Safety and alarming applications using ISA100 Wireless

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Presenter

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The History of Radio

• Marconi had an early interest in science, and was especially interested in the work of Hertz

• He quickly realized the potential of wireless transmission and filed a British patent
  – Awarded on 2nd July 1897, GB12039

• At 12:00pm on the 12th December 1901 Marconi sent and received the first Transatlantic radio transmission
The History of Radio

• On Sunday evening 14\textsuperscript{th} April 1912 the largest passenger ship in the world, Titanic struck an iceberg

• The radio operators onboard were employed by Marconi International Marine

• They sent a distress signal \textit{alerting} the world and the Carpathia  
  \textit{“CQD CQD SOS Titanic Position 41.44 N 50.24 W………”}

• Radio had proven it worth…

\textbf{Wireless safety application has been started over 100 years ago.}
Today’s topics

1) Review WCI end use seminar Mar 1st survey
2) Motivation of wireless for plant safety
3) Benefits of wireless
4) Key requirements
5) ISA100 Wireless solutions
6) Applications
7) Summary
Review WCI end use seminar Mar 1\textsuperscript{st} survey -1
Review WCI end use seminar Mar 1\textsuperscript{st} survey -2

Circle the top 3 barriers to you adopting Industrial wireless technology
Wireless application map

End users are expecting industrial wireless to adapt to more wide coverage of applications including safety.

- Process monitoring & control
- Health, Environmental, Safety and Maintenance

- Fast update / Reliable
  - Closed loop
  - Open loop

- Low speed
  - Temperature
  - Pressure
  - pH

- Small scale
- Large scale

- Emergency action
- Gas detection

- Vibration
- Environmental monitoring

- Steam trap
- Corrosion
Motivation of adopting wireless for safety

• **Preventive measures**
  – Process condition / status monitoring: Temperatures / Pressures / Flows / Levels / etc.
  – Asset condition monitoring: Vibration / Corrosion / Temperature / etc.

• **Accident avoidance / Limit the extent of damages**
  – Alarm / Warning: **Gas leak detection** / Safety shower detection / **Tsunami detection**
  – Emergency shutdown: **Remote valve control** for safety mode

• **Human safety**
  – People tracking on site / Communication to navigate for evacuation / etc.

- Gas explosion \(\rightarrow\) Plant wide monitoring
- Tsunami disaster \(\rightarrow\) Predictive monitoring
- Fire of floating-roof tank \(\rightarrow\) Emergency shutdown
Unique benefits of wireless

Even more remarkable points are

- Robust to physical damages
- Easy expansion for additional measurement points
Key requirements for safety

• Robust communication
  – Committed reliability and availability
    - Reliable radio / Fault tolerant system
• Emergency actions
  – Committed deterministic performance
    - Timeliness / Rapid response time
• Plant wide coverage
  – Committed large scale configuration
    - Long range communication / Flexible configuration

Dependable wireless system is required
How to realize dependable wireless system?

Operation and Maintenance

Field devices

Infrastructure

Engineering

Large scale wireless network

Tanks, Heat exchangers

Motors, pumps

Pipes

Pipes, reactors

Process: Temp, Press, Level

Vibrations

Corrosions

Gas leakages

DCS

PRM

Gateway
## ISA100 Wireless is ready for safety applications

<table>
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<tr>
<th>Field devices</th>
<th>Wireless Infrastructure</th>
<th>Engineering</th>
<th>Operation &amp; Maintenance</th>
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<tr>
<td>- Channel hopping</td>
<td>- Redundant Gateway and Access point</td>
<td>- Fixed mesh network engineering for deterministic communication</td>
<td>- Monitoring PER/RSSI and com routes</td>
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<tr>
<td>- DuoCast com</td>
<td>- Ch Black listing for coexistence with Wi-Fi</td>
<td>- Fixed mesh network engineering for deterministic communication</td>
<td>- Predictable Battery life</td>
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<td>- Mesh network</td>
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<td>- GW high side I/F to support Safety protocol</td>
<td>- Satisfy IEC60079-29-1 performance requirement</td>
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<td>- Retry</td>
<td>- CCA compliant to EN 300 328 v.1.8.1.</td>
<td>- Sky Mesh NW to minimize latency</td>
<td>- Easy expansion of sub networks by adding access points</td>
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<tr>
<td>- AES 128 encryption</td>
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<td>- Backbone highway Ethernet, Wi-Fi, Opt-F</td>
<td>- Long range com 600m (line of sight), 5km with 15dBi Ant</td>
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<td>- Sky Mesh NW to minimize latency</td>
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</table>
ISA100 Wireless (ISA100.11a / IEC 62734) was developed by end users voice

**Plant wide solution:**
- Industry
- Oil & Gas, Petrochemicals,
- Powers, Metals, etc.
- Applications
- Process monitoring
- Process control
- Asset management
- Safety alarm management
- Energy monitoring
- Environmental
- etc.

**Breakthrough Technologies:**
- Two layered Security, OTA
- Mesh / Star / Duocast
- Battery Alert
- Interpretability
- Multiple subnets (co-existing)
- Bandwidth management
- Backbone network (Small-Large)
- Country code
- QoS (contracts)
- Multi-protocols by Tunneling
- Publish / Subscribe

**Provide Solutions**

**Standardization**

**Implementation**
- Assure multivendor interoperability
  - ISA100 compliance test
  - Developing Implementation specifications

**End-user architectural requirements**

1. Security
2. Reliable communication
3. Good power management
4. Open
5. Multi-speed monitoring
6. Multi-functional
7. Scalable
8. Global usability
9. Quality of service
10. Multi-protocol
11. Control ready
ISA100 Wireless key implementations

Reliability

Fault Tolerance

Redundant Gateway and Duocast

ISA100 Wireless Architecture

Production Control System

Redundant Gateway

Duplicate

Standby

Field Wireless Management Station

Filed Wireless Backbone

Radio Path

Field Wireless Access Point

Wireless Field Device

Fault Tolerance

Redundant Gateway and Duocast

Fault Tolerance

Redundant Gateway and Duocast
Timeliness

- **TDMA**: Time Division Multiple Access / QoS Management
- **Publish / Subscribe**: Periodic data transmission
- The “Sky Mesh”: Network planning concept

1) **Deterministic communication with short latency** (minimizing hops)
2) Reliable communication with **redundant paths**, Predictable battery life
Scalability

Plant wide large scale wireless infrastructure

ISA100 Full Functional

Field Wireless Access Point

Redundant Gateway 1 sec Switchover

20 Access Points

500 devices@5sec update
200 devices@1sec update
World first SIL2 Gas detection system

- Wireless protocol: ISA100 Wireless
- Safety protocol: PROFIsafe over PROFINET
Key implementations for dependable wireless infrastructure

1. Reliability
   - Robust radio
   - Ch hopping
   - DuoCast
   - Redundant Gateway

2. Timeliness
   - TDMA
   - Sky Mesh design
   - Publish/Subscribe
   - Non-routing function

3. Scalability
   - IP Backbone
   - Mesh/Multi-hop
   - Long distance communication

4. Security
   - Device & Message authentication
   - AES-128 encryption
   - Time stamp

5. Easy Engineering
   - Predictive battery life
   - Manageable network configuration
   - Multi-vendor interoperability

6. SIL2 compliant
   - Safety protocol
   - Event notification
   - Black Channel principle
   - Device diagnostics

Dependable wireless infrastructure for safety applications
Applications

Gas explosion → Plant wide monitoring

Short latency

Tsunami disaster → Predictive monitoring

Long range

Emergency shutdown

Fire of floating-roof tank

Tsunami warning system

ISA100 adapter + level meter

Downlink QoS

Remote valve control

World first SIL2 compliant
ISA100 Wireless Gas detector
Use cases – 1: Upstream

Conclusion

The test has proven the capability of improving asset management and improving safety via wireless implementation.

- ISA100 wireless system stays interoperable during the six (6) months test period. The communication remained robust and stable over the 5km distance in heavy steel multi-deck structure and the harsh offshore environment with monsoon, thunder storm and high tidal differences.
- ISA100 wireless network installation and commissioning time is only 5% to 10% of that required for a conventional wired system – lower project cost.
- ISA100 wireless implementation in offshore platform has proven to be beneficial in terms of safety, operational flexibility and cost saving as demonstrated during the testing period.
- ISA100 as Wireless Standard is able to deliver the full wireless functionality as promised.

http://www.isa100wci.org/en-US/Learning-Center/White-Papers
Use cases – 2: Downstream

Fit for purpose solution

Benefits

• Reduction in overall project risk. No cables; hence no excavation and working at height.
• Installation can be done quickly, safely and seamlessly while plant is online.
• Simplifies engineering and drawing updates.
• Significant reduction in overall project cost.

Lessons Learned

• Good stakeholder management
  - Client, principal, local business partner and vendors were involved right from the beginning.
• Good communication plan
  - Good support and collaboration between all parties involved ensured the system was tested successfully to the client’s requirements.
• Need to pay attention on future upgrades of hardware that may affect the network.

20 February 2016
WCI assures multi-vendor interoperability for best in class solution.

GasSecure - A Dräger Company

Riken Keiki

New Cosmos

Multiple suppliers are providing ISA100 Wireless Gas detector products
Summary

• **Dependable plant wide infrastructure** must be required to cover variety of wireless safety applications

• **Multi-vendor devices and interoperable wireless network** provide the best-in-class solution.

• **World first SIL 2 wireless gas detection system** has been realized with *co-innovation* of multiple vendors and multiple breakthrough technologies of the ISA100 Wireless
Thank you for your attention

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