART, any HART device can be made ISA100 Wireless compliant, such as many available devices for temperature, level, flow, pressure, valves, liquid, and gas.

An ISA100 Wireless Adapter for HART can appear transparent to Plant Asset Management applications and allows for remote health monitoring and management through such systems. With remote access to instrument diagnostics, the worker can improve productivity with in service testing and reduced troubleshooting time while minimizing downtime. Employee safety is enhanced by remote access to points in hazardous areas without manual field readings.

At the same time, the adapter converts process data to ISA100 Wireless format for delivery to a process control system.

A fundamental objective for many installations is to avoid running cables and conduit. With the ability to wirelessly access the field device's HART information, it saves making special arrangements to strip-off the HART data in the marshaling cabinet and interfacing that data through additional multiplexer modules into an asset management solution. This saves cost as compared to a wired option; and in many cases provides access that would otherwise be physically or financially infeasible. In some situations, wireless is actually more reliable than wires, such as in corrosive environments where wiring is a potential point of failure, or for rotating or mobile platforms wireless can provide the only reliable solution.

An ISA100 Wireless Adapter for HART makes it possible to collect data wirelessly from any HART device, expanding system reach. Safe and secure remote access is provided to all of the device's process and diagnostic data through a secure and reliable ISA100 Wireless network. A universal ISA100 Wireless network can thereby provide consistent and high-performance wireless coverage for hundreds or thousands existing and new devices, with plant-wide support for a full range of process industry applications including monitoring, alerting, supervisory control, open loop control and closed loop control.

How It Works

ISA100 Wireless provides a flexible framework that is designed to accommodate a variety of legacy applications. This section will describe how the ISA100 Wireless object-oriented application model has been adapted by the ISA100 Wireless Compliance Institute to enable seamless and interoperable integration with HART devices. The object model of ISA100 Wireless can similarly accommodate additional protocols in the future, all within the same interoperable framework.

An ISA100 Wireless Adapter for HART builds upon the ISA100 Wireless framework to autonomously publish a rich set of process data from HART devices. At the same time, it also provides remote access to asset management commands in the connected HART device. The adapter supplements the HART protocol with features that provide secure and efficient access of process data over a common network infrastructure. Process data is reported with standard units, range representation, data integrity status and other standard ISA100 Wireless features that are essential for flawless and latency controlled data reporting under challenging industrial conditions.

The fundamentals are shown in Figure 3.

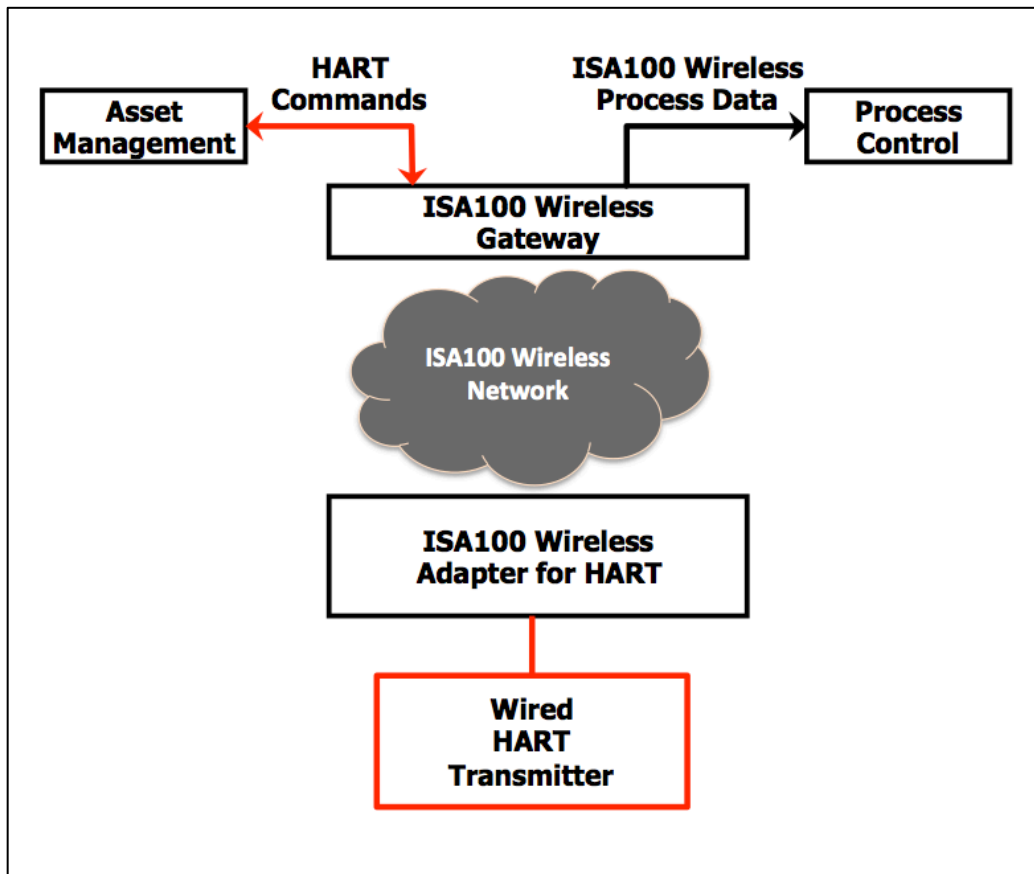


Figure 3: ISA100 Wireless Adapter for HART

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The ISA100 Wireless Adapter for HART is designed to support two types of application interfaces, as indicated in Figure 3.

On the right side of Figure 3, the gateway reports process data from the adapter to a process control system, following ISA100 Wireless conventions for reporting process data.

On the left side of Figure 3, a gateway passes HART commands and responses between an asset management system and a HART transmitter, wirelessly through the adapter. The gateway presents the interface as a virtual wired HART connection, so no changes to the asset management system should be required.

A more detailed view is shown in Figure 4.

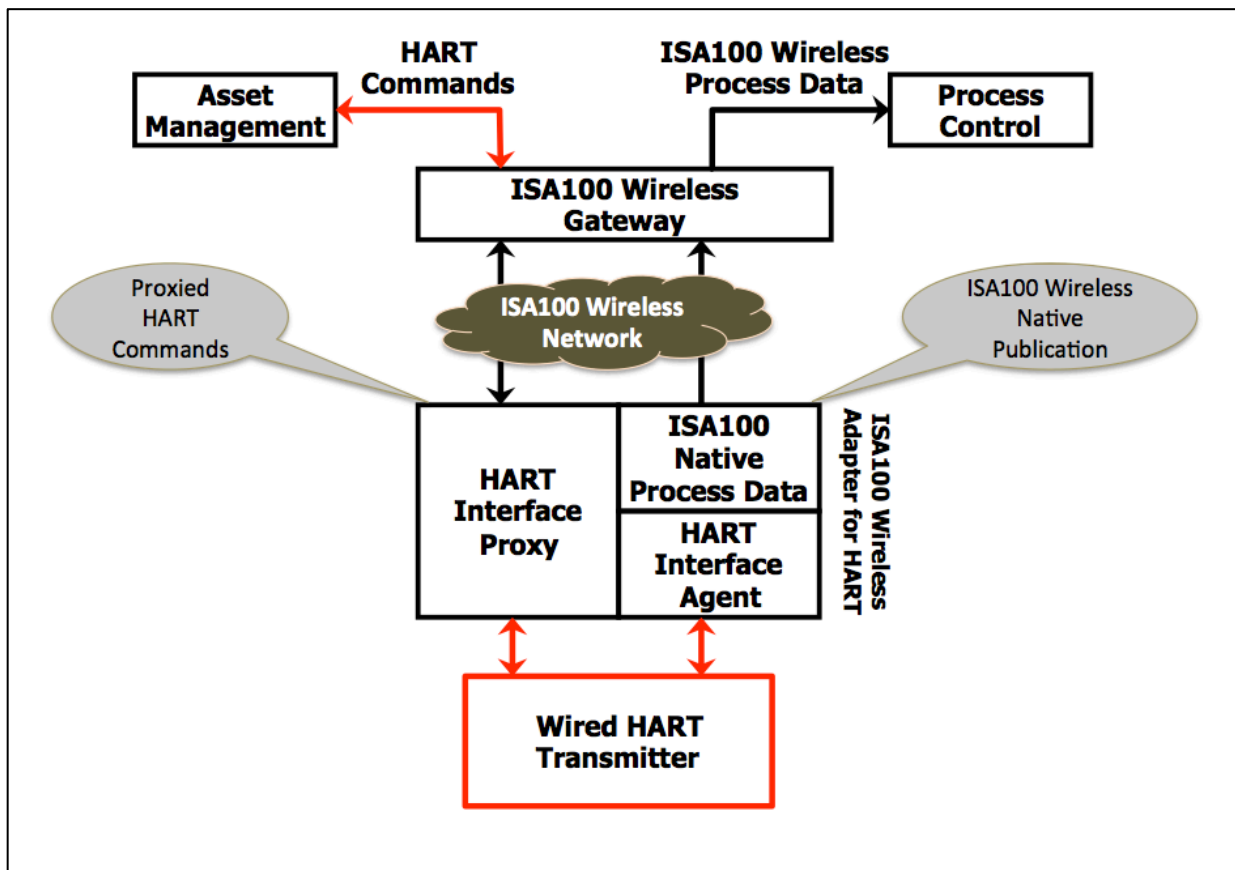


Figure 4: Wireless Adapter Internal Model

Figure 4 shows that the ISA100 Wireless Adapter for HART uses different approaches for process data and maintenance commands.

On the asset management side, the adapter acts as a “proxy”: an intermediary that passes HART application commands to and from a wired HART transmitter. The asset management

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application interfaces with the ISA100 Wireless Adapter for HART like any other wired HART device, so no change to the asset management system is required.

On the process control side, the adapter fully translates HART data into ISA100 Wireless format. The adapter acts as an “agent”: a smart ISA100 Wireless transmitter, that autonomously collects the requested process data from the wired HART transmitter, translates it to ISA100 Wireless data format, and then sends that data to an ISA100 Wireless process control application.

A summary of the Adapter model for process data is shown in Figure 5.

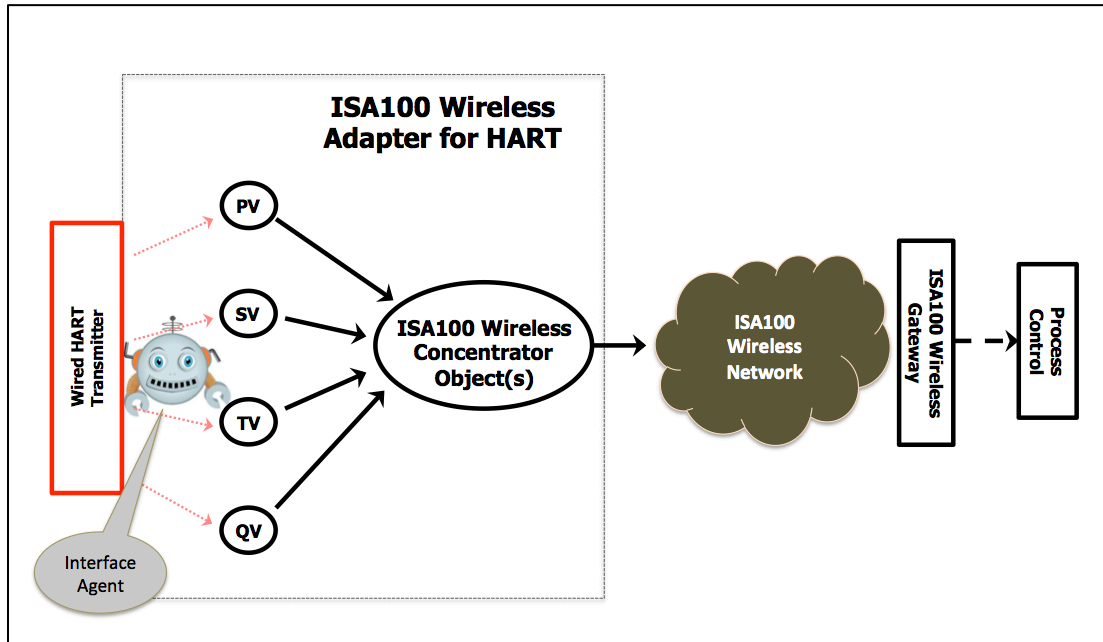


Figure 5: Adapter Model for ISA100 Wireless Process Control Industry Standard Objects

The ISA100 Wireless Adapter for HART contains an interface agent, shown as a robot in Figure 5, that autonomously collects process data from the wired HART transmitter. This data is then placed in ISA100 Wireless *Process Control Industry Standard Objects* that correspond to HART PV, SV, TV, and QV values with status. Once the data is converted to ISA100 Wireless format, it can be published just like any other ISA100 Wireless process values.

Figure 5 shows those four values being consolidated for collection into a standard ISA100 Wireless concentrator object, which can be configured to publish data at a fixed and regular interval such as every 10 seconds. The ISA100 Wireless standard also provides interoperable interfaces to configure triggers for alerts, read values and loopback, manual mode, and so forth. Once the interface agent populates the analog input objects, all of these ISA100 Wireless standard services become available.

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A summary of the Adapter model for *HART® commands* is shown in Figure 6.

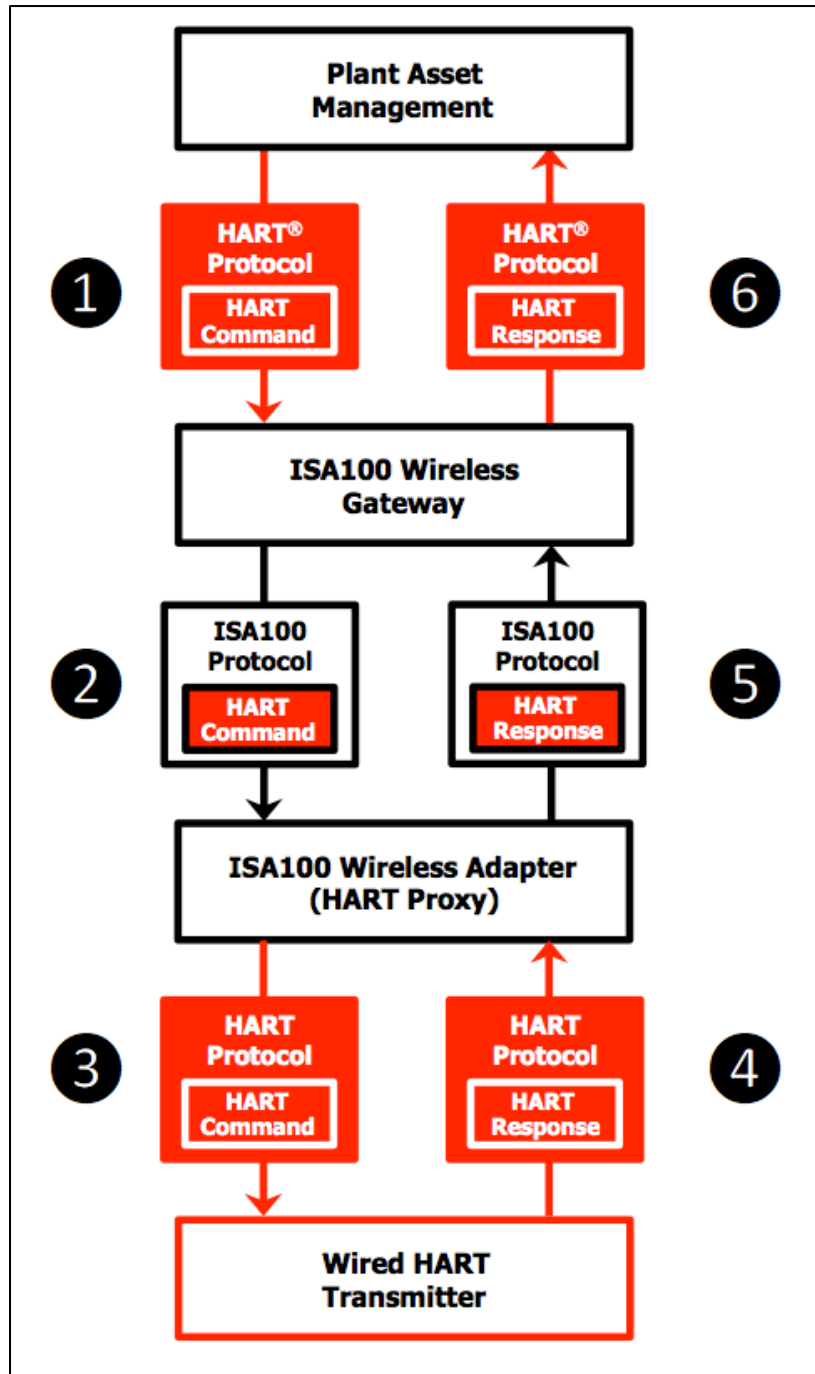


Figure 6: Adapter Model for HART® Commands

Following the numbered steps in the figure:

1. The Plant Asset Management system sends a HART command to the ISA100 Wireless Gateway, using the HART protocol.

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2. The gateway compresses the message by removing the HART protocol wrapper, and embeds the HART command payload in the ISA100 Wireless protocol for secure and reliable transmission to the field device.
3. The proxy in the HART Adapter constructs an appropriate wired message around the received HART command, and sends it to the wired HART transmitter.
4. The wired HART transmitter responds.
5. The proxy in the HART Wireless Adapter receives the HART response, and embeds that payload into an ISA100 Wireless message for secure and reliable transmission to the ISA100 Wireless Gateway.
6. The ISA100 Wireless Gateway receives the HART response, embeds that payload in a HART message, and forwards it to the Plant Asset Manager.

Figure 6 shows a single HART command/response in each message. The proxy can also handle multiple messages packaged together in each message, thereby allowing several commands to be processed in a batch. This optimization, called concatenation in ISA100 Wireless, can greatly improve response time if supported by the Gateway and Plant Asset Management System.

The ISA100 Wireless Adapter for HART is a good example of the flexibility that is intrinsic in the ISA100 Wireless application and object model. It is this application and object model that allows ISA100 Wireless the unique ability to support existing industrial automation field protocols. The ISA100 Wireless Adapter framework can be easily adapted in the future for other legacy protocols and embedded applications.

Conclusion

The ISA100 Wireless Adapter for HART can connect to new and existing HART devices and integrate them seamlessly with a state of the art ISA100 Wireless system. ISA100 Wireless provides reliable and fast transmission of field information from HART devices into control and SCADA systems.

Extends ISA100 Wireless Capabilities: ISA100 Wireless systems are scaled seamlessly, with IP technology, to cover an ever-expanding collection of monitoring and control applications. Unique, wired HART products can be incorporated into an ISA100 Wireless network today and ISA100 Wireless offers a technical pathway for other fieldbus protocols.

Improved Asset Management and Uptime: Effective monitoring and trending of parameters enable earlier issue detection, notification and correction.

Faster Troubleshooting: Access to diagnostic data helps quickly pinpoint issues resulting in faster problem resolution while eliminating unnecessary field checks.

Reduced Maintenance Costs and Savings: Savings derive from not running additional high cost wiring and HART multiplexers to obtain and utilize inaccessible HART information. In cases where such wiring is not cost effective, savings result from the process and maintenance data itself, which is otherwise inaccessible without wireless.

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Safer and More Efficient Employees: Provide access to stranded HART diagnostics information allowing employees to quickly analyze the situation and pinpoint the issue without necessarily having to go to hazardous or remote locations.

Future Proof: The same general approach can be applied in the future to other protocols, allowing for an ever-expanding portfolio of applications within an interoperable object-oriented framework.

Technical Excellence: The ISA100 Wireless standard, with its user-driven, scalable, global, control-ready and flexible framework, ensures that the choice to implement ISA100 Wireless is the most safe, cost effective, and stable choice for a wireless communication solution.