WirelessHART®
Deployment Methodology and Guidelines
Agenda

- About the Speakers
- Why Choose WirelessHART?
- Requirements Collection Phase
- Network Design Phase
- Network Deployment and Commissioning Phase
- Network Operation and Maintenance Phase
- Practical Deployment Considerations
- Q&A
Robert Assimiti is the Co-Founder and CEO of Centero, LLC. He has over 18 years of technical leadership in the wireless IoT/IIoT arena. He has architected and developed several highly scalable, widely deployed mesh based wireless product lines for both commercial and industrial wireless markets and applications. Robert manages a team of technologists focused on the creation of new technologies, standardization and generation of novel intellectual property. He has also authored and co-authored several patents. Centero is a provider of wireless products, technologies and services for IIoT connectivity.
Shane Hale
Global Director of Business Development
Emerson - Pervasive Sensing

Webinar Speaker

Shane has over 25 years’ experience in the instrumentation and control field in many industry segments including Oil & Gas, petrochemicals, and metals & mining. Shane joined Emerson 20 years ago as a field technician in Sydney, Australia, and has held various roles including project design & commissioning engineer for international projects, business development manager, director of product management, and now global director for business development for Emerson’s pervasive sensing business. He is now living with his young family in Minneapolis, MN.
WirelessHART Facts

- Architected to meet rigorous requirements for industrial process automation
- International standard IEC62591 – approved January 2009
- Built on the *solid foundation of the HART open protocol* - deployed since 1986
- Deployed ecosystem of 50K+ networks.
- Same application layer is used in HART and WirelessHART
- FieldComm Group is chartered and tasked with:
  - Defining and maintaining clear specifications
  - Ensuring Interoperability through registration program
  - Providing training workshops and in-depth support
Why Choose WirelessHART?

**Communication Reliability**
99.99% uptime in well-formed networks

- Path diversity – mesh routing
- Time diversity – TDMA slotted access
- Frequency diversity – channel hopping

**Interoperability**
15 device manufacturers have products registered via FieldComm Group's registration program (see product links on last page)

- Fully defined application layer
- Utilizes well understood HART structures
- Interoperable with existing control systems

**Cybersecurity**
Secured to a two-layer strategy

- Mandatory security protocols
- Data link layer hop-by-hop authentication
- Transport layer authentication + encryption
Why Choose WirelessHART? (continued)

**Scalability**
Hundreds or devices per network
- ✓ Self-organizing mesh networks
- ✓ No need for Gateway line-of-sight
- ✓ Deterministic technology

**Full Data Context**
Application layer data structures
- ✓ Application layer data points have full context
- ✓ Maximized value of data for analytics

**Publish-by-Exception**
Periodically published data flows
- ✓ Data published based on process/device conditions
- ✓ Ensures availability of data for monitoring/control
- ✓ Reduces energy needed compared to polling
Collect Requirements

● RFP/RFQ that details field deployment requirements

OR send out requirement survey

● Map(s) or drawings of facility or area where coverage is desired

● GPS coordinates used for preliminary RF link modeling
  ○ Distances between network components (field instruments, control rooms, etc)
  ○ Elevation differences

Industrial IoT Field Deployment - Requirement Survey

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<tbody>
<tr>
<td>1</td>
<td>Customer name</td>
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<tr>
<td>2</td>
<td>Application/Market</td>
</tr>
<tr>
<td>3</td>
<td>Type of environment (please describe in detail, also include any HAZLOC area designation)</td>
</tr>
<tr>
<td>4</td>
<td>Target line-of-sight range between field instruments</td>
</tr>
<tr>
<td>5</td>
<td>Desired scalability per Gateway</td>
</tr>
<tr>
<td>6</td>
<td>What is the typical real estate area covered by one deployment?</td>
</tr>
<tr>
<td>7</td>
<td>Is standards compliance desired or mandatory? Is instrument certification desired or mandatory?</td>
</tr>
<tr>
<td>8</td>
<td>How often is periodic data transmitted? (in msgs/sec)</td>
</tr>
<tr>
<td>9</td>
<td>What is the typical data payload sent?</td>
</tr>
<tr>
<td>10</td>
<td>What is the max data payload sent?</td>
</tr>
<tr>
<td>11</td>
<td>Are instruments engaged in monitoring, control, or both?</td>
</tr>
<tr>
<td>12</td>
<td>Any latency requirements?</td>
</tr>
<tr>
<td>13</td>
<td>What is the size of the periodic data payload (bytes)?</td>
</tr>
<tr>
<td>14</td>
<td>Are there any latency requirements associated with periodic data (ms)?</td>
</tr>
<tr>
<td>15</td>
<td>Are non-periodic commands being sent to the field instruments?</td>
</tr>
</tbody>
</table>
Collect Requirements

Deployment vertical
Deployment segment

Downstream
Upstream
Mining

Oil and Gas, Chemical, Pharma, Mining, Paper and Pulp, Power etc
Downstream, midstream or downstream
Collect Requirements

- Area designation (HAZLOC, non-HAZLOC, zones etc)
- Scalability and geographic area to be covered
- Type of instruments and data transfer requirements
- Monitoring and/or control
- Connectivity to the plant network
- Select equipment with appropriate classifications and certifications
- Determine deployment topology
- Network throughput decisions – number of hops + repeaters
- Latency considerations
- MODBUS, HART IP, OPC UA,
Components of a WirelessHART Network

Devices
- WirelessHART sensors from multiple vendors used for process and asset monitoring

Gateway
- Connects to sensors and manages the mesh network to optimize reliability

Host
- Data communication with wide range of secure, industry standard protocols

Data communication with secure, industry standard protocols:
- Ethernet
- Serial
- Wi-Fi
- LTE/5G
- HART-IP
- OPC
- Modbus TCP
- Ethernet/IP
- Wi-Fi/5G
Components of a WirelessHART Network

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*Antenna should be placed in the middle of the network*
Network Design

Site Walkdown

- WirelessHART should co-exist with other wireless protocols with good planning
  - Antennas for any wireless signals should kept at least 1 meter/3 feet apart

- Site walkdown should identify
  - Location of WirelessHART sensor applications
  - Location of existing Wi-Fi or other wireless antennas
  - Location of backhaul signal access, such as Plant LAN connections, Serial communication connections, or Wi-Fi access points
  - Location of power supply for WirelessHART Gateways (DC/AC/Power-Over-Ethernet)

Combined Wi-Fi and WirelessHART Access Points

- Ideal for connectivity infrastructure rollout
- High-bandwidth (power hungry) Wi-Fi access for Mobile Worker applications and data backhaul
- Very efficient and secure WirelessHART sensor communications
- Line power for Wi-Fi Access-point that provides Power Over Ethernet (POE) to WirelessHART Gateway
Network Design - Deliverables

Network Proposed Physical Layout
- Shows proposed location of the equipment to be installed
- Includes distances and wireless coverage

Network Proposed Logical Layout
- Shows proposed network topology
- Highlights mesh redundancy for wireless communications reliability

List of Equipment
- Includes infrastructure devices
- List of accessories: antennas, mounting brackets, cables, surge arrestors, RF connectors etc
- Should include spares for all equipment

<table>
<thead>
<tr>
<th>Icon</th>
<th>Product Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌟</td>
<td>WirelessHART Gateway</td>
<td>9</td>
</tr>
<tr>
<td>🌟</td>
<td>WiFi Mesh Router</td>
<td>7</td>
</tr>
<tr>
<td>🌟</td>
<td>Industrial Wi-Fi MODBUS TCP/RS485/Ethernet Adapter/Router/Gateway</td>
<td>4</td>
</tr>
<tr>
<td>🌟</td>
<td>Asset Manager</td>
<td>2</td>
</tr>
<tr>
<td>🌟</td>
<td>High-gain, rugged omni-directional antennas 2.4 GHz</td>
<td>70</td>
</tr>
<tr>
<td>🌟</td>
<td>High-gain, rugged omni-directional antennas 5 GHz for WIFI MESH+</td>
<td>232</td>
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</tr>
<tr>
<td>🌟</td>
<td>Surge Arrester FT-RR, DC-6 GHz N MALE TO N FEMALE</td>
<td>Optional - recommended</td>
</tr>
<tr>
<td>🌟</td>
<td>Low RF loss cable high-gain antenna, L=3M, L=4M, L=9M</td>
<td>48</td>
</tr>
<tr>
<td>🌟</td>
<td>Wall mount kit</td>
<td>70</td>
</tr>
<tr>
<td>🌟</td>
<td>Pole mount kit</td>
<td>30</td>
</tr>
</tbody>
</table>
## Signal Range Is Dependent on the Density of Obstructions

<table>
<thead>
<tr>
<th>Obstruction Type</th>
<th>Distance (ft/m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line of Sight, Extended Range</strong></td>
<td>&gt;½ mile, 2600ft 800m</td>
<td>Extended range antennas above obstructions, up to 2 miles.</td>
</tr>
<tr>
<td>Clear Line of Sight</td>
<td>~750ft 230m</td>
<td>The antenna for the device is mounted above obstructions and the angle of the terrain change is less than five degrees.</td>
</tr>
<tr>
<td>Light Obstruction</td>
<td>~500ft 150m</td>
<td>Typical of tank farms. Despite tanks being big obstructions themselves, lots of space between and above makes for good RF propagation.</td>
</tr>
<tr>
<td>Medium Obstruction</td>
<td>~250ft 80m</td>
<td>Process areas where lots of space exists between equipment and infrastructure.</td>
</tr>
<tr>
<td>Heavy Obstruction</td>
<td>~100ft 30m</td>
<td>Heavy density plant environment; where a truck or equipment cannot be driven through.</td>
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3. 25% of network within range of the gateway antenna
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4. 3 good neighbors for every device
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A well-formed network will easily achieve 99% Data Reliability
Network Connections

- Network connection depends on what is the sensor data being used for?
Network Connections

● Network connection depends on what is the sensor data being used for?

○ Process Monitoring or control: Gateway connection should be connected to the Control System control network (level 2)
Network Connections

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  - **Process Monitoring or control**: Gateway connection should be connected to the Control System control network (level 2)
  
  - **Reliability Monitoring**: Gateway communication should be connected directly to the business network through a DMZ (Typically level 3 or 4)

- Multiple WirelessHART networks can co-exist so that some devices can be connected to the control network, and others to the Reliability network
Network Commissioning Phase

- Install the Gateway first
  - Locate the gateway near the center of where sensors will be located, with line-of-site to as many devices as practical

- Install wireless devices nearest the Gateway first, then expand outward

- Install power modules into sensors after the Gateway is powered on

- Turn on active advertising in the Gateway when adding devices to a network

- Enter the WirelessHART Network ID and the Join Key into each sensor
  - Sensors can be ordered with the Network ID and Join Key pre-configured

- Confirm communication to Host Device (HART-IP, Modbus, OPC, etc.)
Network Commissioning Phase

- Once network is formed, confirm network best practices

<table>
<thead>
<tr>
<th></th>
<th>Regular Network</th>
<th>Fast Update Network</th>
<th>Blended Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(all devices are 4 seconds or more)</td>
<td>(&gt;20% of devices are 1 or 2 seconds)</td>
<td>(&lt;20% of devices are 1 or 2 seconds)</td>
</tr>
<tr>
<td>Minimum # of devices within range of the Gateway</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Minimum # of good Neighbors (min. path stability)</td>
<td>3 (each path &gt;60%)</td>
<td>3 (each fast path &gt;70%)</td>
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</tr>
<tr>
<td>% of network within range of the Gateway</td>
<td>25%</td>
<td>50%</td>
<td>25%</td>
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- Turn on “Rotate Network Key” option to improve cyber-security
- Save backup of gateway for future reference
Network Operation and Maintenance

Monitor Wireless Health Status

- Wireless Health Reports
- Wireless Link Health Indicators (Field instruments, repeaters, Gateways)
- Monitor Wireless Interference Wireless Co-existence Mechanisms
- Monitor Gateway Load

Device Reports – Field Instruments, Repeaters, Gateways
Network Health Reports

Packet Success Rates (PSR)
RSSI – Received Signal Strength Indicators

Clear Channel Assessment Backoffs
Proactive Spectrum Management through channel admission/exclusion mechanisms

Gateway Load should be below 80% to ensure reliable communication during high traffic periods
## Network Operation and Maintenance

### Software and Firmware Upgrades

<table>
<thead>
<tr>
<th>Gateway Software/Firmware Upgrades</th>
<th>Gateway software/firmware updates will require the network to re-form, and which can take up to 1 hour for large (&gt;50 devices) networks</th>
</tr>
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<tbody>
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<td>Field Instrument Upgrades (Wired or Over-the-Air OTA)</td>
<td>WirelessHART Communication Stack Upgrades Application Processor Upgrades</td>
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### Battery Life Monitoring and Replacement

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<th>Field Instrument Battery Status</th>
<th>Part of the field instrument health report Replace batteries as needed</th>
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<td>Aggregate Field Mesh Network Energy</td>
<td>Ensure the wireless traffic in mesh network is balanced and does not cause high battery drain on particular instruments Enforce mesh topology if needed</td>
</tr>
</tbody>
</table>
Practical Deployment Considerations

Antennas

- WirelessHART: 2.4 GHz, high-gain omni-directional antennas
- WiFi: 5 GHz, high—gain omni-directional or directional antennas
- Installation height matters – the higher the better
- Always have RF qualification tests assemblies of antenna + extension cable + arrestor + all connectors

Surge Arrestors

- Install surge arrestors as close to the RF port as possible
- Always weatherproof RF connections with appropriate tools and materials
Practical Deployment Considerations

Power

- Undervoltage and over-voltage protection
- Power conditioning components
- Surge protection
- Battery backup desired – especially in upstream applications
Conclusion

WirelessHART network deployment is greatly simplified if recommended guidelines are being followed.

Network planning and design decisions have a significant impact on the wireless health of the networks and battery life of field instruments.
INTREPID WirelessHART Gateway Product Line

- WirelessHART Network/Security Manager, Gateway and Access Point
- Includes both WirelessHART and WiFi MESH+ high throughput backbone connectivity
- Intuitive INTREPID application modeled after field device lifecycle
- Supports scalable deployments of up to 250 field instruments per Gateway
- Extended WirelessHART connectivity range to field instruments – up to 1.2 miles (2,000 meters) LOS
- Supports Over-the-Air upgrades for field instruments
- Supports transfer of large files for condition/vibration and corrosion monitoring
- Secure HART-IP (HART 7.7) high-side connectivity to the plant network or cloud-hosted applications
- Power redundancy (DC and PoE)

https://centerotech.com/product/intrepid-wirelesshart-field-gateway/
Emerson’s Wireless Transmitter Portfolio

Process Monitoring

Measurements in lieu of traditionally wired monitoring points, routed through wireless gateways to the PLC/DCS saving on signal wiring and I/O costs

- Pressure
- Temperature
- Level
- Flow

Reliability Monitoring

Measurements that aid in Maintenance, Reliability, and Safety, connected to the business network rather than traditional (and expensive) Control I/O

- Vibration
- Acoustic
- Discrete Signals
- Gas Monitoring
- Location Awareness
- THUM Stranded Diagnostics
- Corrosion & Erosion
- Connected Lighting
# Emerson WirelessHART Gateways

## 1410S + 781S
- 200+ devices
- AC/DC/PoE (Powered Device Only)
- RS-485, Ethernet
- Modbus TCP, OPC-DA, OPC-UA, Ethernet/IP, HART-IP *WirelessHART*
- Intrinsic safety barrier (option)
- ISA 100A (Option)

## IW6300
- Class 1 Div. 2 / ATEX/IEC-Ex Type n
- 5Ghz and 2.4GHz Wi-Fi-Mesh Networks
- Power over Ethernet
- RS-485, Ethernet
- Modbus TCP, OPC-DA, OPC-UA, Ethernet/IP, HART-IP
- Fiber-Optic
WirelessHART Registered Products from FCG Members

FieldRay MR2200-ML
Manufacturer: ABB
Protocol: HART
Category: WirelessHART Field Device Adapter

702 Wireless Discrete Transmitter
Manufacturer: Emerson Automation Solutions
Protocol: HART
Category: WirelessHART Field Device

3308A
Manufacturer: Emerson Automation Solutions
Protocol: HART
Category: WirelessHART Field Device, Level

M11085 DEV-MH-X
Manufacturer: Microcyte Corporation
Protocol: HART
Category: WirelessHART Field Device, Development Solution, Stack

ADDER Acoustic
Manufacturer: Armstong International
Protocol: HART
Category: WirelessHART Field Device, Acoustic

587770 Steam Trap
Manufacturer: Armstrong International
Protocol: HART
Category: WirelessHART Field Device, Steam Trap Monitor, Acoustic

OTIS 7453-6-W-HART
Manufacturer: Osi Instruments
Protocol: HART
Category: WirelessHART Field Device, Acoustic

BULLET WirelessHART Adapter
Manufacturer: Pfeiffer-Fuchs SE
Protocol: HART
Category: WirelessHART Adapter, WirelessHART Field Device

ERTRAN AM510
Manufacturer: Siemens AG
Protocol: HART
Category: WirelessHART Field Device, Analog

MITEXX Stack Starter Kit
Manufacturer: Streeting AG
Protocol: HART
Category: WirelessHART Field Device, Development Solution, Stack

Onset Wireless Temperature
Manufacturer: Onset
Protocol: HART
Category: WirelessHART Field Device, Temperature

WirelessTED Module
Manufacturer: Ipsa Srl
Protocol: HART
Category: WirelessHART Field Device

VT07461-ML-41
Manufacturer: Vega-Neuchatel KG
Protocol: HART
Category: WirelessHART Field Device, Level

WirelessHART Field Device Adapter
Manufacturer: Fieldcomm Group
Protocol: HART
Category: WirelessHART Field Device Adapter

https://www.fieldcommgroup.org/registered-products
<table>
<thead>
<tr>
<th>Company</th>
<th>Products</th>
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<tbody>
<tr>
<td>Fieldbus International AS</td>
<td>• T810 Built-in WirelessHART adapter</td>
</tr>
<tr>
<td></td>
<td>• T910 DIN-rail mounted WirelessHART converter,</td>
</tr>
<tr>
<td>Manometer Factory LLC</td>
<td>• Safir W, pressure transmitter</td>
</tr>
<tr>
<td>Metal Samples Company (a Division of Alabama Specialty products, Inc.)</td>
<td>• MS800XUT-HRT Ultrasonic Corrosion/Erosion Monitoring instrument</td>
</tr>
<tr>
<td></td>
<td>• High Resolution Wireless HART ER Transmitter, MS50XXE-HRT</td>
</tr>
<tr>
<td>ProComSol, Ltd</td>
<td>• DevCom2000 - HART Communicator Software, Windows, Software</td>
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<td></td>
<td>• DevComDroid - HART Communicator App, Android, Software</td>
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<tr>
<td></td>
<td>• DevCom.iOS - HART Communicator App, iOS (Apple), Software</td>
</tr>
<tr>
<td>United Electric Controls Company</td>
<td>• Vanguard WirelessHART Fixed Point Gas Detector</td>
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THANK YOU FOR YOUR ATTENTION!

Q&A Session