White Paper

Honeywell

Honeywell Process Solutions

# An Open, Standard-Based Wireless Network: Connecting *Wireless*HART® Sensor Networks to Experion™ PKS Using Honeywell's OneWireless™ Network

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## Introduction

Honeywell's OneWireless™ Network is a high-speed, high-throughput and multi-standard industrial network that offers wireless coverage, as needed by industrial applications, from a simple wireless field instrument network to a complete, integrated, plant wide multi-application wireless network.

As one of the most secure and cost-effective industrial networks available today, the OneWireless Network is designed to offer the openness processing and manufacting plants expect from modern industrial networks. This feature is made possible thanks to the self-discovering and self-meshing industrial OneWireless Network's access point: Honeywell's Multinodes and Cisco's 1552S Aironet Access Points. These access points host multiple radios types: IEEE 802.11 a/b/g/n radios, which can be used to provide access to Wi-Fi devices and to establish connections with other access points, and 802.15.4 radios providing access to ISA100.11a devices. The access points also offer Ethernet uplink connectivity that allows users to connect any IP-based device to the network.

In this paper, the Ethernet uplink will be used as the interface to connect an IEC 62591 network, referred to as a *Wireless*HART® network throughout the document, to the access point and use the OneWireless Network as a high-speed backhaul to send process data to the control system. This use case demonstrates the flexibility of Honeywell's OneWireless Network and Experion architecture and explains how to design a network that supports the variety of wireless standards used in today's industrial and manufacturing facilities (i.e., Wi-Fi for mobile devices, ISA100.11a and *Wireless*HART for wireless field instruments).

## Why Use a Wireless Local Area Network to Send Process Data?

Both ISA100.11a and *Wireless*HART standards enable wireless field instruments to send data reliably and securely using radio waves. The standards have been developed to allow wireless field instruments to be powered by batteries or other low-power options, to self-discover neighboring devices, and form a mesh network and act as routers (i.e., sending their own data and routing data received from neighboring devices).

However, it is important for automation experts to be aware of the limitation of a wireless sensor network. A pure sensor mesh network with only battery-powered devices cannot be scaled up to tens of devices without having a negative impact on data latency and battery life. In fact, most vendors recommend limiting the number of hops between the wireless field instrument and the gateway, or breaking the sensor network into smaller clusters.

Why? There are two main reasons.

First of all, the throughput available in a wireless sensor network, regardless of the standard, is limited to 250 kbps. Though the wireless field instruments are designed to send the minimal amount of data required, most users expect their wireless field instrument to behave like their 4-20 mA or bus-based smart devices. They also want to get additional data from their wireless devices such as health diagnostics. In fact, for wireless devices, the user will need to get not only device diagnostics but also wireless transmission diagnostics. These expectations mean users will quickly run into the 250 kbps limitation.

Secondly, there are only so many time slots available on the 2.4 GHz spectrum channels used by these devices. The field instruments follow a very rigorous time synchronization, which is orchestrated by the sensor network's system manager. The fairly complex time synchronization is designed to obtain optimized latency and maximum battery life. However, as more devices join the network, more data needs to be routed and more devices have to wake up to route data, the balancing act becomes very difficult and the user will have to choose between latency or battery life. In general, if the network is not broken into smaller clusters, the user will end up with a system that has a poor latency, or devices that have poor battery life, or both.

The solution to the communication bandwidth and battery constraints limitations is to use a line-powered, high data rate and low latency network to route data to the process control network. Such a topology reduces the need of battery-powered repeaters. The wireless field instruments act simply as transceivers of data, which results in improved battery life. The high data rate network also allows plants to install hundreds of field devices without any impact on network performance.

The ISA100.11a Standard defines a device called a backbone router, which allows the use of a backbone to send data from the wireless field instrument to the sensor network gateway typically installed in the control room. A backbone could be an industrial Ethernet, IEEE 802.11 or any other network (preferably a high data rate network). The *Wireless*HART standard does not include the concept of a backbone router. However, a *Wireless*HART network can also leverage a network infrastructure to send the process data to the control system. Although in this case, the *Wireless*HART gateway has to be connected to the high data rate network (i.e., the gateway is physically located in the field).

In brief, a high data rate network is the only option available to users planning to install tens to hundreds of wireless field instruments in the plant without having to worry about latency and network performance. And the most popular high data rate network being implemented in today's plants is the IEEE 802.11-based wireless local area network (WLAN). IEEE 802.11-based WLANs with meshing access points are attractive as the access points are able to wirelessly route data received from Wi-Fi devices and wireless field instruments. There is no need to pull industrial Ethernet or fiber optic cables into the process unit.

## ISA100.11a Network Overview

A typical ISA100.11a network consists of:

- ISA100.11a field instruments, which can also act as routers.
- ISA100.11a backbone routers (BBRs), which are able to route data between ISA100.11a field instruments and the ISA100.11a gateway directly via a high-speed backbone or other existing plant communications network such as an industrial Ethernet or IEEE 802.11 wireless network fiber optics. A backbone router can have its own enclosure such as Honeywell's field device access point, or be integrated in a WLAN access point such as Honeywell's Multinode or Cisco 1552S Access Point.
- An ISA100.11a system manager, which is responsible for configuring the network, scheduling communications between devices, managing message routes, and monitoring network health. The system manager can be integrated into the gateway, host application, or process automation controller. The ISA100.11a Standard includes the concept of subnets, which allows a single ISA100.11a system manager to manage multiple ISA100.11a subnets.
- ISA100.11a gateways, which enable communication between these devices and host applications, connected to a high-speed backbone or other existing plant communications network. The gateway may employ a variety of field protocol interfaces (e.g. Modbus, OPC, HART) required to send wireless field instrument process data in the format best suited to the host applications.

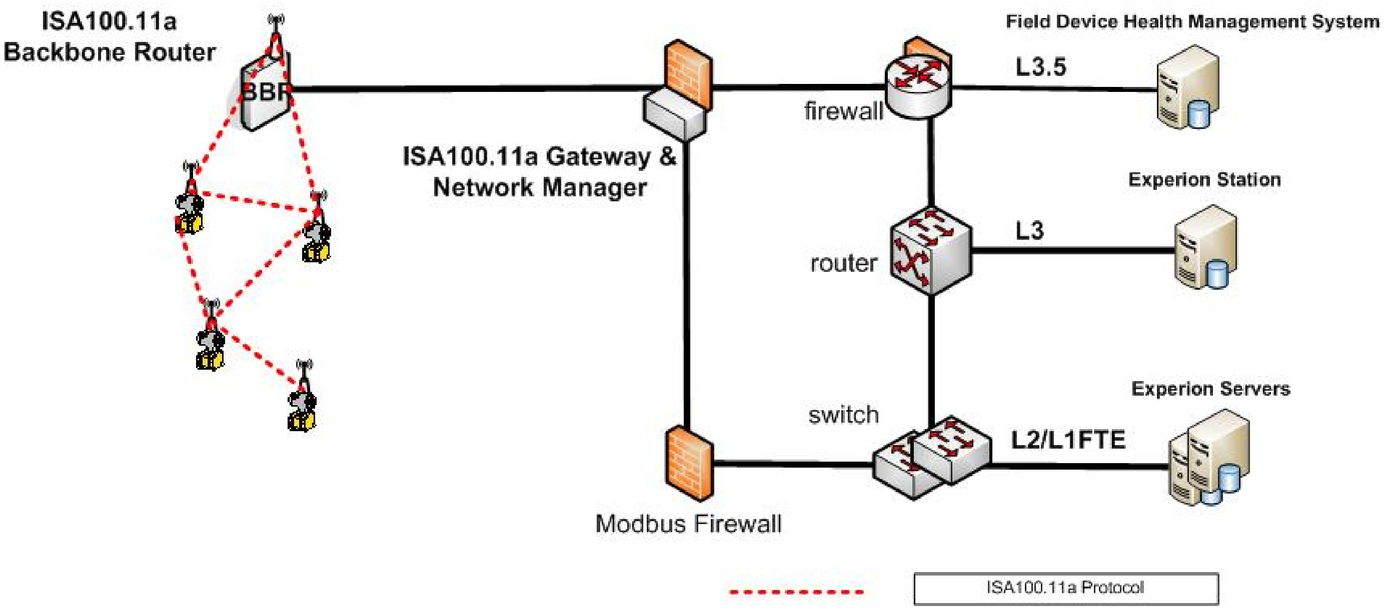



**Figure 1: ISA100.11a sensor network directly connected to Experion**[1]

A typical *Wireless*HART network consists of:

- *Wireless*HART field instruments, which can also act as routers.
- A *Wireless*HART gateway, which enables communication between devices and host applications connected to a high-speed backbone or other existing plant communications network. The gateway hosts the various field protocol interfaces (e.g., Modbus, OPC, HART) required to send process data from the wireless field instrument to the host applications.
- A *Wireless*HART network manager, which is responsible for configuring the network, scheduling communications between devices, managing message routes, and monitoring network health. The network manager can be integrated into the gateway, host application, or process automation controller.

  *Wireless*HART does not support subnets. So, *Wireless*HART users planning to install hundreds of devices in their plants will have to create clusters of *Wireless*HART networks with each network managed by a dedicated network manager.

  The *Wireless*HART gateways host an Ethernet port used to connect the gateway to a network device such as a switch or wireless local area network access point. Figure 2 illustrates a typical *Wireless*HART network connected to an Experion PKS network.

[1] Please refer to ISA99 Purdue model for L1, L2, L3, L3.5 definition

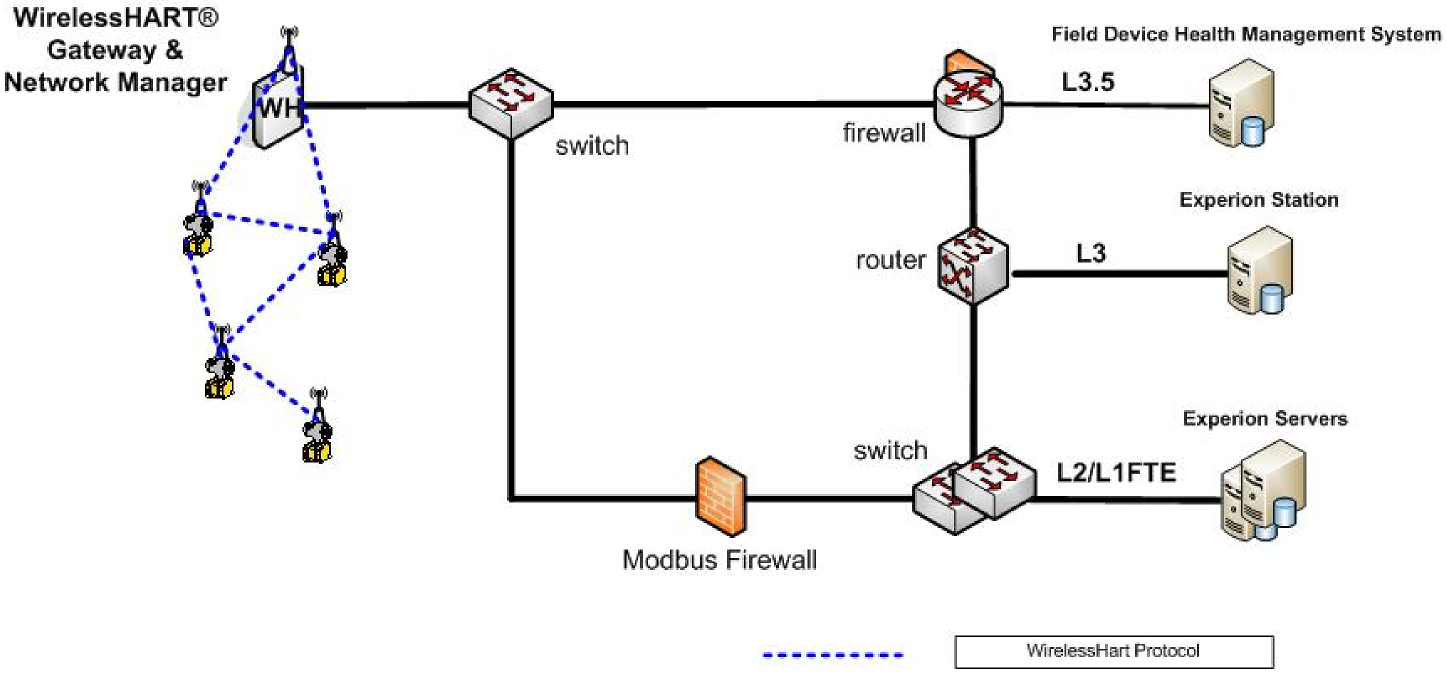



**Figure 2: *Wireless*HART sensor network directly connected to Experion.**

## Connecting *Wireless*HART Gateway to a OneWireless Network

The connection of a *Wireless*HART gateway to a OneWireless Access Point involves these two simple steps:

- Plug one end of an Ethernet cable into the *Wireless*HART gateway.
- Plug the other end of the Ethernet cable into one of the OneWireless Network's access point Ethernet ports and assign an IP address to the *Wireless*HART gateway. This will be used when configuring the host application to establish communication with the *Wireless*HART gateway either via Modbus TCP or OPC.

Figure 3 illustrates a OneWireless Network with Cisco 1552S Aironet Access Points that supports ISA100.11a and *Wireless*HART sensor networks.

## ISA100.11a Network Data Flow

An ISA100.11a data flow is represented by the red arrows in Figure 3.

The ISA100.11a field instruments communicate directly with the Cisco 1552S Access Points thanks to the ISA100.11a radios integrated into each access point. ISA100.11a field instrument devices can also be configured as routing devices. Routing field instruments send their own process data as well as data received by neighboring field instruments.

Once the process data reaches an access point, it is then routed through the high-speed wireless network to the wireless device manager (Honeywell ISA100.11a gateway). The wireless device manager, which is typically located in the cabinet in a control room, exposes the process data via different field protocol interfaces such as Modbus, OPC, HART and GCI.

The Modbus and OPC interfaces are used for integration with Experion. The HART interface is used to monitor the ISA100.11a instruments' health using their preferred field instrument health monitoring systems such as Honeywell's Field Device Manager (identified as HART client). The HART interface is also used to extract diagnostic information from wired HART devices equipped with the OneWireless Adapter. Finally, the GCI interface is a generic interface that can be used to monitor other types of data types such as vibration spectrums to associated host applications.

The wireless device manager has an embedded firewall that ensures only process data is communicated to the control system.

## ***Wireless*HART Network Data Flow**

*Wireless*HART data flow is represented by the blue arrows in Figure 3. As shown, *Wireless*HART field instruments communicate to *Wireless*HART gateways. The *Wireless*HART gateways are located in the field and will be connected to the Cisco 1552S Access Points via an Ethernet conduit. The data is then routed to Experion over the OneWireless Network via Modbus TCP or OPC. Figure 3 illustrates a Modbus TCP connection. A Modbus firewall is recommended between the *Wireless*HART gateway and Experion to protect the process control network from malicious attacks. Users can monitor the diagnostics of their *Wireless*HART field instruments using their preferred field instrument health monitoring system (identified as HART Client in the figure).

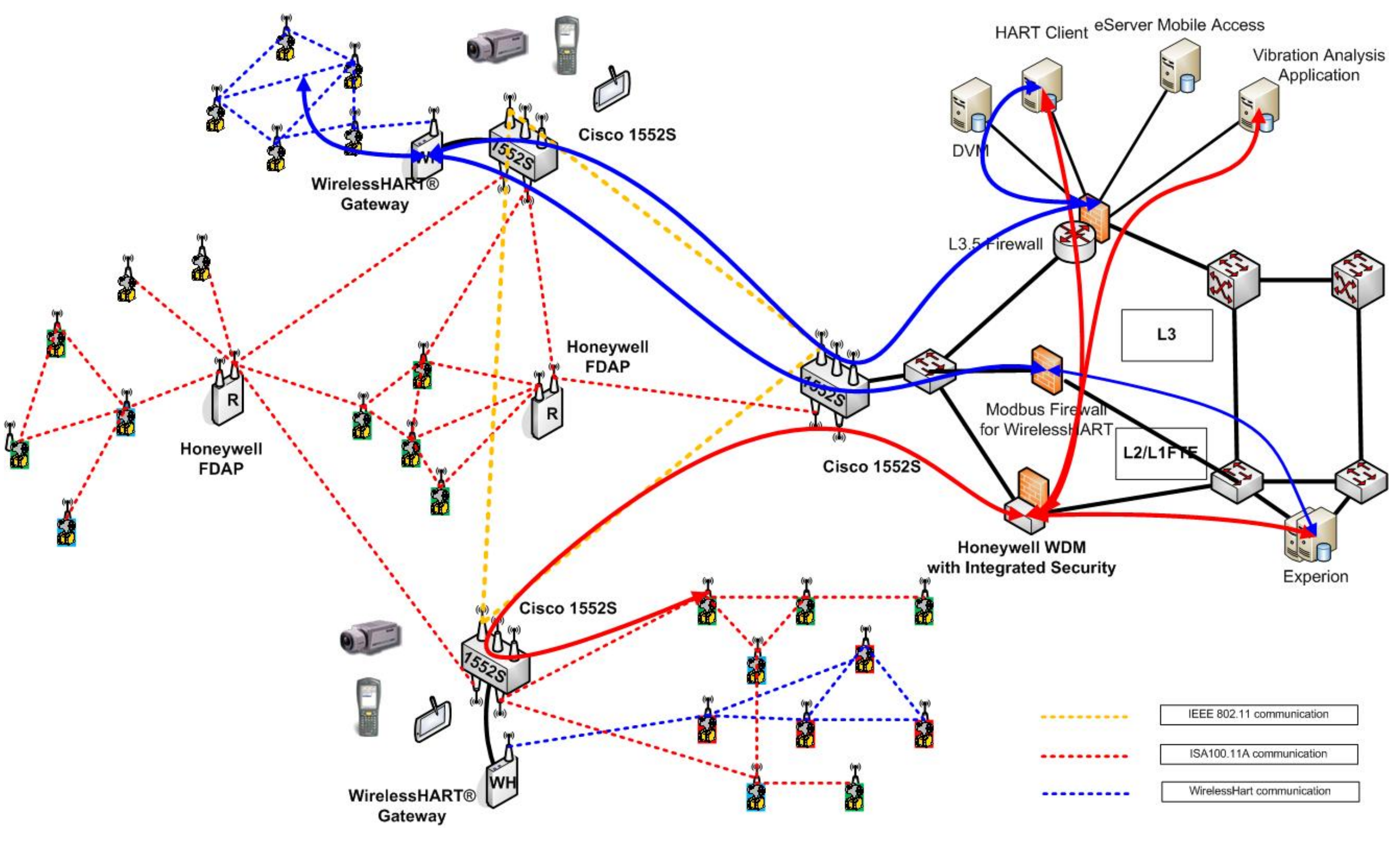



**Figure 3: OneWireless Network connecting ISA100.11a and *Wireless*HART devices to Experion.**

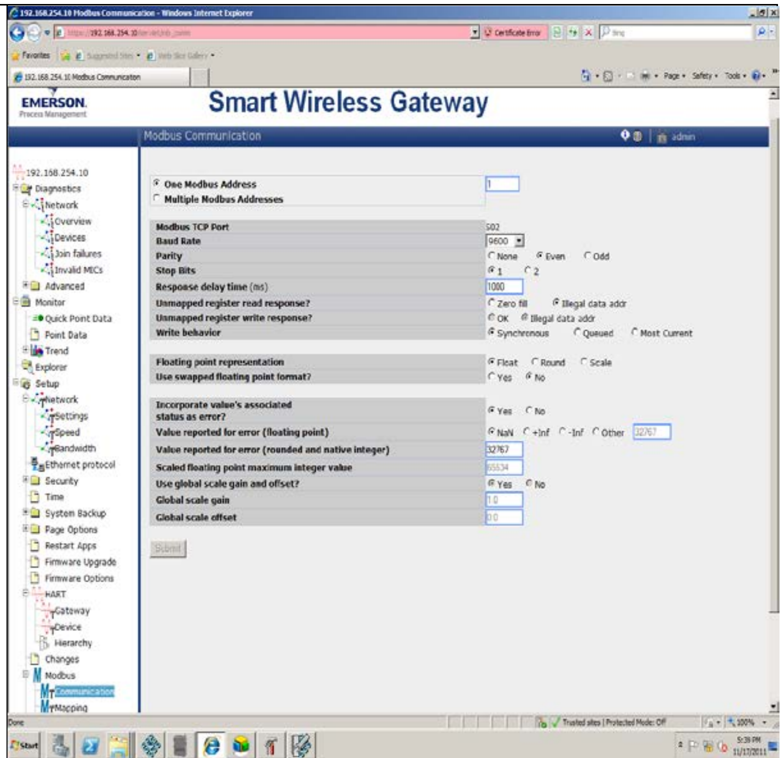
## Option 1: Connecting *Wireless*HART Data to Experion via Modbus

The *Wireless*HART gateway exposes *Wireless*HART data via Modbus TCP and OPC. The user configures the Modbus channel, controller and SCADA points in Experion that will link to the *Wireless*HART transmitters' PV, SV, TV and QV. These SCADA points can then be referred to in the Experion custom displays. Please refer to the *Wireless*HART gateway user's manual for configuration of the Modbus server inside the *Wireless*HART gateway. Emerson's *Wireless*HART gateway will be used for the step-by-step procedure explained below.

This step-by-step procedure connects Emerson's 1420 *Wireless*HART gateway to Experion.

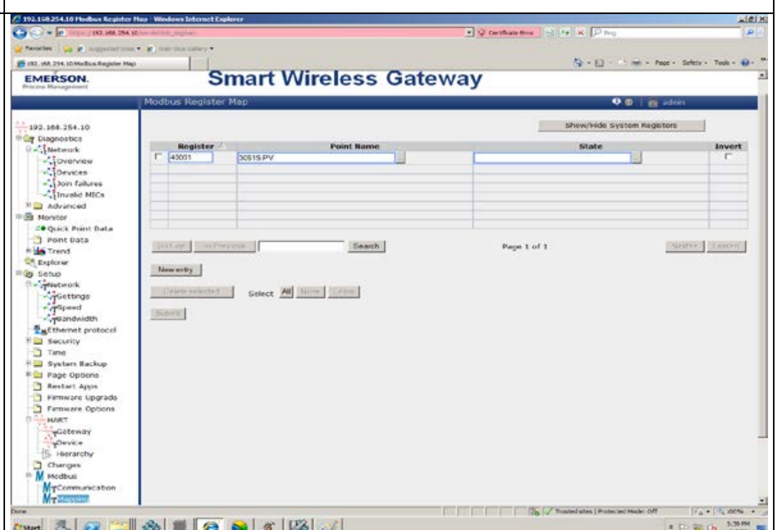
**Step 1: Configure Modbus server inside the *Wireless*HART gateway**

- Login to *Wireless*HART gateway using gateway IP address from web browser
- Configure the *Wireless*HART gateway Modbus interface by going to the Modbus>>Communications Section in the *Wireless*HART gateway login view:
  - Baud rate: 9600
  - Parity: Even
  - Stop bits: 1
  - Floating point representation: Float
  - Use swapped floating point format: No
  - Value reported for error (floating point): NaN
  - Rest of the parameters can be set as per integration requirement



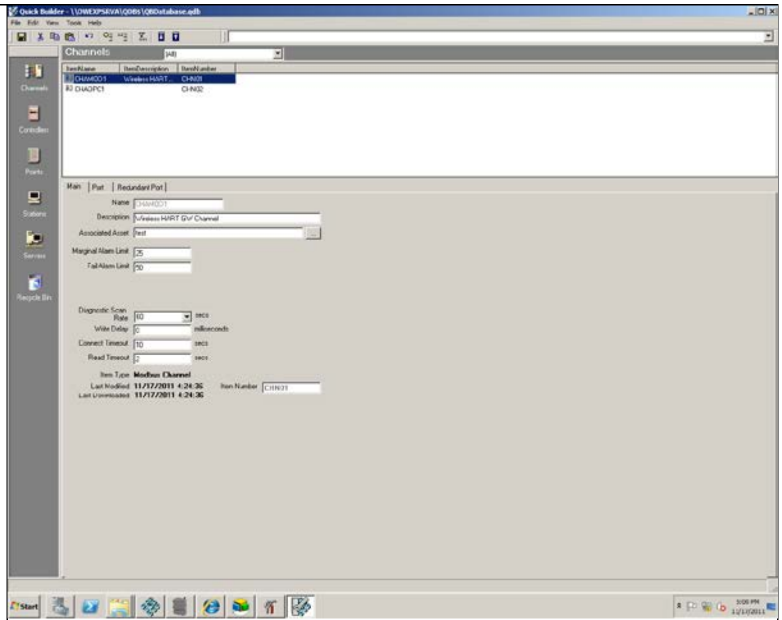

**Step 2: Modbus server address mapping inside the *Wireless*HART gateway**

- Go to the Modbus>>Mapping Section in the *Wireless*HART Gateway Login view
- Set the Modbus server address mapping to the following:
  - Register: 40001 (for reading PV/SV/TV/QV)
  - Point name: Tagname.PV (TD101.PV)
  - Browse the point and parameter details and submit the configuration

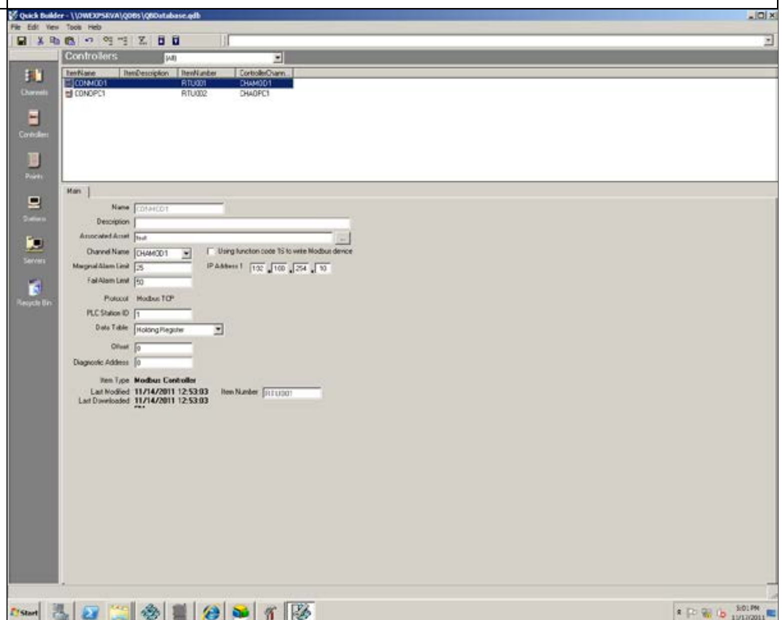


**Step 3: Configuration of Modbus channel in Experion**

- In Experion Quick Builder, create a new channel
- Download the new channel into the system



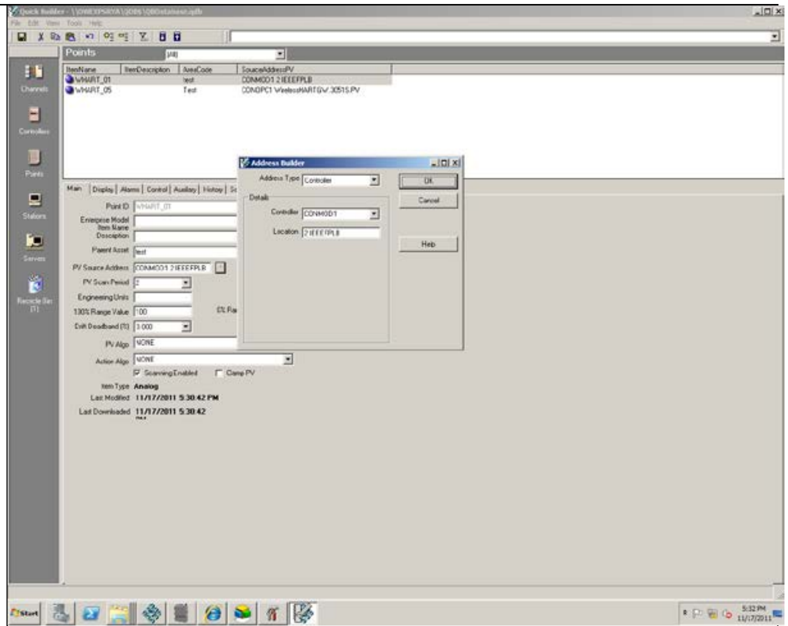
**Step 4: Configuration of Modbus controller in Experion**



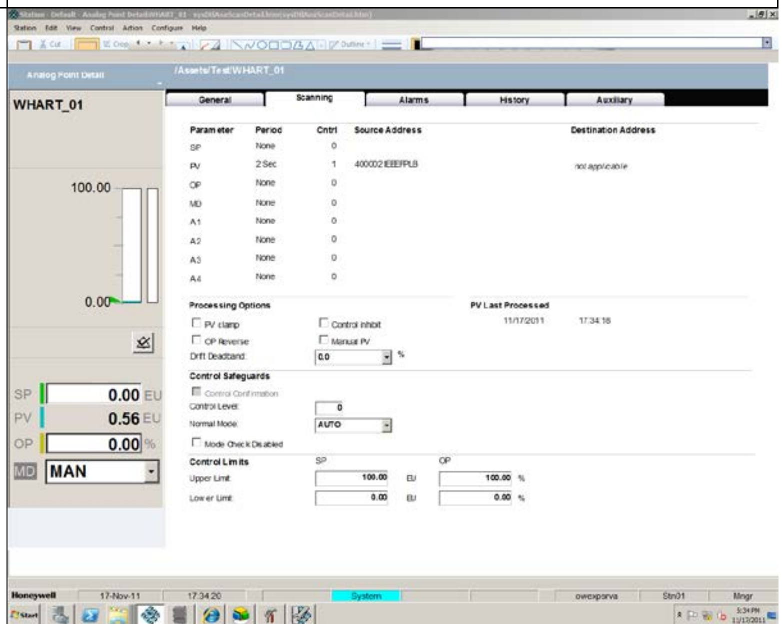
From the Experion Station, verify the channel and controller are enabled and status is OK

**Step 5: Configuration of Modbus point in Experion**

- Ensure the correct Modbus data format



**Step 6: Monitoring of point details in Experion Station**

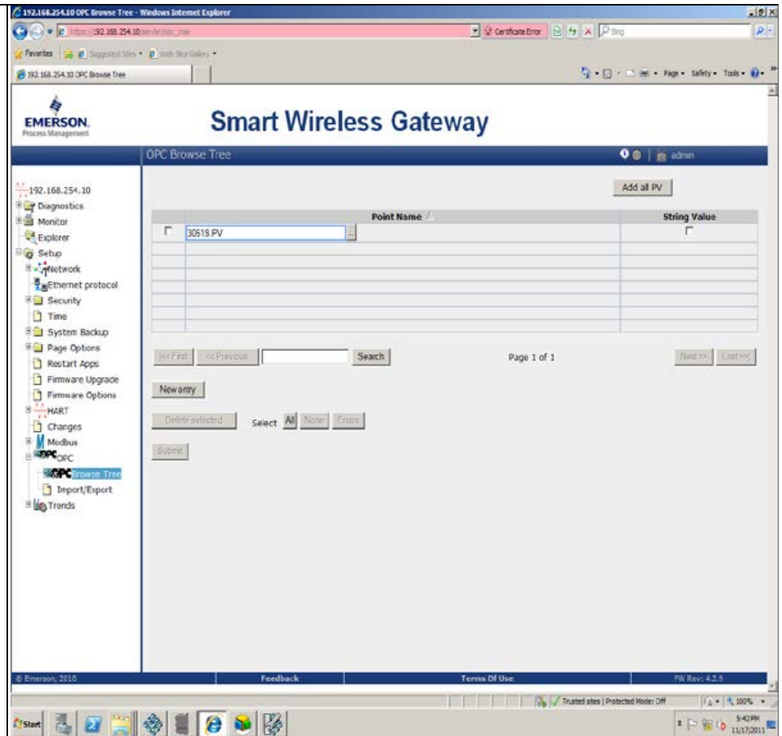
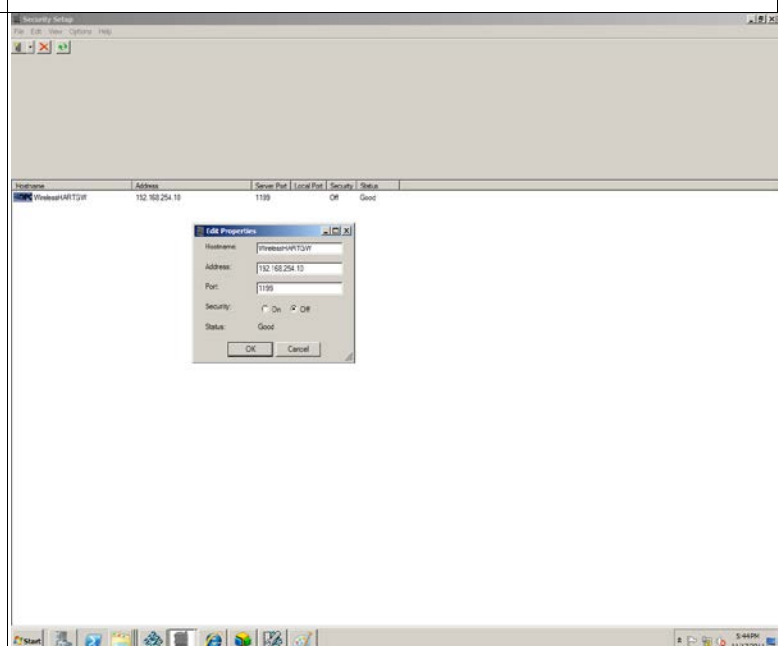



## Option 2: Connecting *Wireless*HART Data to Experion via OPC

The *Wireless*HART gateway exposes *Wireless*HART data via standard OPC interface. A user would configure the OPC channel, controller and SCADA points in Experion with references to the *Wireless*HART transmitters' PV, SV, TV and QV.

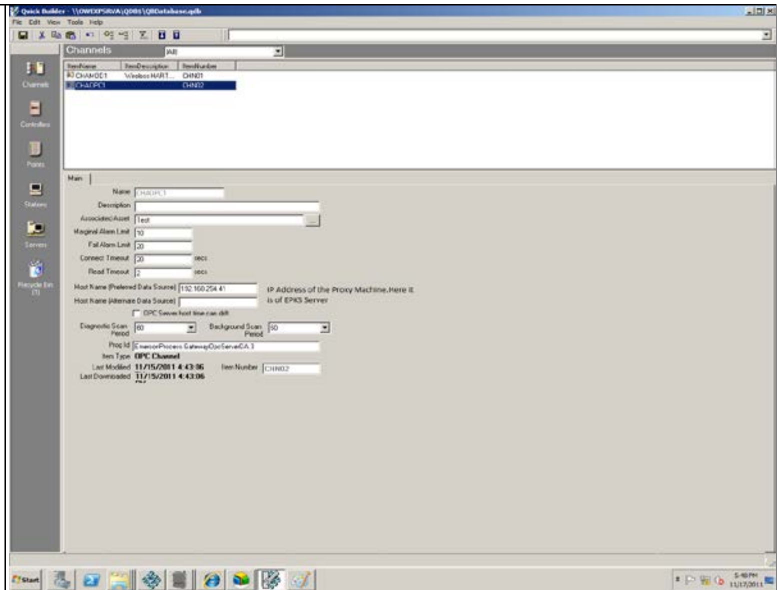
The SCADA points can then be used in Experion custom displays.

Please refer the *Wireless*HART gateway manufacturer's documentation for the configuration of OPC server/proxy and other settings to allow accessing data via OPC. The following steps illustrate how you can send data from Emerson's *Wireless*HART gateway to Experion.

| | |
|---|---|
| **Step1: Configuration of OPC in *Wireless*HART gateway**<br><br>• Login to *Wireless*HART gateway using a web browser and the gateway's IP address<br>• Go to the OPC>>Browse Tree Section in the *Wireless*HART gateway login view<br>• Browse the point and parameter details, and save the configuration using submit button |  |
| **Step 2: Install *Wireless*HART gateway OPC proxy on the Experion server machine** | |
| **Step 3: Configuration of OPC Proxy**<br><br>• Open the Security setup installed on the Experion server as mentioned in Step 2 and provide the *Wireless*HART gateway details for OPC proxy communication such as host name and IP address of the *Wireless*HART gateway<br>• Check for the "good" status once the details are saved |  |

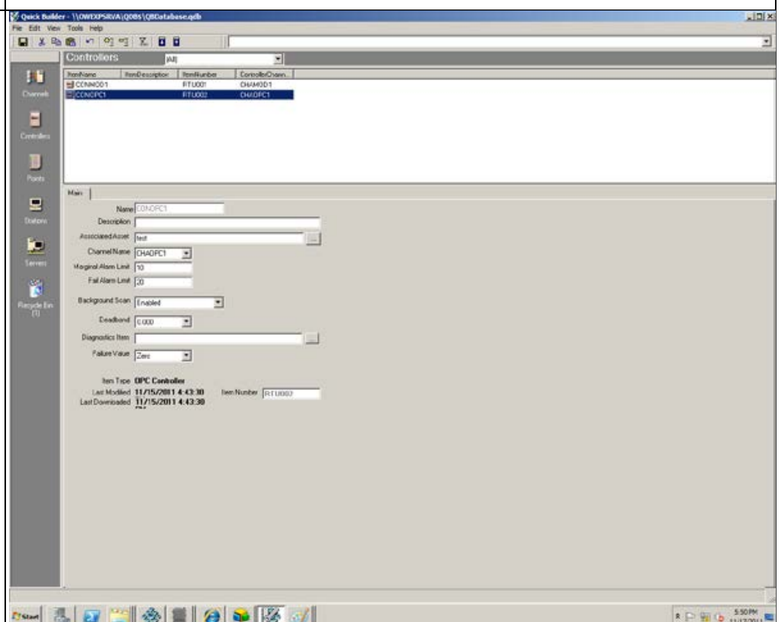
**Step 4: Configuration of OPC channel in Experion**

- In Experion Quick Builder, create a new channel
- User will have to provide the Experion server IP address on which the *Wireless*HART gateway OPC proxy has been installed
- Enter the prog id as “EmersonProcess.GatewayOpcServerDA.3”
- Download the new channel into the system



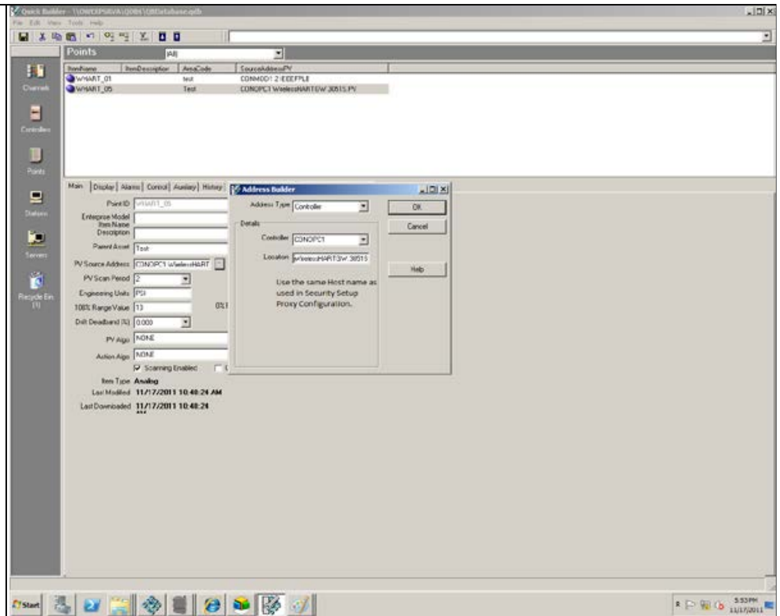

**Step 5: Configuration of OPC controller in Experion**

- In Experion Quick Builder, create a new controller
- Download the new controller into the system



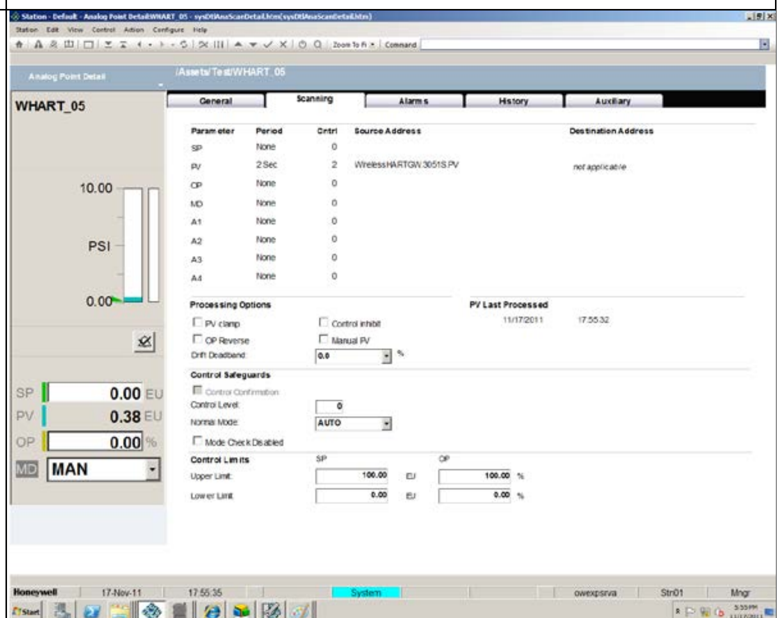
**Step 6: Configuration of OPC point in Experion**

- In Experion Quick Builder, create a new point
- The PV source address is the controller that refers to the channel associated with the *Wireless*HART gateway OPC proxy
- Download the new point into the system



**Step 7: Configuration/monitoring of OPC point in Experion**

- In Experion Station, call the OPC point to see all the values read from the *Wireless*HART gateway OPC server




## Conclusion

Honeywell is a strong supporter of the ISA100.11a Standard, since its unique features provide unparalleled benefits to end-users (e.g., tunneling, dual-casting, etc.). That is why Honeywell and a growing number of automation providers continue to invest heavily in the development of ISA100.11a-compatible devices. However, as the industrial wireless solution and infrastructure leader, it is important for Honeywell to support all industrial standards including *Wireless*HART. This paper has explained how a single plant-wide network, the OneWireless Network, can be used to support both the *Wireless*HART and ISA100.11a wireless field instrument standards for the industrial manufacturing market.

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