Why Wireless Gas Detection?

Technologies Coming of Age
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Agenda

1. Wireless & Gas Detection - some background.
2. Explore pervasive customer problems uncovered by our research.
3. Some solutions
Portable / Personal Solutions

• These are battery powered, carried by plant personnel. Pocket-sized and can detect several different gases
Examples of Fixed Gas Detection Solutions

- Single fixed point monitors installed in permanent (or semi-permanent) installations similar to other field devices - like pressure or temperature transmitters.
Open Path Detectors

• Designed to cover a wide area, but less effective in protecting specific areas.

• Gas concentrations can vary depending on the weather.
Ultra Sonic Detectors

• Detect high pressure gas leaks by sensing the ultrasonic "noise" generated by the leak.

• These detectors do not measure gas concentrations. They are determine the volume of the leak.

• These tend to be the most expensive devices.
Point Detectors

- These are placed where gas emissions are most likely to occur. Gas must come into contact with the device’s sensor to be detected.
Gas Detection Solutions
Market share

65%
Portable

35%
Fixed

Source: ARC Advisory Group, Inc.
Fixed Gas Detection Market share

3% Open Path

85% Point

12% Ultrasonic

Source: ARC Advisory Group, Inc.
Example of Wireless Fixed Point Solution

• Only fixed point detectors are available in a wireless configuration.
Why Wireless Gas Detection?

- Wireless plays a large role in gas detection by providing more freedom on where the detectors are located, or placed.
- Placement of gas detectors varies by the type of gas and by application.
Methane (CH₄)

- Methane gas is lighter than air and will rise and collect at the highest point.
- Example: The ceiling of a garage where CNG vehicles are operated and refueled.
- Mounting high in the ceiling of enclosed spaces is common.
Hydrogen sulfide is heavier than air and will tend to collect at the lowest point.

Wells and vaults are known to collect H2S.

So detecting gas from inside these areas is essential for maximum safety.
Lack of Power and Wiring

• Common to both of these areas is the lack of power and wiring.

• Field instruments need to transmit their signals to a monitoring control station, thus the need for wireless.
Over 50 WirelessHART products available (and growing)

<table>
<thead>
<tr>
<th>40 million HART devices installed</th>
<th>Wireless sensors for IoT are estimated to grow 27.7% annually</th>
<th>Over 50 WirelessHART products available (and growing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26,000 WiHART networks operate in over 140 countries</td>
<td>Wireless sensors are projected to reach 62 million connections by 2021</td>
<td>WirelessHART is 1 of 5 globally approved standards</td>
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</tbody>
</table>

Source: Fieldcomm.org & Berg Insight
Fixed Point Wireless Gas Detection Will Grow Dramatically

Source: ARC Advisory Group, Inc.
• *WirelessHART* and *ISA100* are the most common open industrial protocols – both are IEC standards

• Selected *WirelessHART* due to the most installations and supplier support.

Source: *Fieldcomm.org & Berg Insight*
Qualified Assertion from SME’s

• Network reliability has dramatically increased to better than 99%
Self-organizing Mesh Network

• Self-building
• Self-healing
• Redundant paths
• Simplifies commissioning
• More instruments build a stronger wireless network.
**Other Attributes**

• Interoperability with any WirelessHART device – P, T, Flow, Level, Gas detection functions, brands, etc.

• To add a device to the network, use a field communicator to provide the gateway network ID and the join key.

• The gateway will then detect the device, add it to the network.

• The gateway automatically optimizes the wireless network connections for obstructions, distance and signal strength.
• The map here shows a wide variety of devices from several different manufacturers coexisting on the same wireless network.

Source: Pepperl+Fuchs, Demonstration Lab
Wireless HART Mesh Networks Provide Broad Coverage

• In heavily obstructed areas, signal distance may be affected.

• 800 feet is the recommended maximum distance between field instruments with clear line of sight.

• Frequency hopping provides:
  • Primarily: optimization for traffic
  • Secondarily: security
What Has Changed in the Marketplace?

• For those that considered wireless in the past, the technology has changed to increase reliability while reducing complexity.

• Open protocols, such as WirelessHART, promote more instrument types and vendor participation.

• WirelessHART gas detectors can coexist to augment and compliment wired gas detectors.

• Not intended to replace.
What else?

• WiHART is a cost-effective way to increase coverage in areas of the plant that are difficult to reach.

• Additional sensors (Pressure, Temp, Flow, Level) are easily added to existing wireless networks.

• Wireless provides an instant monitoring solution, especially for brownfield facilities.
Game changer: Battery Life

• Some wireless gas detectors provide a guaranteed 5+ year battery life.

Courtesy of https://www.technobezz.com
How far have we come?

**From**
- Proprietary
- Costly wireless infrastructure
- 6 to 12 month battery life
- Limited diagnostics
- Long deployment
- Steep learning curve
- Difficult to maintain

**To**
- Open
- Existing wireless infrastructure
- 5-year battery life*
- Expanded diagnostics
- Short deployment
- Available expertise
- Easier

* 2017 has seen the release of WirelessHART fixed point gas detectors with 5-year battery life.
Gas Detection Hazards

3 main types:

**Toxic**
Units: Parts Per Million (PPM - PPB)
e.g., Hydrogen sulfide, Carbon monoxide, Chlorine

**Combustible**
Units: % Lower Explosive Limit (LEL)
e.g., Methane, Propane, Butane

**Asphyxiate**
Oxygen deficiency
Why Hydrogen Sulfide ($\text{H}_2\text{S}$)?

- $\text{H}_2\text{S}$ is extremely poisonous & explosive
- Fatal in high concentrations
- Causes 1/3 of all fatalities

- Biggest risk in upstream O&G and refining
- Soluble in liquids like oil
- Expands when reaching atmosphere

- Colorless, smells like rotten eggs, can’t smell in high concentrations (100 PPM)
Why Methane (CH\(_4\)) ?

• A methane cloud is very explosive (volatile).

• For ignition to occur:
  ❖ Fuel source
  ❖ Oxygen
  ❖ Ignition source

• Our research of toxic and combustible gas processing cited methane (CH\(_4\)) and hydrogen sulfide (H\(_2\)S) making up more than 80% of the gases present in O&G.
Pervasive Customer Problems

- Costly and labor intensive to install wired gas detectors
- Infrastructure can’t support additional devices
- Installing wired detectors can take months
- Proprietary wireless too costly to install & maintain
- Unavailability of line power
Pervasive Customer Problems

- Personal detectors are inadequate
- Local alarms are not visible in the control room
- Insufficient coverage leads to accidents
- Can’t detect emissions leaks from pipes and other infrastructure
- Insufficient resources for maintenance
Solution: Augmenting Wired Gas Detection with Wireless

- Monitor the previously “unreachable”
- Improve gas detection coverage
- Avoid the cost additional wiring
- Provide coverage where and when needed
Where and Why?

- Storage tanks, piping, rotating equipment
- Perimeter fences, wellhead, closed spaces
- Avoid the cost of design, pulling, and testing of additional wiring
- Saves not only cost but precious time to improve safety
- Provide coverage where and when needed
- Anywhere without the physical constraints
Monitor Assets (infrastructure)

- Predictive Maintenance (PM)
- Reduce inspection rounds
- Infrastructure: pipes, valves, tanks, seals, pumps, compressors
- Increase productivity
Monitor Methane – Remote Drill Sites

- Most remote sites have little to no wired infrastructure.
- Adding conduit for power and signal requires design, trenching, and testing.
Monitor Methane – Remote Drill Sites

- Distance from controller, limited wiring infrastructure, existing Wi-HART network.
WirelessHART Gas Detector in Remote Upstream O&G

Gas Detector
*WirelessHART Output*

ROC800 with Embedded Gateway
Cellular Output

Central Control
Located Anywhere
Monitor Methane & H2S Analyzer Housing

- Confined space protection in a analyzer shelter
- Available power & Wi-Hart but far from control room
Monitor Methane & H2S Analyzer Housing

- Plug-and-play anywhere in an existing WirelessHART mesh.
- Fixed point gas detectors to complement personal detectors
Detect H$_2$S – Coke Gas Refinery

- Running 24 x7, lacked coverage, H$_2$S corrosion, Wi-HART
Monitor Remote Onshore Locations

- No power and wiring infrastructure
- Monitor tank farms, fence line locations
- Saves thousands in conduit, wire and labor
Monitor Temporary Work Areas

- Easy to deploy when & where needed
- Work site perimeter and closed spaces
WirelessHART Gas Detector – Simple Monitoring

Gas Detector
WirelessHART Output

Wireless - HART Gateway
Ethernet Output

PC or DCS
Network Manager Software
Aliso Canyon Gas Blowout

- Massive natural gas leak
- Emerging state regulations in California
Emerging Regulations
Monitoring Gas Storage Locations

• The delay of the Federal EPA emissions rule motivated the California Air Resource Board (CARB) to approve a rule to cut methane emissions by 40%
Southern Company
Natural Gas Storage
WirelessHART Gas Detector – Remote Gas Storage

Gas Detector
WirelessHART Output

Emerson 1420 Gateway
Modbus Output

Laptop
Modpoll
Modbus Input to laptop
Increasing Coverage in the World’s Largest Refinery

- More than 1M bbl/D
- 128 km Fence
- Due to the Size: too costly and takes too long to deploy wired detectors
Complements Fire & Gas Systems

4-20 mA Input

WirelessHART Gas Detectors

Gas Detectors
Fire Detectors
Smoke Detectors
Flame & Heat Detectors
Manual Call/Shutdown

F&G Control System

HMI CCTV

Control System

HVAC Control
PA/GA System
Fire Suppression
Deluge Control
Sounders & Beacons
WirelessHART Gas Detector - Refinery

1. Gas Detector
   - Wireless HART Output

2. Emerson Gateway
   - Modbus Output

3. Fire & Gas Safety System
   - Ethernet or Modbus Output

4. DCS Alarm Output

5. Fire House
Best Practices for Wireless Gas Detection (continued)

- True wireless devices not wireless adapters
- Deploy GD with long battery life
- Ensure devices are easy to test and maintain
- Identify areas not protected
- Expand the role of gas detectors
- Test wireless gas detectors now as it can save your life
Best Practices for Wireless Gas Detection

- Check out fieldcommmgroup.org and isa100wci.org
- Deploy open wireless communication protocols
- Use a mesh network
- Look for wireless registered or certified GD
- Ensure suppliers routinely test devices with host solutions
- Follow the Technical Guidance from well known entities.
Thank you!

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