Safety and alarming applications using ISA100 Wireless

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Today’s topics

1) Motivation of wireless for plant safety
2) Benefits
3) Key requirements
4) ISA100 Wireless solutions
5) Applications
6) Summary
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 warning*
  - Emergency shutoff: *Remote valve control* for safety mode

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

Gas explosion  
→ Plant wide monitoring

Tsunami disaster  
→ Predictive monitoring

Fire of floating-roof tank  
→ Emergency shutoff
Unique benefits of wireless

- No signal wiring
- No power supply wiring

Measurement in places where it has never been done before
- Measurement in places where it is hard to access with wiring
- No feasible wiring cost
- Making intelligent existing devices
- Temporary installation
- No power environment

Expected benefits
- Reducing field work
  - Improving safety
- Improving efficiency
- Reducing maintenance costs
- Reducing construction costs

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?
ISA100 Wireless solutions

Field devices
- **Long distance** communication (600m line of sight)
- **Safety layer** is implemented on the top of ISA100 Wireless stack
- **Multivendor interoperability** for best in class solution

Wireless Infrastructure
- **Redundant Gateway** for highest reliability
- **Multiple access point** for scalable and flexible network
- **500 devices** can be managed per one Gateway
- **Coexistence management** with CCA/Ch Black listing

Network Engineering
- **Sky mesh concept** (Installation guide) for scalable and stable network
- **Support safety protocol (PROFIsafe)** to connect SIL compliant system

Network Maintenance
- **Network monitoring tool** for visualize condition of the network
- **Predictable & Long battery life** by well managed NW
ISA100 Wireless (ISA100.11a / IEC 62734)
Industrial wireless network standard

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

Assure multivendor interoperability
- ISA100 compliance test
- Developing Implementation specifications

Provide Solutions

Standardization

Implementation

ISA100 Institute

ISA100.11a Architecture

Open Expert Involvement Yielding Best in Class Designs
ISA100.11a wireless system

- Pressure transmitter EJX110B/EJX430B/EJX310B
- Flange mounted Differential Transmitter EJX210B
- Dual input Temperature Transmitter YTA510
- Temperature Multiplexer YTMX580
- Field Wireless SMARTDAC+ GX20W
- Field Wireless Access Point YFGW510
- Field Wireless Management Station YFGW410
- Field Wireless Access Point YFGW510
- Field Wireless Media Converter YFGW610
- Pressure transmitter EJX510B
- Differential Transmitter With Diaphragm Seal EJX118B/EJX438B
- Multiprotocol Adapter FN310/FN110
- Multifunction Adapter FN510/FN110
ISA100 Wireless implementations

1. Reliability

Fault Tolerance

Redundant Gateway and Duocast

Production Control System

Redundant Gateway

Duplicate

Active

Standby

Field Wireless Management Station

Field Wireless Backbone

Field Wireless Access Point

Radio Path

Duocast

Wireless Field Device

ISA100 Wireless Architecture
2. Timeliness

- **TDMA**: Time Division Multiple Access / Time slot comm.
- **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
3. Scalability

Plant wide large scale wireless infrastructure

Redundant Gateway 1 sec Switchover

20 Access Points

500 devices@5sec update
200 devices@1sec update
4. Security

Security threats:
- Sniffing
- Data falsification
- Spoofing
- Reply attack

ISA100 Wireless Network

Secure A-I-C
A: Availability
I: Integrity
C: Confidentiality

Spread spectrum modulation
Channel hopping
Mesh network
Re-try
Duocast, Redundant GW
Provisioning
Network Join
Hop-to-hop security
End-to-end security

Encrypted data

Wireless device

Control system
5. Engineering

RF network planning tool

- Fix communication paths visually on graphic display
- Press auto paths button so that communication paths are automatically indicated: Easy engineering
6. SIL2 certification

SIL2 Gas detection system

- Wireless protocol: ISA100 Wireless
- Safety protocol: PROFIsafe over PROFINET
Summary
ISA100 Wireless technologies

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 key
   - Time stamp

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

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

Dependable wireless infrastructure for safety applications
Applications
1: Tsunami warning system

Lessons learned from the great east Japan earthquake disaster

Level meters equipped with the wireless adaptor are installed on a storm surge barrier near the plant to monitor the tide level. Because a tsunami is usually preceded by a sudden ebb tide, detecting a sudden lowering of tide level may indicate a tsunami.

System overview
• Level mater is connected ISA100 Wireless adapter
• Long range communication from field wireless device to Access Point without repeaters (up to 600m)
• Duocast for redundant communication
Serious fire accident was happened at the tank firm in northern part of Japan after the big earthquake. Floating roof tank was shaking and oil was leaked via the drain for rain water. Then fire accident was happen by ignition on leak oil.

2: Remote valve control for emergency action

System overview
- Rapid response for controlling valve
- Read back status can be monitored
- 10 years battery life
- Compliant to Japanese regulations regarding to the earthquake and tsunami for hazardous materials facilities

Close drain valve to avoid fire accident when big earthquake occurred

Note:
This wireless Tx are certified to use actually in Japan only!
3: LNG terminal pipeline temperature safety monitoring

System overview
- 1,2 km long LNG terminal pipeline
- 125 pcs dual wireless transmitters
- Wireless skin temperature sensors
- 6 years battery life
- In case of leakage temperature drop
### System overview

- Radiation monitors have Modbus comm.
- FN110/310M wireless adapters
- 5 years battery life
- In case of High radiation level alarming
5: SIL2 Wireless HSE safety application in UK

System overview
- The HSE safety application use 30 pcs of GS01 (GasSecure - A Dräger Company) wireless gas detectors to measure hydrocarbon gas concentrations and Yokogawa ISA100 Gateway and access points.
- Rapid response gas-detecting time & comm. & Low energy consumption
- The gateway has PROFINET comm. to connect with the PROFIsafe based PLC.
Summary

• Industrial wireless technology creates great opportunities to provide new paradigm for plant safety

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

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