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Wireless Instrumentation for process Industries

www.abb.com/fieldbus

Contents

- Wireless World
- Drivers
- Wireless For Instrumentation
- Standards and Technologies
- Typical applications
  - Process Monitoring
  - Maintenance Checking
  - Safety and Environmental
- WirlessHART Summary
- The wireless time line – “What happens next?”

The World is Becoming Wireless

Wireless Technology Use is Growing

Wireless World

Wireless Industry

Wireless Market Drivers

- **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?

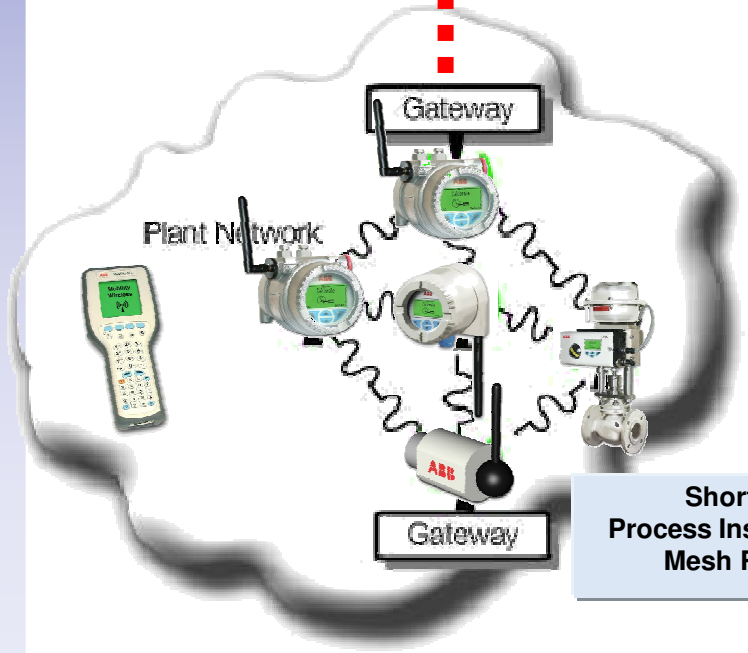
Short & Long Range Plant & Mobile Worker

Long Range Information Transfer

Gateway

Gateway

Communication Backbone



Short Range Process Instrumentation Mesh Reliability

Long Range Process Information Transfer

ABB Wireless Product and Pilot 2005/6

Long range - Utility

Mesh – Pilot Process Plant

Medium range – Rail Switching

Short range - Factory Automation

Diverse Wireless Knowledge

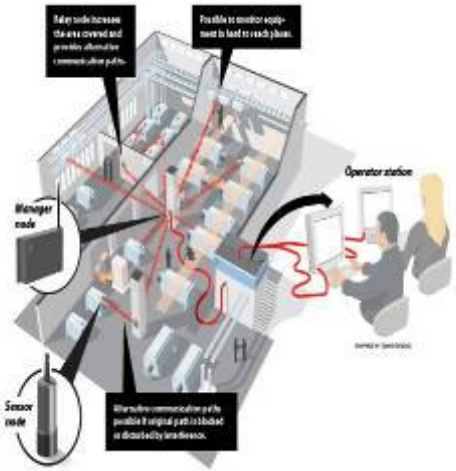
Short range - Remote HMI Mobile Worker

ABB Wireless 2007

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 Multivendor Demo HCF

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

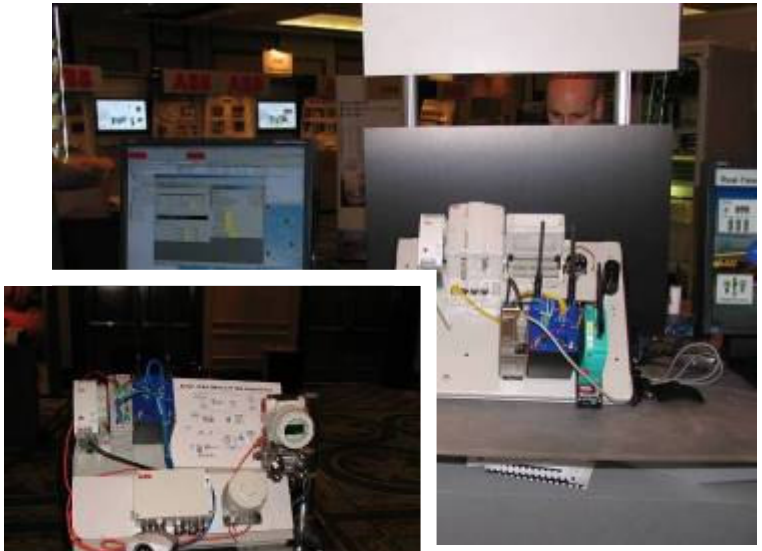
- **Wireless Plant wide and instrument level**
- **High Speed Ethernet backbone**
  - **FF – HSE**
  - **Profinet**

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**



FF – HSE WiFi Prototype

Zigbee Point - Point HMI

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,

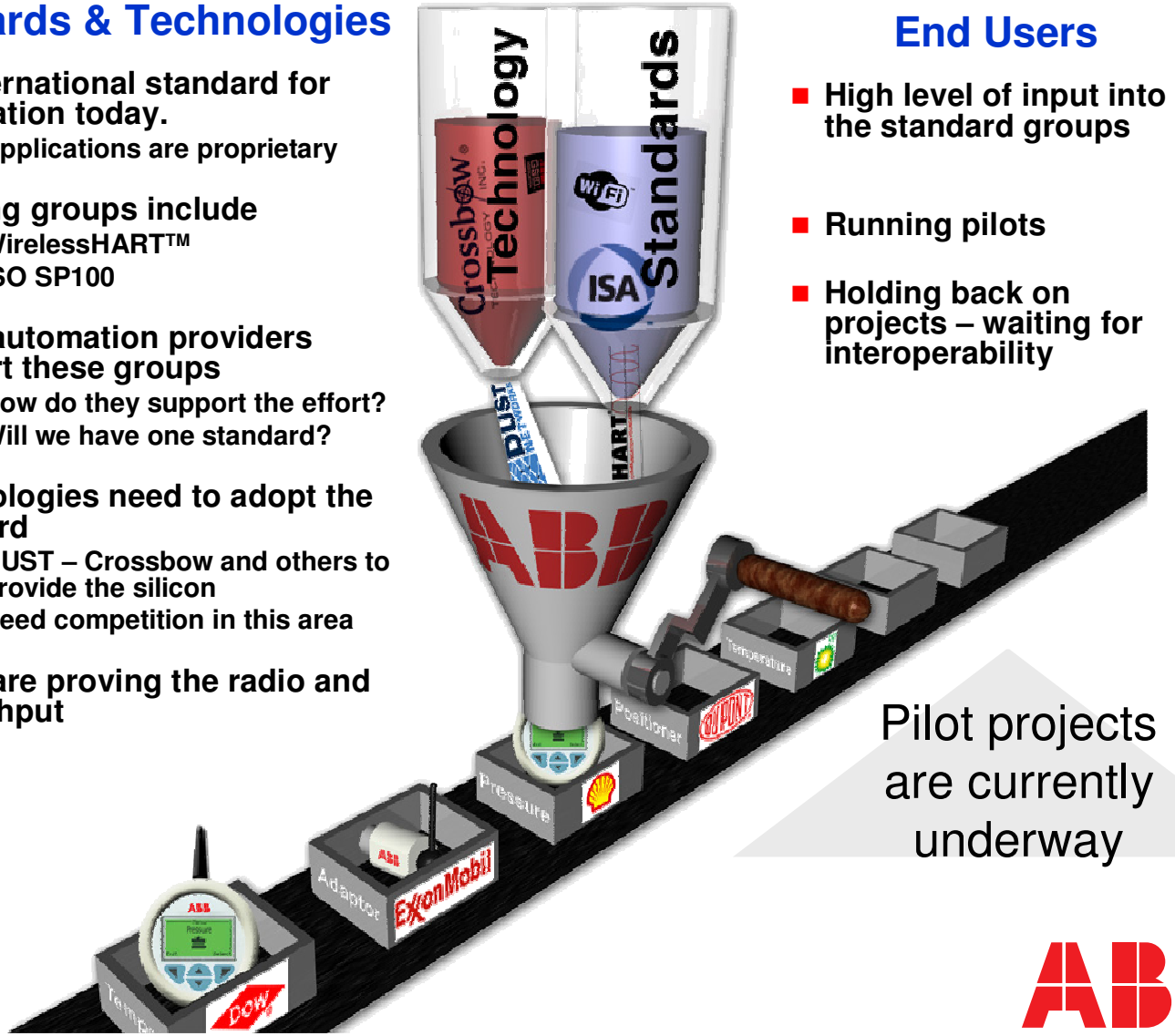
General

- WiFi, WISA, GSM etc, proven technologies

End Users, Standards and 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

WirelessHART™	ISA SP100.11a
■Standard Radio 802.15.4	■Standard Radio 802.15.4
■MESH – Star – Linear Topologies All routing device	■MESH – Star – Linear Topologies Routing and non-routing devices
■HART Command Response protocol	■Provides structure to overlay HART – Profibus – Foundation
■Existing tools can be used for commissioning Instruments	■Requires specific tools for commissioning Instruments
■Ballot voting passed Pilot devices shown 2006	■Specification ready for ballot Q3 07 (Will miss this target)
■Specification target August 07	■Specification target Q1 08

Supported by the major automation vendors

Industrial Automation Use Cases

ISA SP100 Use Case Definitions

Most Widely Accepted Use Cases

Logging
- Data/messages with no immediate operational consequence

Alerting
- Short term operational consequence

Open Loop Control
- Human interaction

Closed Loop Supervisory Control
- Usually non-critical

Closed Loop Regulatory Control
- Often critical

Safety
- Emergency actions – always critical

"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

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

What are Target Examples

Asset Management

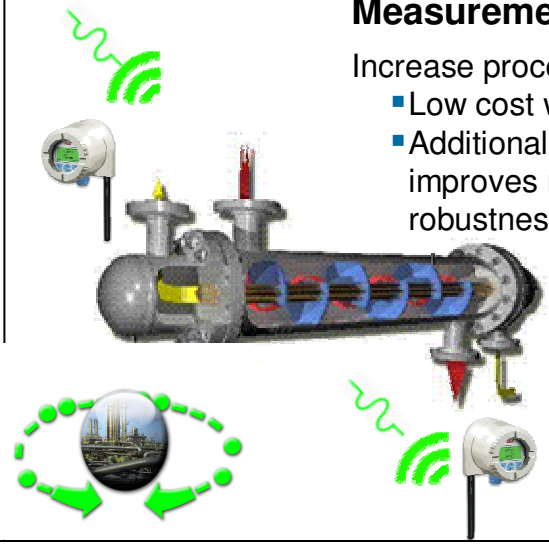
Maintenance Monitoring

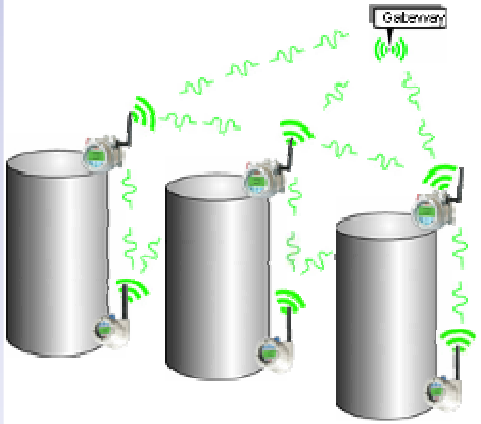
- Add a wireless adaptor
- Detect maintenance Conditions
- Route messages (CMMS – Pager)

Short Term Measurements

Increase process visibility

- Low cost wireless solution
- Additional devices improves mesh robustness





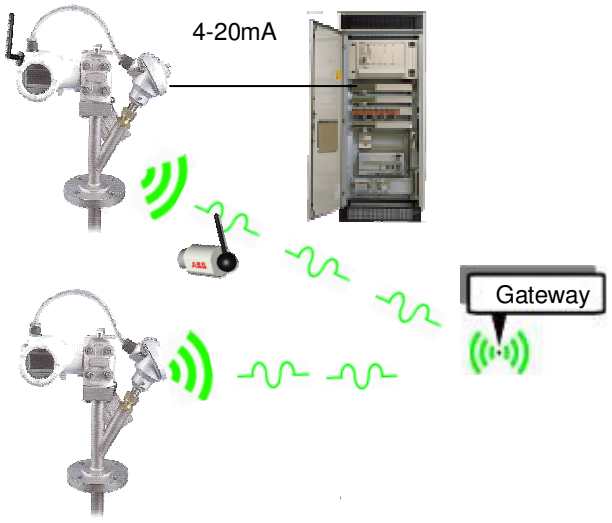
Process Monitoring

Tank Gauging

- Expensive & difficult to run new cable
- Hazardous Instrument locations

Multivariable Instruments

- Difficult to modify marshalling cabinet
- Wireless solution could be low cost



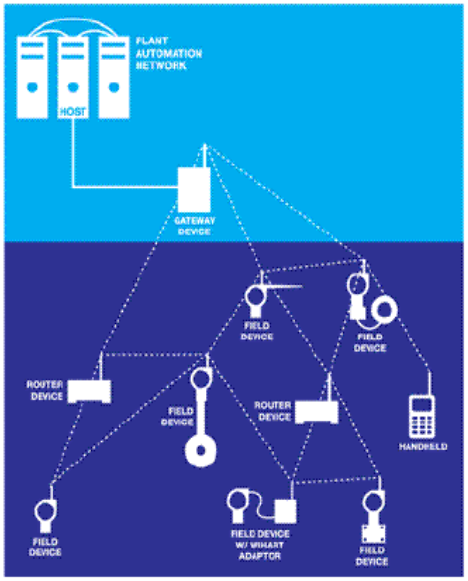
WirelessHART™ summary

HART is a simple Command Response protocol

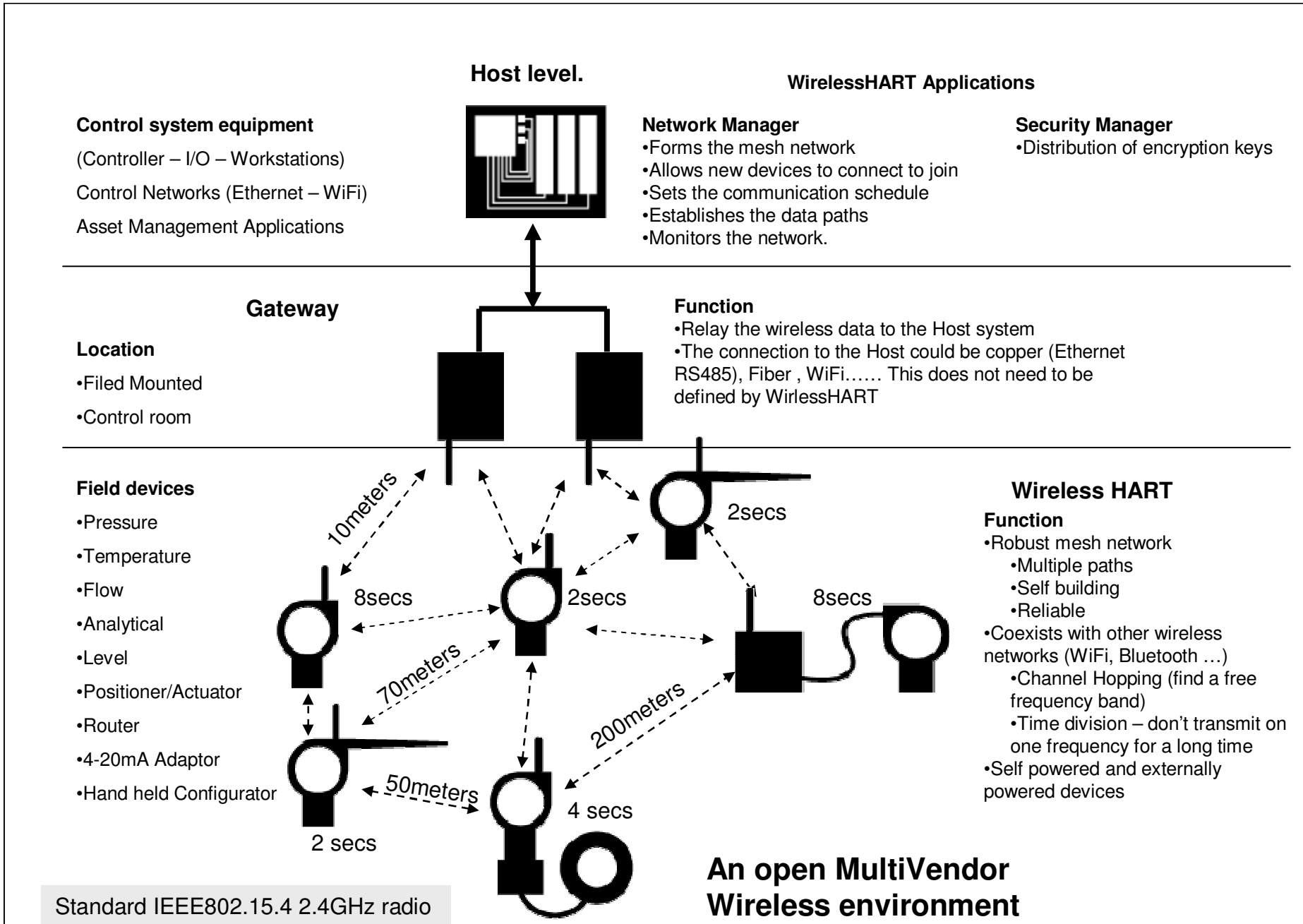
- **Wireless HART adds a new physical layer with additional commands**

Wireless HART has been designed to satisfy the major user requirements

- **Reliability**
- **Security**
- **Ease of use**



OSI Layer	Function	HART	
Application	Provides the User with Network Capable Applications	Command Oriented. Predefined Data Types and Application Procedures	
Presentation	Converts Application Data Between Network and Local Machine Formats		
Session	Connection Management Services for Applications		
Transport	Provides Network Independent, Transparent Message Transfer	Auto-Segmented transfer of large data sets, reliable stream transport, Negotiated Segment sizes	
Network	End to End Routing of Packets. Resolving Network Addresses		Power-Optimized Redundant Path, Mesh to the edge Network,
Data Link	Establishes Data Packet Structure, Framing, Error Detection, Bus Arbitration	A Binary, Byte Oriented, Token Passing, Master/ Slave Protocol.	Secure & Reliable ,Tme synched TDMA/CSMA, Frequency Agile with ARQ
Physical	Mechanical / Electrical Connection. Transmits Raw Bit Stream	Simultaneous Analog & Digital Signaling. Normal 4-20mA Copper Wiring	2.4GHz Wireless, 802.15.4 based radios, 10dBm Tx Power
		Wired FSK/PSK & RS485	Wireless 2.4GHz

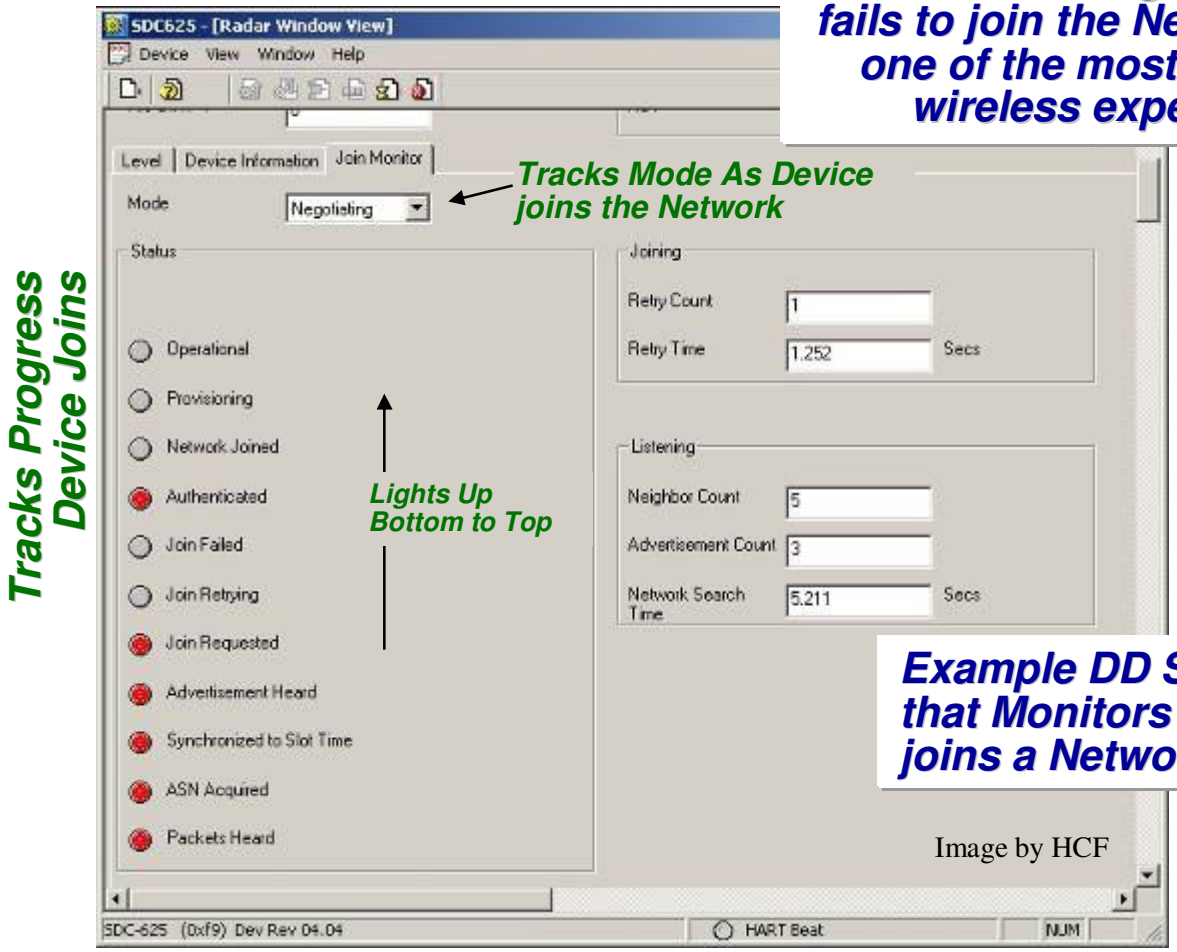

Host level.
WirelessHART Applications
Control system equipment
(Controller – I/O – Workstations)
Control Networks (Ethernet – WiFi)
Asset Management Applications
Network Manager
•Forms the mesh network
•Allows new devices to connect to join
•Sets the communication schedule
•Establishes the data paths
•Monitors the network.
Security Manager
•Distribution of encryption keys
Gateway
Location
•Filed Mounted
•Control room
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 WirlessHART
Field devices
•Pressure
•Temperature
•Flow
•Analytical
•Level
•Positioner/Actuator
•Router
•4-20mA Adaptor
•Hand held Configurator
10meters
2secs
8secs
2secs
8secs
70meters
200meters
50meters
2 secs
4 secs
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
Standard IEEE802.15.4 2.4GHz radio
An open MultiVendor Wireless environment

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.



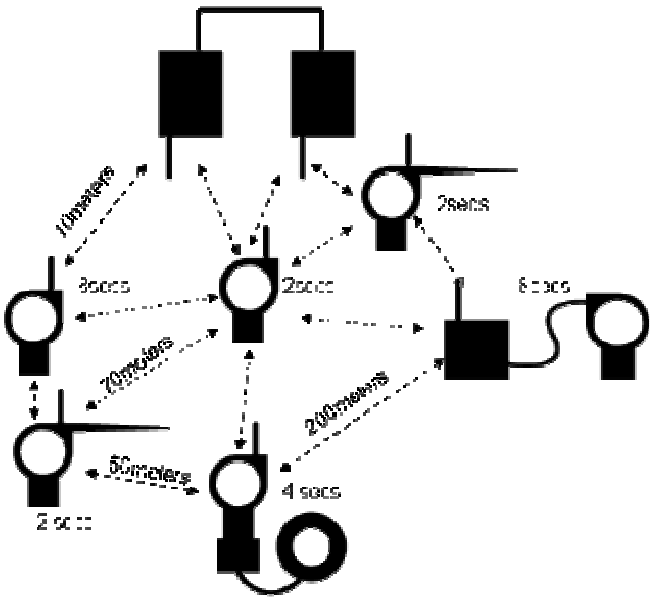
Example DD Showing Dialog that Monitors Device as it joins a Network

Image by HCF

Performance

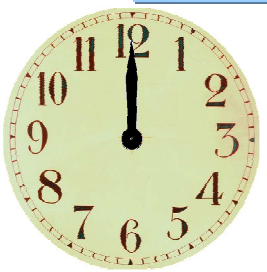
How quickly is data updated?

- 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.



The Wireless Clock is Ticking From Midday – Today

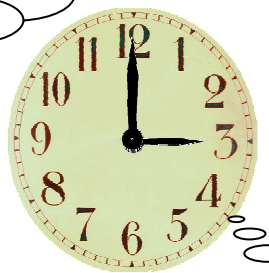
Where Industry is Today



- Single Vendor Solution
  No Standard
- WirelessHART™ Ballot Passed

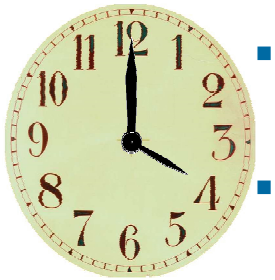
- WirelessHART™ Standard (Pilot Instruments available)

Silicon availability
Test specifications



- Wireless HART retrofit adaptor
- Vibration Condition Monitor

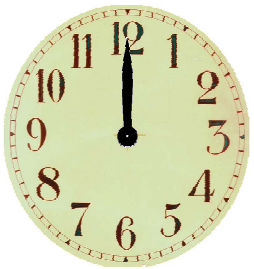
Certification



- Battery Operated Wireless HART Instruments
- ISA SP100 Standard

- Wireless Fieldbu (FF, Profibus) Instruments

Where ABB is Aiming



- 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


ABB