Applying Wireless Technologies to Industry Automation

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Yokogawa IA Global Marketing (USMK)
Outline

- Introduction
- Business drivers for wireless
- Wireless application in Industry Automation (IA) today
- Key challenges for applying wireless for IA (focus on Industrial Control Systems)
- Recent direction of wireless standard - International Society of Automation (ISA)
  - Wireless Sensor Network
  - Wireless Backhaul Backbone Network
  - Security Standard (ISA99)
- Vision of wireless application in IA
Yokogawa – “GE” of Japan

Corporate Management (ERP*)
Integrated business operation systems

Production Management (MES*)
Systems for advanced control, simulation, production management, and scheduling

Integration
SAP, Oracle etc.

APC & AOA
Advanced Process Control & Advance Operation Assistance

PIMS
Process Data Acquisition & Management

Exa Series, Trainer
Exaquantum

Production Control System
Production control systems

Field Instruments
Field instruments, sensors, measuring instruments, analyzers and other equipment

Fieldbus Networks
FF, Profibus-DP, DeviceNet, Ethernet/IP

DCS/SIS
Integrated Production Control-Safety Instrumented System

Hybrid RTU/SCADA System

Instrumentation

Gas Chromatography
GC NIR

Analytical Instruments
O2, pH, ISC

* ERP = Enterprise Resource Planning
* MES = Manufacturing Execution System
As a result of Yokogawa’s high R&D investment and the consistent long term migration policy of the CENTUM DCS family our investment are secure.

Christian Vermum
Manager of Electrical Engineering Department
Degussa Oxpeno, Germany

- Unique Pair & Spare reliability technology
- Seven 9’s (99.99999959) availability
- 20,000 systems installed worldwide
Why Wireless for Industry Automation?

Because I always know where my signals are going!
Installations

Simple starting point, Open space
Installations

Middle of no where, Unmanned
Installations

Small world that miles away from coast
Case Study

Mountain provides challenge as well as opportunity
Case Study

Many high points available above the congestion
Case Study

Large tank farm covers hundreds of miles
Case Study

Longest shot, wharf to mountain-top tower
Business Drivers for Wireless

- Staying competitive in digitalization is essential
- Industrial wireless drives down the cost of digitalization (e.g. design cost, material cost, installation cost, maintenance cost, etc.)
- Industrial wireless opens new opportunities, new demands, new angle to do business
- Lots of successful wireless application stories, lots of tangible benefits
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Wireless Opens New Opportunities – Wireless Measurements

- **Enhanced Plant Asset Management (PAM)**
  - Cost effectively increase process and asset monitoring
    - Freeing up cable resource for higher priority measurements
    - Allows measurements that could not be justified before

- **Reduction of “blind spots”** – higher visibility into operations
  - Allows measurements on rotating and/or moving equipment
    - Wiring difficult - no power available
  - Allows measurements in remote locations
    - “Unlock” remote processing units in general – well heads, tank farms, loading bridges e.g.
  - Temporary measurements for process diagnostics and optimization
Wireless Opens New Opportunities –

Wireless Camera & Mobility

- Field inspection data gathering and sharing using mobile devices anywhere anytime
  - Bring global virtual field environment to control center
    - Video stream bring field virtually -- Pipeline Facilities
  - Local indicator measurement data collection
    - Historic process data trend (last 8 values)
- Visual inspection & repair management of any equipment in the field
  - Valves, pumps, leakages, dangerous situations in general
- Time stamping & reporting
Wireless Opens New Opportunities – Wireless Location Aware & Asset Management

- **RTLS/RFID**
  - Location Aware Safety System (LASS™)
    - Provider Safety alarm for field personnel
  - Mobile warehouse & mobile maintenance
  - Fuel trucks tracking
  - RFID tag based remote workforce management
    - RFID concept is guiding mobile worker – Task Tracker
Industrial Requirements

Characteristics

- Mission Critical
  - Continuous Operation
  - Large Energy
  - Extraordinary Incident

- Harsh Environment
  - Ambient Condition
  - Explosive Gas
  - Strong EM Noise

- System Attribute
  - Wide Area
  - Large Scale
  - Complex
  - Long Plant Life Time

Requirements

- Reliability
- Robustness
- Quick Response
- Regulatory Compliance

- Scalability
- Flexibility
- Maintainability

+ Wireless Property
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Different wireless technology has its characteristics that can be best suited for particular applications.
Blanket the Facility with RF Energy
Current Challenges for Wireless Application

- Implemented as silos
  - Inconsistent common security - Authentication, Authorization, Encryption
  - Inconsistence network service
  - Spotty support
  - Lacks end-to-end data support

- No uniformed implementation
  - Unable to leverage scale, difficult to replicate success
  - Higher support cost
  - Unreliable

- Entry cost is high – first application pays the toll for backbone

- Approached as infrastructure solution rather than overall integrated system solution
Technical Issues

Reliability
- Security, Robustness, Fault tolerance, Co-Existence, ...

Scalability
- Small & Large, Radio range, Throughput, ...

Openness
- Interoperability, Global Standardization, ...

Easy Deployment
- Installation, Management, Maintenance, Power, Lifetime...

Multi-function
- Multi-protocol, Use case coverage, Latency, ...

Individual Tech. is ready, but Balance is needed
Security Issues in ICS

- **Characteristics**
  - Poor Authentication and Authorization
  - Many fields devices lack crypto support
  - Many unmanned field sites can be easy backdoor to the control center

- **Availability, Integrity and Confidentiality**
  - Enterprise networks require C-I-A
    - Confidentiality of intellectual property matters most
  - ICS requires A-I-C
    - Availability and integrity of control matters most
    - Control data has low confidentiality
    - Many ICS vendors provide Five to Seven 9’s of availability
QoS & Priority of Service (PoS)

QoS are determined by a traffic class’s tolerance to:
- Delay -- How much delay in packet delivery can be tolerated?
- Loss -- To what degree can packet loss be tolerated?
- Jitter -- How much variability in packet delay be tolerated?

PoS

<table>
<thead>
<tr>
<th>Application</th>
<th>L3 Classification</th>
<th>DSCP</th>
<th>IETF RFC</th>
</tr>
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<tbody>
<tr>
<td>Network Control</td>
<td>CS6</td>
<td>48</td>
<td>RFC 2474</td>
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<td>VoIP Telephony</td>
<td>EF</td>
<td>46</td>
<td>RFC 3246</td>
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<td>CS5</td>
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<td>34</td>
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<td>Real-Time Interactive</td>
<td>CS4</td>
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<td>RFC 2474</td>
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<tr>
<td>Multimedia Streaming</td>
<td>AF31</td>
<td>26</td>
<td>RFC 2597</td>
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<tr>
<td>Broadcast Video</td>
<td>CS3</td>
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<td>Low-Latency Data</td>
<td>AF21</td>
<td>18</td>
<td>RFC 2597</td>
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<td>CS2</td>
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<td>High-Throughput Data</td>
<td>AF11</td>
<td>10</td>
<td>RFC 2597</td>
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<tr>
<td>Best Effort</td>
<td>DF</td>
<td>0</td>
<td>RFC 2474</td>
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<tr>
<td>Low-Priority Data</td>
<td>CS1</td>
<td>8</td>
<td>RFC 3662</td>
</tr>
</tbody>
</table>

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Emerging Wireless Requirements

A variety of wireless technologies have been or is going to be deployed for different types of applications in mixed environments:
- **RFID, UWB** – asset tracking and location awareness
- **ISA100.11a, Wireless HART** – field sensor wireless
- **802.11a/b/g/n** – multimedia applications for data, video, VoIP
- **WiMAX, Cellular, Satellite** – middle and long range data carrier

The key successful elements for wireless solutions are:
- Interoperability
- End-to-End Security
- End-to-End QoS
Success Criteria for Wireless

- **Common Backbone** infrastructure supporting all wireless applications
- **Appropriate Prioritization** and **QoS** for application classes
- Works with **Many Transports Medias**
- **Common Support Services** such as Authentication, Authorization, Administration
- **Common Management** backhaul with one HMI
- **Provide Robust, Secure** communications for all wireless applications
- **Low Initial Entry Cost**
- **Cost Effectively** support of less dense applications (Tank Farms, Perimeter Security, Gate Systems)
- **Future Approve**
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Why Standard?

Because somebody will always invent an adapter
ISA100 Overview

A Complimentary Family of Standards that Accommodate your Plant-wide Needs
Two major field sensor wireless solutions

WirelessHART

ISA100.11a
ISA100.15 Wireless Backhaul Network WG

- **Mission:**
  The ISA100 Wireless Backhaul Backbone Network Working Group will develop and maintain a standard to address one or more dedicated or shared wireless backhaul backbone to support one or more technologies, running multiple applications.

- **Focused on:**
  - Interoperability
  - End-to-End Security
  - End-to-End QoS

- Cooperation with FF

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ISA99 Security Standard


ISCI  →  Certification  →  ISA99  →  ISA100

IEC/ISO  →  DHS  →  NI ST
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Wireless Digital Umbrella Vision

Integrated Solution to Provide Common Service for All Wireless Applications
High Security Network Architecture

Level 3.5 DMZ

Level 4 Wireless DMZ

Level 3 Advanced Control

Level 2 Supervisory Control

Level 1 Process Control

DMZ = Demilitarized Zone

Non-FTE redundancy

Optional Router - depending on PGN complexity (may connect directly to FW)

COMM flow

L4 to L4

Limited L3.5 to L3.5

Very Limited L3.5 to L4

Very Limited L3 to L3

Very Limited L2 to L3.5

Limited L3 to L2

Limited L2 to L2

Limited L2 to L1

No Direct communications between L1 & L3

No Direct communications between L2 & L3

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Lots of Issues ==
Lots of Opportunities

Thank you!

For more information, please contact:
Penny.Chen@us.yokogawa.com