Smart Wireless Field Network: Recommendations for Planning, Installation, and Commissioning

INTRODUCTION

A Smart Wireless Field Network from Emerson Process Management is easy to plan, install, and commission. Below are recommendations for ensuring proper network performance without the need for site surveys as required for point-to-point wireless technologies.

HARDWARE CONSIDERATIONS

Wireless Devices

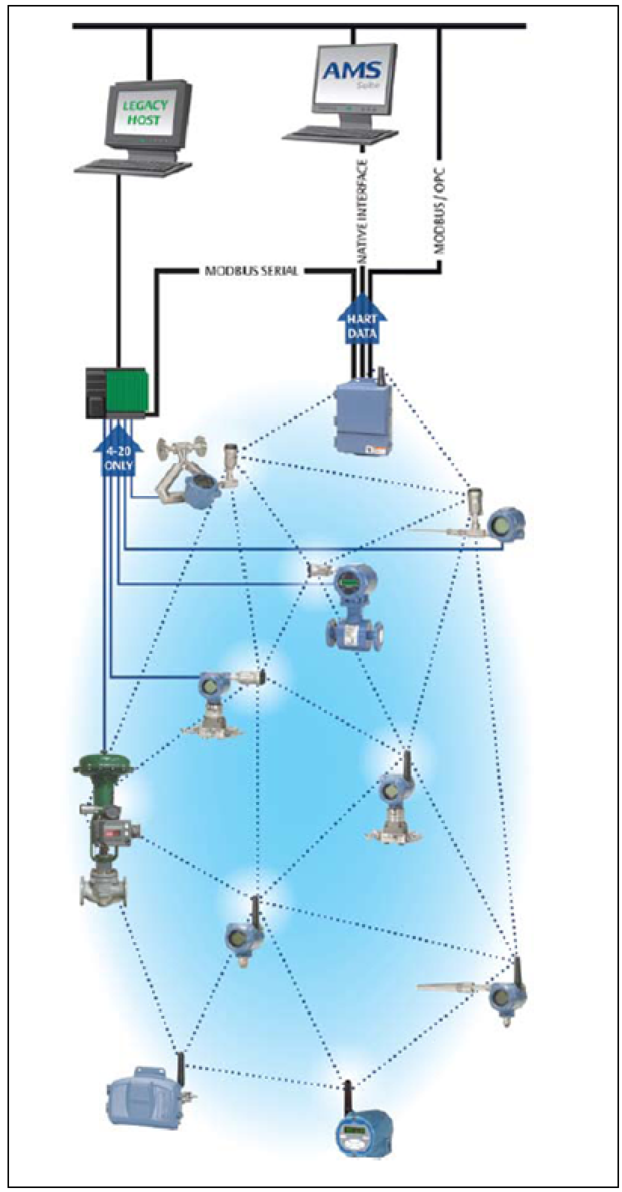
Emerson's Smart Wireless instruments are designed to be installed using traditional process connections and work practices to ensure accurate process measurements. Wireless instruments physically install like wired instruments. Wireless instruments will require an intrinsically safe power module instead of loop wires and the Smart Wireless THUM™ Adapter for wired HART® instuments will be powered by the existing 4-20 mA loop. See links below for proven wireless applications and detailed information on all of the available wireless instruments:

- o Wireless Applications
- o Wireless Products

Smart Wireless Gateway

The Smart Wireless Gateway connects the Smart Wireless Field Network to the host system and needs continuous line-powered 24V DC service at 0.5 AMPs from an uninterrupted power supply.

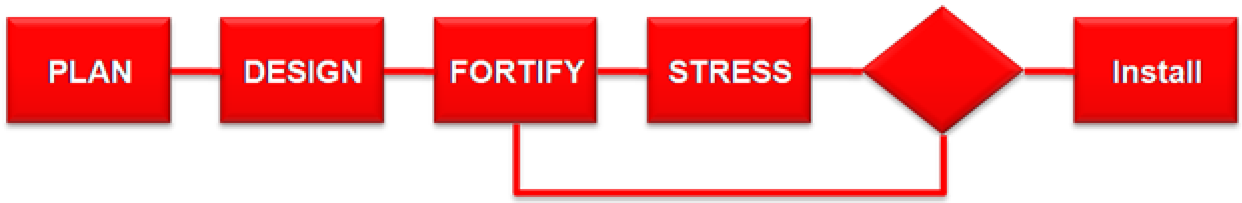
The Smart Wireless Gateway has options for remote mounted antenna that require installation with lightning protection and earth grounds by certified electricians per local electrical code. Antenna height will be determined in the network design phase of planning.



Smart Wireless Field Network containing wireless THUM Adapters and wireless instruments connected to any host system via the Smart Wireless Gateway.

OVERVIEW

There are 5 key steps to planning a Smart Wireless Field Network.



Plan

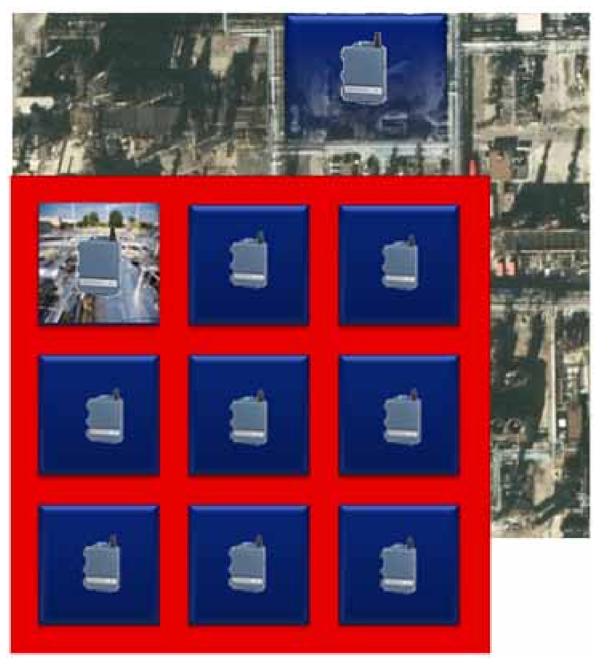
Planning a Smart Wireless Field Network requires three essential steps:

Mitigate Risk of Broadband Interference

Many facilities have existing high power wireless systems that work in different parts of the RF Spectrum from 450 MHz to 5.8 GHz. Some of these systems are known to produce broadband RF noise that may interfere with the reliable operation of other wireless devices. The most common source of broad-band RF noise encountered in a typical application is long range two-way voice communication systems. To mitigate the risk presented by these high power systems, verify that low pass filters are properly installed to limit the RF emissions to the segment of the spectrum that other wireless systems are using (including the 2.4 GHz band). This filtering should have no effect on the operation or performance of the high power communication system but will help to ensure reliable operation of other wireless devices. It should be noted that out of more than 1000 successful installations, only three sites experienced this issue. In each case, the installation of low pass filters successfully resolved the problem.

Scope

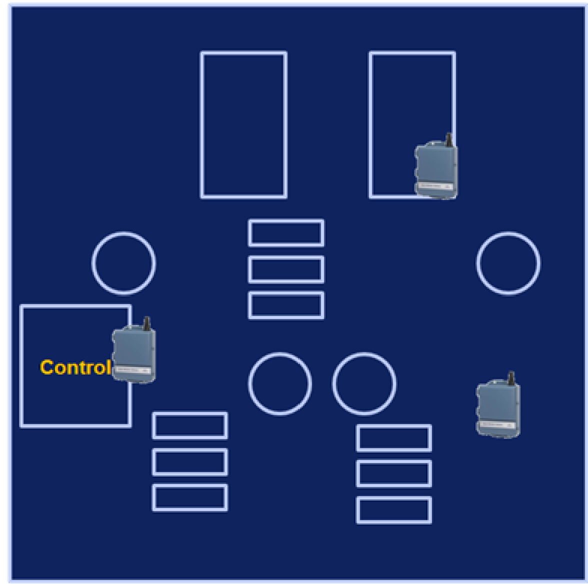
Every process facility is split into process units for the purpose of organizing the people, process, work practices, and flow of data from instruments. Every Smart Wireless Field Network must have a unique Network ID and should be dedicated to a unique process unit so that the wireless instruments and data can leverage existing work practices and data flows. Remember, wireless instruments compliant with WirelessHART™ standards are installed and configured just like wired HART instruments using the same Field Communicators. The design step will require a scaled drawing for laying out wireless instrumentation, selecting a gateway location, and testing the layout against proven network design recommendations that have been automated with the AMS Wireless SNAP-ON™ design tool. An existing instrument location plan, equipment location plan, or aerial picture from Google Earth works perfectly.



Typical process facility organized by process units with a dedicated Smart Wireless Gateway in each process units. Multiple gateways can exist in each process unit for network capacity spacing from 100 points to thousands of points.

Integrate

Anyone can initiate the implementation for a Smart Wireless Field Network. Wired instrumentation has typically been reserved for Process Control and Safety Systems due to the cost of installing wires. Wireless removes those cost barriers and allows maintenance, I&E, environmental, and other functional roles to cost justify automation using wireless instruments. A key project step will be to determine where wireless data should be seen and how the data should get there from the Smart Wireless Gateway. If your role is not in systems or application management, then you need to find the right person to help you. If you have an application to which you record and access data, then that application is likely to be on your local Ethernet LAN and has an administrator. This person will be in the best position to consult on how to connect the Smart Wireless Gateway via an Ethernet LAN or Serial Modbus connection to the place where you access data by using protocols such as OPC, Modbus TCP, and Modbus RTU. This application can be anything from a DCS, PLC, data historian, or dedicated database. Additional Smart Wireless Gateway capabilities can allow for integration directly into DeltaV, Ovation, and AMS Device Manager. A key understanding is that the Smart Wireless Gateway can be integrated into any host system or application leveraging standard data protocols through a process that is repeatable once locally established. The application administrator can also help to identify potential integration points in control rooms, instrument sheds, and other similar places for physically mounting the Smart Wireless Gateway in the field and making the physical connection to the host system via the Ethernet LAN or Serial Modbus connection. This step will be necessary to the design step. This administrator who acts as your integration resource will become an invaluable team member for quickly enabling wireless points.



Scaled image of process unit from either an equipment diagram, Instrument Location Plan, Google Earth aerial image, or similar source showing all potential Smart Wireless Gateway integration points.

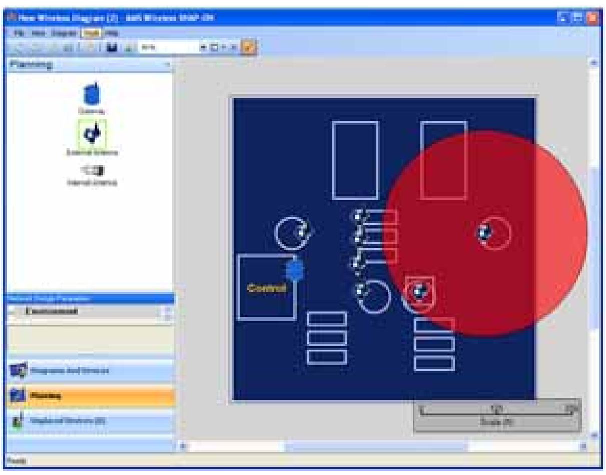
Design, Fortify, and Stress

The design, fortify, and stress aspects of engineering a Smart Wireless Field Network are the implementation of design recommendations learned from over 1000 unique installations across all industries and climates.

When **Designing** a Network:

1. Network should be scoped to a single process unit.
2. Contain a minimum of 5 wireless instruments within effective range of the Smart Wireless Gateway.
3. Have 25% of wireless instruments in network within range of Smart Wireless Gateway.
4. Each wireless instrument has three neighbors within the effective range.
5. Effective range is determined by type of process unit and the density of infrastructure that causes obstruction of wireless signals.

These recommendations may seem complex, but each helps to ensure a robust network that gets stronger as more wireless instruments are added and all are automated within the AMS Wireless SNAP-ON design tool. Each recommendation can be implemented and tested on paper, but that is time consuming and is not an efficient means for adding wireless instruments in the future. All that is needed to get started with the AMS Wireless SNAP-ON is a scaled drawing from the Planning step with the potential gateway integration locations identified.



Network Design in AMS Wireless SNAP-ON showing a broken design recommendation that is fortified by adding wireless instruments, repeaters, or moving the Smart Wireless Gateway location.

When **Fortifying** a Network:

1. A design recommendation will be broken and indicated by a red circle that is proportional to the effective range of the wireless instrument.
2. Solutions include:
   a. Adding additional wireless instruments for collecting additional process information.
   b. Adding repeaters, which are wireless instruments just used as a reinforcing radio in the network.
   c. Locating the Smart Wireless Gateway in the location that maximizes connections with in the network. This is why working with the application administrator to identify all potential gateway integration points is a useful process.

The AMS Wireless SNAP-ON enables the very quick design and testing of Smart Wireless Field Networks. Complete design only takes a few moments if instrument locations are known. Furthermore, the instrument mounting locations do not need to perfectly match the location used during the design process, because the self-organizing, wireless technology naturally adapts to the actual details of the environment once installed. The AMS Wireless SNAP-ON ensures the network designers put the technology in position for high reliability.

When **Stress** Testing a Network Design:

1. The network designer is identifying the weak spot in the network by reducing the effective range against which all the design recommendations are tested. This process builds confidence in the design.
2. Take an example:
   a. A medium density process unit, such as an aromatics unit has an effective range of 250 ft.
   b. Reducing the effective range by 10% to 225 ft reveals no broken design recommendations. A 10% increase in the confidence of the design is achieved.
   c. Suppose we then reduce the effective range by 20% to 200 ft reveals a broken design recommendation. We can then manage design risk by being satisfied with the 10% additional confidence from step 2b or choose to fortify further the network.

For most process units, designing a network with 30 wireless instruments or more creates a network so strong that design recommendations can only be broken if the effective ranges for stress testing are reduced well below 50 ft, which is far in excess of typical performance in even the most dense process units.

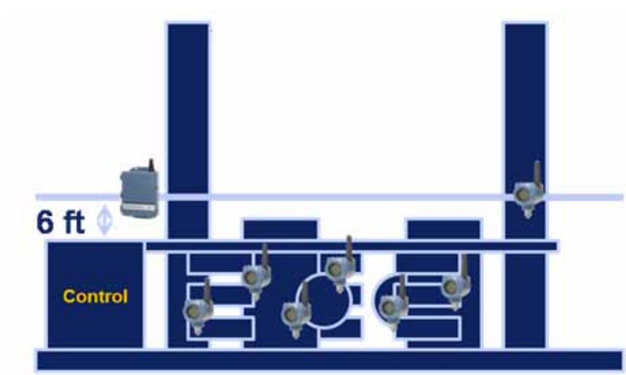
This overview planning a Smart Wireless Field Network is applicable to all networks where wireless instrumentation is updating at rates less than once every 8 seconds. Additional considerations should be taken when operating wireless instruments at update rates faster than once every 8 seconds. Look for additional design examples by industry, update rates faster than 8 seconds, and for high speed control in the near future.

Installation

Wireless instruments should be installed with the same work practices as for wired instruments to ensure a good process connection. Take caution to keep the antenna from being directly mounted against metal surfaces, a forearm's length from vertical surfaces is a good rule of thumb. Be sure to reference the manuals and installation guides for each instrument. Additional tips:

1. Fiberglass instrument enclosures provide no significant impact to wireless performance where enclosing instruments is a standard work practice.
2. If instruments are mounted inside a building or enclosure, relative to the majority of the wireless instruments, a passive antenna through the wall (two antenna connected by coaxial cable and a lightning arrestor) or additional repeaters should be used to ensure proper connectivity.
3. Wireless instruments mounted underground, underwater, or inside of tanks will likely not work well.

Gateways and repeaters should be mounted 6 ft above the majority of process infrastructure to ensure maximum range across the process unit as well as penetration into the process unit. Always be sure to have gateways properly grounded to earth and egresses to enclosures protected with included lightning protection.



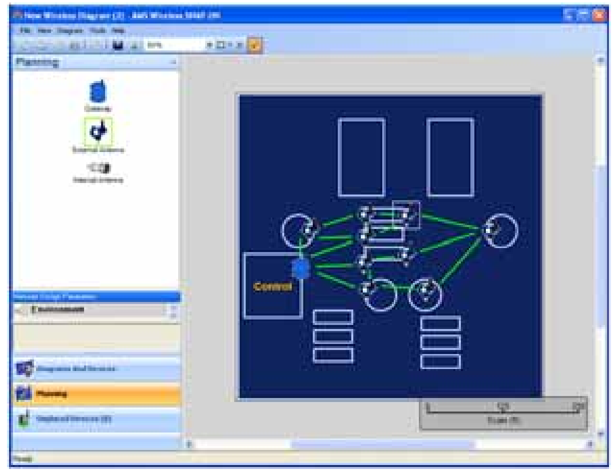
Cross section of process unit with gateway and repeaters installed about the obstruction with wireless instruments installed like wired instruments.

Commission

When commissioning a Smart Wireless Field Network two things must be commissioned:

1. Wireless Instrumentation
   a. Each wireless instrument has proper configuration per application.
      i. Use Field Communicator with proper device descriptor.
   b. Each Wireless instrument has proper security to join a unique wireless network.
      i. Configure Network ID and Join Key in addition to normal HART instrument configuration parameters.
   c. Verify through the Smart Wireless Gateway each wireless instrument has at least two neighbors.
      i. The design rule is 3 neighbors due to the dynamic nature of the environment; the commission rule is 2 neighbors.
   d. Verify through the Smart Wireless Gateway that the process variables are updating at the desired rate.
2. Smart Wireless Gateway
   a. Verify all devices are connected with a reliability >99%.
   b. Verify a minimum of 15% of wireless instruments are direct connected to the gateway.
      i. The design rule is 25% of wireless instruments due to the dynamic nature of the environment; the commission rule is 10% neighbors.
   c. All data from wireless instruments is properly appearing in desired applications.

When complete, all wireless connections between wireless instruments can be viewed live in the AMS Wireless SNAP-ON. Don't be surprised if there are connections in the densest of process units that unpredictably span several times the effective range used to check the design rules. The self-organizing technology essentially places a wireless engineer inside of each WirelessHART compliant instrument that dynamically responds to the current state of the process environment. If we were to conduct a site survey to make those surprising links happen, then they would eventually fail due to changing conditions. The self-organizing technology will always use the best possible links and the conservative application of design rules ensures there are plenty of potential connections, from which the best connections can be chosen by the radios, without the end user needing to be a wireless expert.



AMS Wireless SNAP-ON showing live connections between wireless instruments for a network designed in AMS Wireless SNAP-ON and then connected to a Smart Wireless Gateway.

Emerson Process Management
Rosemount Measurement
8200 Market Boulevard
Chanhassen MN 55317 USA
Tel (USA) 1 800 999 9307
Tel (International) +1 952 906 8888
Fax +1 952 949 7001

Emerson Process Management
Blegistrasse 23
P.O. Box 1046
CH 6341 Baar
Switzerland
Tel +41 (0) 41 768 6111
Fax +41 (0) 41 768 6300

Emerson FZE
P.O. Box 17033
Jebel Ali Free Zone
Dubai UAE
Tel +971 4 811 8100
Fax +971 4 886 5465

Emerson Process Management Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
Tel +65 6777 8211
Fax +65 6777 0947
Service Support Hotline : +65 6770 8711
Email : Enquiries@AP.EmersonProcess.com

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