Gareth Johnston MIET

Wireless Instrumentation for process Industries

www.abb.com/fieldbus
Wireless World

Drivers

Wireless For Instrumentation

Standards and Technologies

Typical applications
  - Process Monitoring
  - Maintenance Checking
  - Safety and Environmental

WirelessHART Summary

The wireless time line – “What happens next?”
The World is Becoming Wireless
Wireless Technology Use is Growing

Wireless World

Wireless Industry

Wireless Instrumentation for process industries

Wireless World
Drivers
Wireless for Instrumentation Standards & Technologies Applications WirelessHART Timeline
Wireless Market Drivers

“The rapidly emerging market for wireless devices in manufacturing will grow dramatically....”  
– ARC ‘Wireless

- Business Drivers
  - Need to increase productivity
  - Declining capital investment

- Barriers removed
  - Available technology
  - Emerging standards

- Benefits
  - Reduced engineering, commissioning and maintenance costs
  - Improved productivity and compliance
What is Wireless Technology for Instrumentation?

- Short & Long Range Plant & Mobile Worker
- Long Range Information Transfer
- Long Range Process Information Transfer
- Short Range Process Instrumentation Mesh Reliability
- Communication Backbone
- Wireless World Drivers
- Wireless for Instrumentation
- Standards & Technologies
- Applications
- WirelessHART Timeline
Wireless Instrumentation for process industries

ABB Wireless Product and Pilot 2005/6

Wireless World Drivers
Wireless for Instrumentation
Standards & Technologies
Applications
WirelessHART
Timeline

Long range - Utility
Mesh – Pilot Process Plant
Medium range – Rail Switching

Short range - Factory Automation

Diverse Wireless Knowledge

Short range - Remote HMI Mobile Worker
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Wireless Instrumentation

- Wireless HART
- MultiVendor Demo ISA 2006
- ABB – Emerson – Siemens

Wireless Condition Monitoring

- ABB Vibration Monitor
- Self powered
- Simple set-up

Wireless Asset Management

- ABB Wireless Engineering
- Condition Monitoring
- Link to CMMS

AW2006 Technologies
Wireless Instruments

- Wireless access to intelligent device information (Pressure – Temperature – Positioner)
  - Process
  - Configuration
  - Maintenance

- The only multivendor demonstration

- Battery and externally powered instruments

- Wireless network to Asset Management tools, via AssetMaster
  - Via HART DD
  - Via HART DTM

- Wireless network components (Gateway – Antennae …)
  - Low cost infrastructure

- Co-existence with other wireless networks in the hall
  - Reliable
  - Secure
Demonstrations at AW2007

Topologies
- Wireless Plant wide and instrument level
- High Speed Ethernet backbone
  - FF – HSE
  - Profinet

Mobile Worker
- PC, Tablet and PDA Platforms
- GSM/GPRS – 802.15.4 - WiFi
  - Data manager – Data Gatherer
  - Long range information access
- Point to Point device support (fault drill down Zigbee)
- Wireless Device and Network Monitoring

Device Integration
- Enhanced Visualization Methods
  - Improved Graphical Interface (EDD and DTM), Consistent look & feel and method of operation
  - Enhanced DDs for Profibus, FF, HART
## End Users, Standards and Technologies

### End Users:

**Oil & Gas:**
- Future cost savings possible
- Multi-vendor offering
- ABB Pilot test BP and Statoil

**Chemical**
- Same concerns as Oil & Gas
- Fewer obvious cost savings
- Authentication, Security etc concerns

**Utilities**
- Long range wireless established
- Remote HMI and Maintenance monitoring

### Standards:

**Process**
- Two emerging standards WirelessHART™ and ISA SP100

**General**
- WiFi, Zigbee, WISA and Proprietary widely available

### Technologies:

**Process**
- Enabling component manufacturers at an early stage of development DUST, Xbow, Accutech,

**General**
- WiFi, WISA, GSM etc, proven technologies
Standards & Technologies

- No international standard for automation today.
  - Applications are proprietary

- Working groups include
  - WirelessHART™
  - ISO SP100

- Major automation providers support these groups
  - How do they support the effort?
  - Will we have one standard?

- Technologies need to adopt the standard
  - DUST – Crossbow and others to provide the silicon
  - Need competition in this area

- Pilots are proving the radio and throughput

End Users

- High level of input into the standard groups

- Running pilots

- Holding back on projects – waiting for interoperability

Pilot projects are currently underway
Wireless HART – ISA SP100

- Standard Radio 802.15.4
- MESH – Star – Linear Topologies
- All routing device
- HART Command Response protocol
- Existing tools can be used for commissioning Instruments
- Ballot voting passed
- Pilot devices shown 2006
- Specification target August 07

- Standard Radio 802.15.4
- MESH – Star – Linear Topologies
- Routing and non-routing devices
- Provides structure to overlay
- HART – Profibus – Foundation
- Requires specific tools for commissioning Instruments
- Specification ready for ballot Q3 07 (Will miss this target)
- Specification target Q1 08

Supported by the major automation vendors
"We get a lot of head-nodding... when we ask end users if they want to use wireless for closed-loop control. However, when you peel the layers of the onion away, what we find out is that they’re not looking for closed-loop control. There’s no one I’m aware of, an end user, who’s interested in wireless, at this point in their lives, for closed-loop control."

Harris Kagan, WINA President
What’s Needed For Wireless Success

- **Secure**: No Option – It Must be Secure
  - Encryption and Authentication
  - Make it flexible → Enhance the level of security

- **Reliable**: Changing Radio Environment
  - Self healing networks - MESH
  - Redundant Gateways

- **Simple**: As Easy to Use as 4-20mA HART
  - Simple tools to commission and planning

- **Retrofit**: Fits Existing installed instruments
  - Simple to add
  - No impact on existing control loops

- **Open Std**: Multi – Vendor Support
  - Choose most appropriate instrument

- **Co-Exist**: Maximize Co-existence
  - Good Worker and Neighbour

- **Cost**: CapEx Cost Justification
  - Equal or lower cost of installation than 4-20mA
What are Target Applications

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End User Input

**Wireless - Same information as 4-20mA**
- But with greater flexibility
- And reduced costs
- Reliable

**Common Applications Likely to be:**
- Process Monitoring
- Asset Management
- Health & Safety – Environmental Monitoring

Applications

- **H&S Environmental**
  - Area Gas Detectors
  - Water Effluent
  - Gas Emissions
  - Relief Valves
  - Steam Traps
  - Safety Shower

- **Process Measurement**
  - Multivariable Instruments
  - Short term measurements
  - Tank Level gauging
  - Plant Infrastructure
  - Supervisory control

- **Asset Management**
  - Device Support
  - Maintenance
  - Diagnostics
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What are Target Examples

**Asset Management**
- Maintenance Monitoring
  - Add a wireless adaptor
  - Detect maintenance Conditions
  - Route messages (CMMS – Pager)

**Short Term Measurements**
- Increase process visibility
  - Low cost wireless solution
  - Additional devices improves mesh robustness

**Process Monitoring**
- Tank Gauging
  - Expensive & difficult to run new cable
  - Hazardous Instrument locations
- Multivariable Instruments
  - Difficult to modify marshalling cabinet
  - Wireless solution could be low cost

Wireless World Drivers
Wireless for Instrumentation Standards & Technologies
Applications
WirelessHART Timeline
WirelessHART™ summary

HART is a simple Command Response protocol
- Wireless HART adds a new physical layer with additional commands

Wireless HART has been designed to satisfy the major user requirements
- Reliability
- Security
- Ease of use

<table>
<thead>
<tr>
<th>OSI Layer</th>
<th>Function</th>
<th>HART</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Provides the User with Network Capable Applications</td>
<td>Command Oriented, Defined Data Types and Application Protocol</td>
</tr>
<tr>
<td>Presentation</td>
<td>Converts Application Data Between Network and Local Machine Parallels</td>
<td>Auto-segmented transfer of large data sets, reliable stream transport, negotiated segment sizes</td>
</tr>
<tr>
<td>Session</td>
<td>Connection Management Services for Applications</td>
<td>Power-Optimized Redundant Path, Mesh to the edge network</td>
</tr>
<tr>
<td>Transport</td>
<td>Provides Network Independent, Transparent Message Transfer</td>
<td>Secure &amp; Reliable, Time-synchronized TDM/CSMA, Frequency Agile with ARQ</td>
</tr>
<tr>
<td>Network</td>
<td>End to End Routing of Packets, Resolving Network Addresses</td>
<td>2.4GHz Wireless, 802.15.4 based radios, 10K to 100K baud</td>
</tr>
<tr>
<td>Data Link</td>
<td>Establishes Data Packet Structure, Framing, Error Detection, Bus Arbitration</td>
<td>1 Binary, Byte Oriented, Token Passing, Master/Slave Protocol</td>
</tr>
<tr>
<td>Physical</td>
<td>Mechanical / Electrical Connection, Transmits Raw Bit Streams</td>
<td>Simultaneous Analog &amp; Digital Signaling, Normal 4-20mA, Copper Wiring</td>
</tr>
</tbody>
</table>
Wireless Instrumentation for process industries

Control system equipment
- (Controller – I/O – Workstations)
- Control Networks (Ethernet – WiFi)
- Asset Management Applications

Gateway
- Location
  - Filed Mounted
  - Control room

Field devices
- Pressure
- Temperature
- Flow
- Analytical
- Level
- Positioner/Actuator
- Router
- 4-20mA Adaptor
- Hand held Configurator

Host level.

Network Manager
- Forms the mesh network
- Allows new devices to connect to join
- Sets the communication schedule
- Establishes the data paths
- Monitors the network.

Security Manager
- Distribution of encryption keys

Function
- Relay the wireless data to the Host system
- The connection to the Host could be copper (Ethernet RS485), Fiber, WiFi, ... This does not need to be defined by WirelessHART

Wireless HART
- Function
  - Robust mesh network
  - Multiple paths
  - Self building
  - Reliable
  - Coexists with other wireless networks (WiFi, Bluetooth ...)
  - Channel Hopping (find a free frequency band)
  - Time division – don’t transmit on one frequency for a long time
  - Self powered and externally powered devices

An open MultiVendor Wireless environment

Standard IEEE802.15.4 2.4GHz radio
Making Wireless Easy with wirelessHART + Enhanced DDL

Devices must support "Maintenance Port"
- Compatible with Existing HART Tools
- Supports access to all Device properties
- Used to, for example, enter Network ID and Password.

Troubleshooting a device that fails to join the Network can be one of the most frustrating wireless experiences.

Example DD Showing Dialog that Monitors Device as it joins a Network
How quickly is data updated?

- Instruments on the same network can update at different rates from Seconds to several minutes.
- Fast updates will exhaust batteries quicker.
- The refresh rate required by many process and maintenance monitoring applications does not need to be fast.
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The Wireless Clock is Ticking From Midday – Today

Where Industry is Today
- Single Vendor Solution
  - No Standard
- WirelessHART™ Ballot Passed

Where ABB is Aiming
- Battery Operated Wireless HART Instruments
- ISA SP100 Standard
- Wireless Fieldbus (FF, Profibus) Instruments
- ABB Wireless Control loops
Conclusion

- **Wireless connectivity is not new**
  - Proprietary – Multi Vendor
  - Process Automation has special requirements

- **First applications for Monitoring**
  - Control much later

- **User concerns for Reliability and Security**
  - MESH – Encryption

- **Open Standards**
  - ISA SP100
  - WirelessHART