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# Adoption of Wireless for Safety

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2015 Process Control and Safety Symposium
Houston TX
Communication Session
11 November 2015 09:00 – 10:30

# Adoption of Wireless for Safety
# Session Overview

- Adoption of Industrial Wireless in General
  Usage Classes

- Design Principles for Wireless Safety
  Loosely Derived from ISA84 WG8 Draft

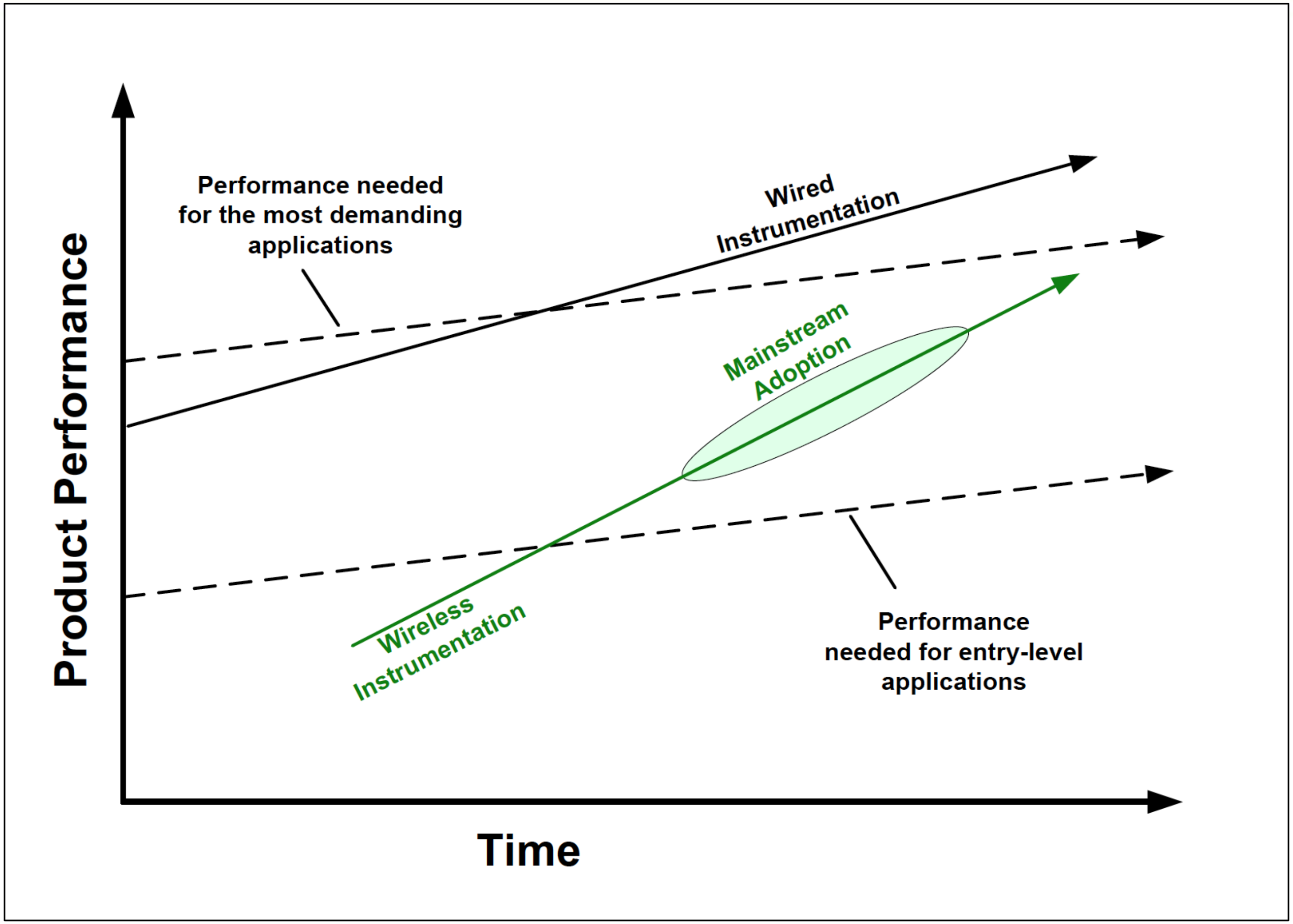
- Four Case Studies
  - Tank Farm Gas Monitoring
  - Gas Detection, Safety System Integration (SIL-2)
  - Time Critical Perimeter Monitoring
  - Tank Farm Safety Compliance

- Q&A, Discussion

# Co-Presenters

| Carsten Buschmann<br>Dräger Safety AG<br><br>Software Engineer<br>Research & Development<br>Gas Detection Instruments | Tim LeFevre<br>Honeywell Process Solutions<br><br>Global Marketing Manager<br>Safety Systems |
|---|---|

# Adoption of Industrial Wireless Classic Model




**Christensen innovation model adapted for industrial wireless**

Courtesy AIW LLC

# Commonly Cited Benefits of Wireless Instrumentation

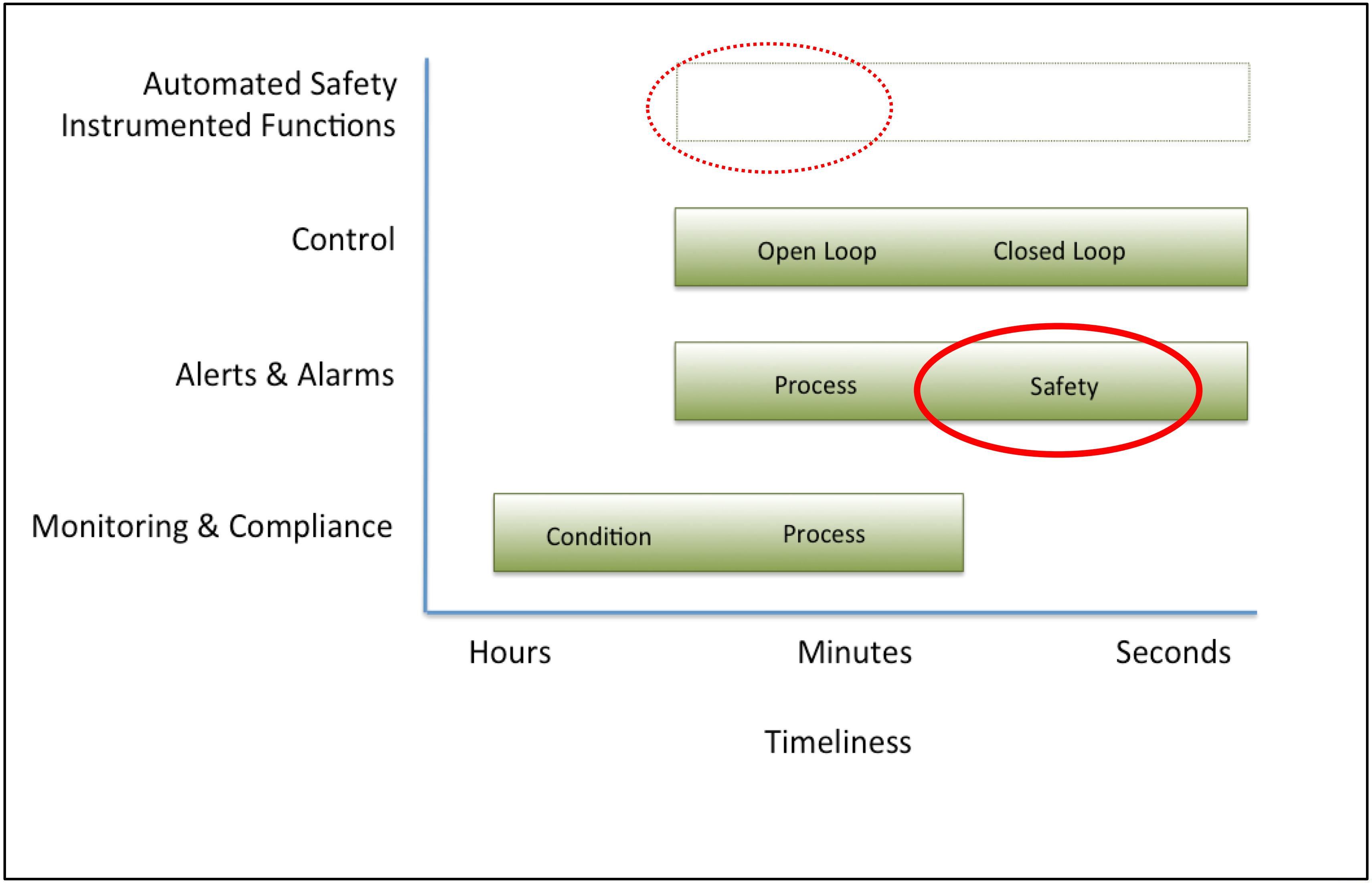
| | |
|---|---|
| **Cost Savings** | • Up to 90% of installed cost of conventional measurement technology can be for cable conduit and related construction.<br>• Typically:  1/5 the time, 1/2 the cost.<br>• New and scaled applications are now economically feasible. |
| **Improved Reliability** | • Wired sensors may be prone to failure in difficult environments.<br>• Wireless can add redundancy to a wired solution. |
| **Improved Visibility** | • Condition monitoring (equipment)<br>• Process monitoring |
| **Improved Control** | • Add wireless to existing processes for more optimal control. |
| **Improved Safety** | • Safety related alarms |

# Legacy ISA100 Usage Class Examples

| | | | | |
|---|---|---|---|---|
| Safety | 0 | Emergency action | Always critical | Safety interlock<br>Emergency shutdown<br>Automatic fire control |
| Control | 1 | Closed loop Regulatory control | Often critical | Direct control of primary actuators<br>High frequency cascades |
| | 2 | Closed loop Supervisory control | Usually non-critical | Low frequency cascade loops<br>Multivariable controls<br>Optimizers |
| | 3 | Open loop control | Human in the loop | Manual flare<br>Remote opening of security gate<br>Manual pump/valve adjustment |
| Monitoring | 4 | Alerting | Short-term consequences | Event-based maintenance<br>Battery low indicator<br>Asset tracking |
| | 5 | Logging Downloading/ uploading | No immediate consequences | History collection<br>Preventative maintenance rounds<br>Sequence of events (SOE) reporting |

***"Classes 1 through 5 and optionally class 0."***

# Top Usage Classes for Wireless Instrumentation




Courtesy AIW LLC

# Industrial Wireless in 2015
# Major Applications

- Process Monitoring & Control
- Asset Health Monitoring & Analytics
- Safety Related Alarms

# Process Monitoring & Control

## Applications

- Temperature
- Pressure
- Flow
- pH
- Dissolved $O_2$
- Valve Position
- Etc…

## Wireless Requirements

- Highly Scalable Network
- Low and Deterministic Latency
- Flexible Configuration
- Predictable Battery Life
- Multi-Vendor Interoperability

# Asset Health Monitoring & Analytics

## Applications

- Vibration
- Corrosion
- Steam Trap
- Etc…

## Wireless Requirements

- Scalability with wide range of data rates
- Prioritize data flows
- Support for large waveforms
- Flexible network configuration

# Safety Related Alarms

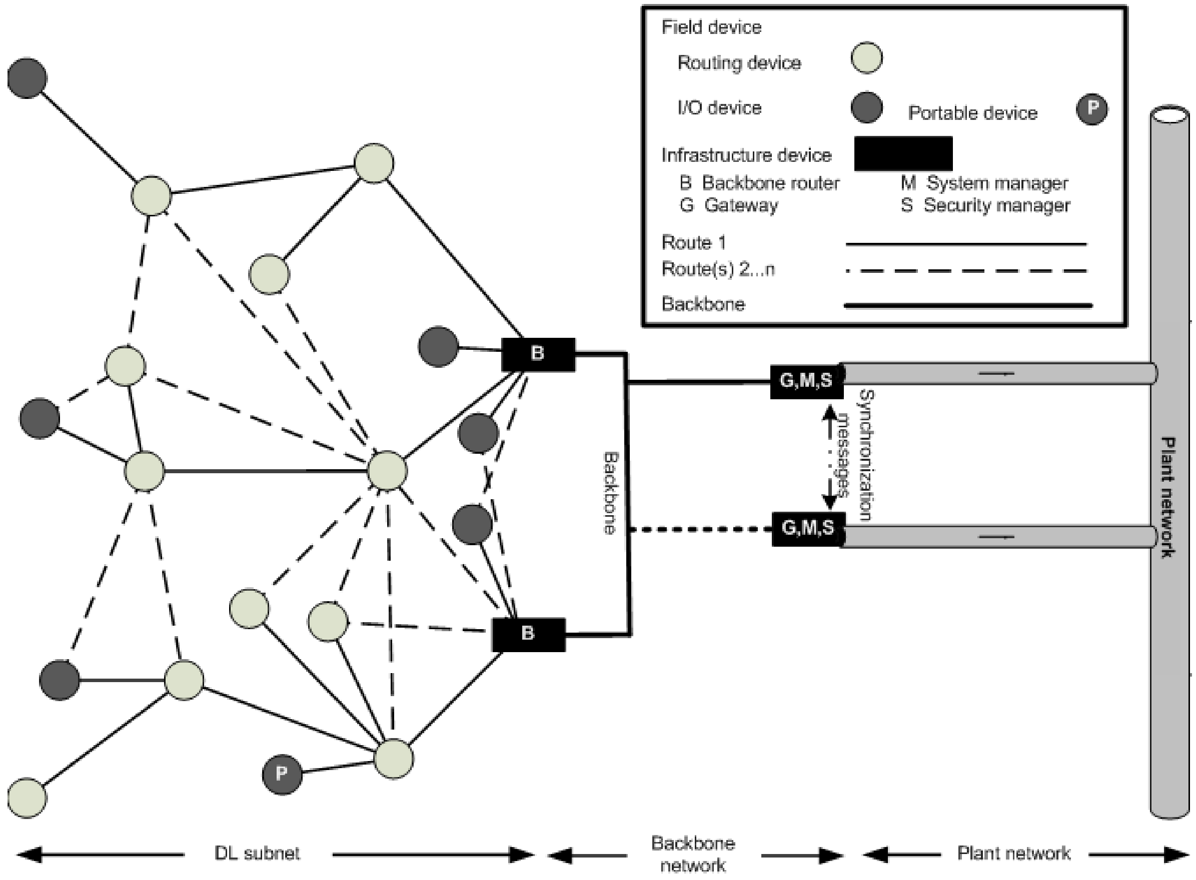
## Applications

- Gas Detection
- Fire Prevention
- Level Detection
- Safety Showers
- Etc…

## Wireless Requirements

- Controlled Quality of Service
  - Diagnostics!
- Low and Deterministic Latency
- Layered Open Architecture
  - e.g. ProfiSAFE

# Adoption of Wireless for Safety Design Principles



# Adoption of Wireless for Safety Design Principles

- ISA84 WG8 (Draft)
  Purpose and Focus of the Technical Report
- Latency and Availability
- Network Design Common Best Practices
- Security Matrix
- Denial of Service
- Some Other Considerations

***The following slides are derived from recent ISA84 WG8 drafts, <u>and other materials</u>.***
***This is not intended as a summary of ISA84 WG8.***
***Emphasis and summaries might not match WG intent.***
***Author's involvement in ISA84 WG8 has been minimal.***

# ISA84 WG8
# Draft Technical Report

## Title

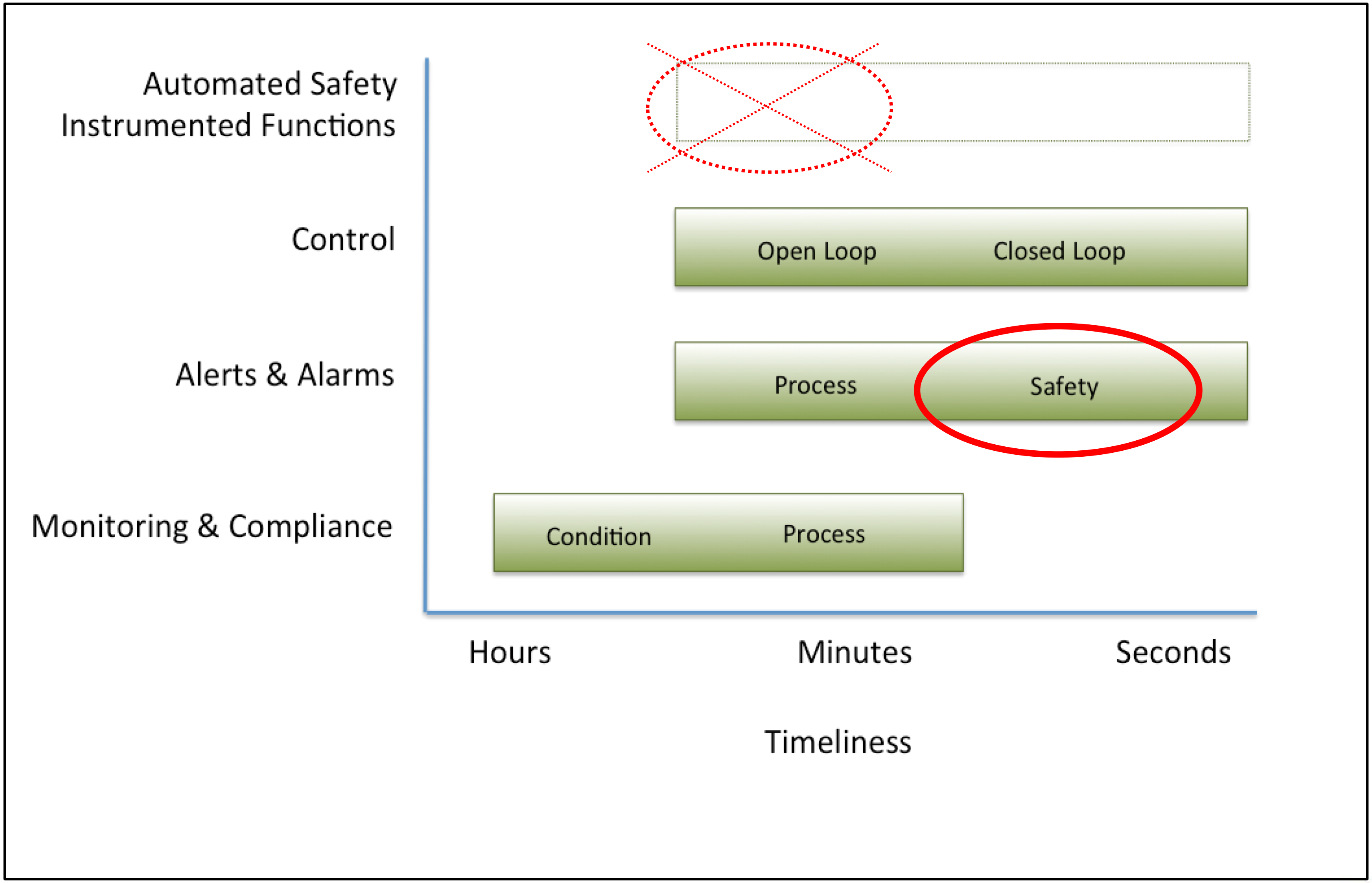
*Guidance for Application of Wireless Sensor Technology*
*To* ***Non-SIS Independent Protection Layers***

## Purpose

- *"This Technical Report was developed to document guidance and considerations to users for application and implementation of wireless sensor technologies for fully non-SIS process Independent Protection Layers.* ***The guidance provided is not intended for the use of wireless as a SIF****."*

- *"This TR provides guidance to demonstrate the wireless system is sufficiently robust to support meeting the requirements of a Non-SIS IPL."*

# Scope of ISA84 WG8




Courtesy AIW LLC

# ISA84 WG8 Focus

- *"For the purposes of this Technical Report it is assumed that the risk analysis team has already determined that the protection layer comprised of an* ***alarm with operator action generated from a wireless transmitter*** *meets the specificity and independence criteria. Instead the Technical Report will focus on providing information on* ***how to establish a design that satisfies the dependability and auditability criteria*** *for an alarm with operator action that is generated from a wireless transmitter. "*

- *"…**Risk reduction claimed is less than 10**."*

# Latency, Availability

## Latency

- *“Wireless sensor network data latency is the time between the acquisition of a measurement value and the delivery of that data via the wireless network to a gateway.”*

## Availability

- Percentage of values received within the required response time.  Can be measured per device or for an overall system.

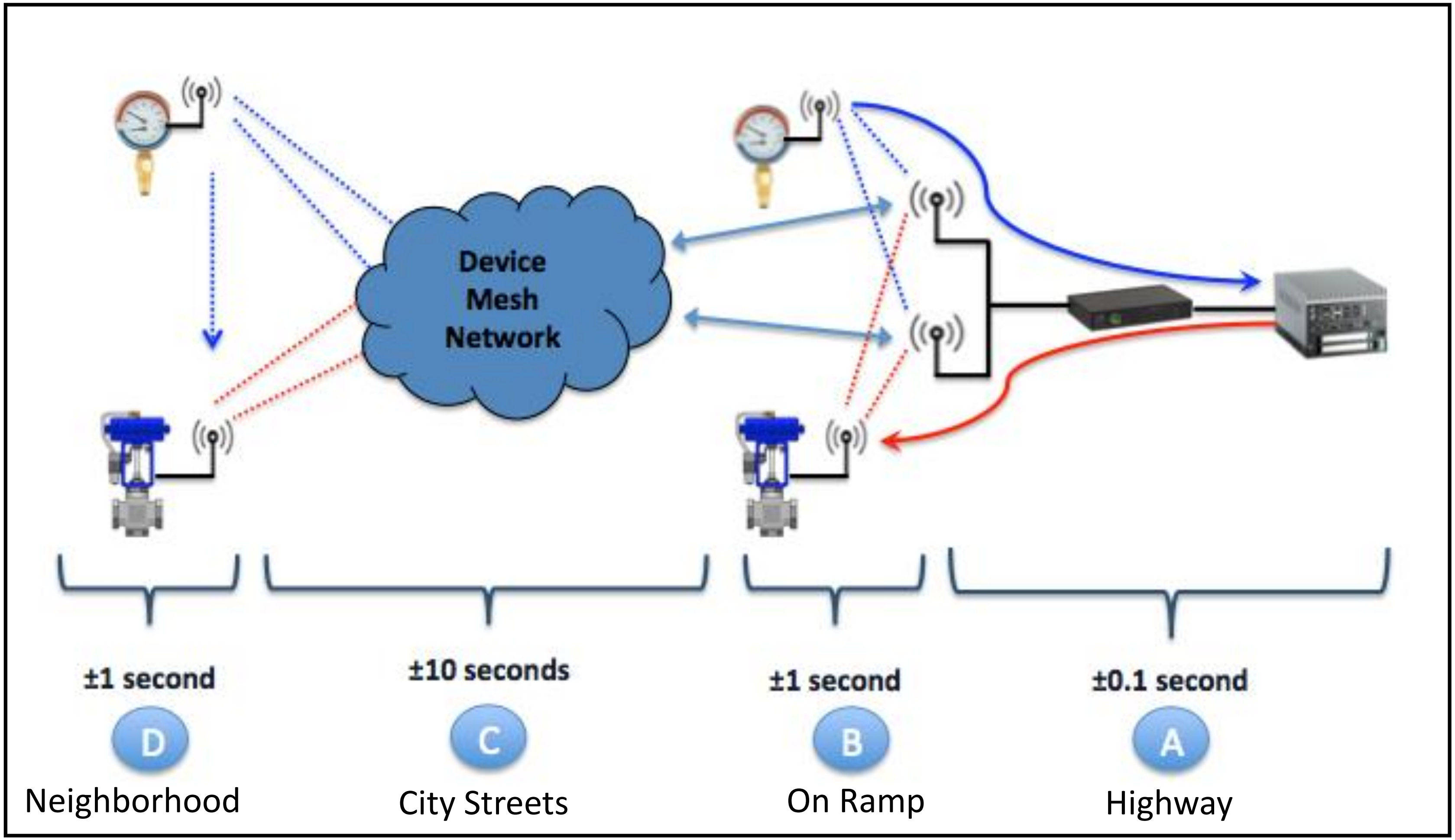
Sidebar

- An exception may be a late-arriving alarm, or a stale state.
- Be alert for freshness requirements at times when there is no alarm.

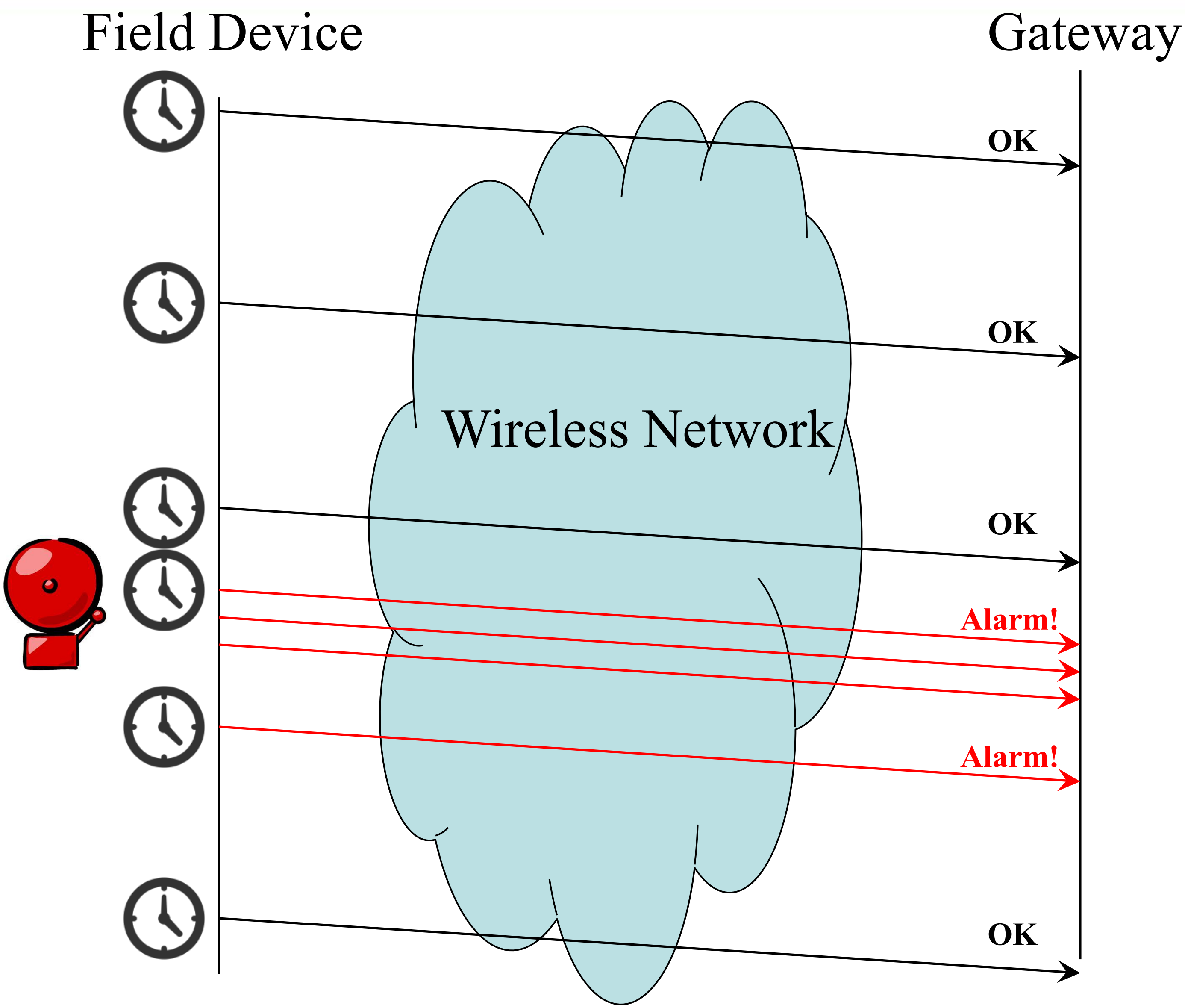

**Figure 3 SRA**


**Figure 4 Unavailable SRA**

# Mesh Networks
# Latency Considerations



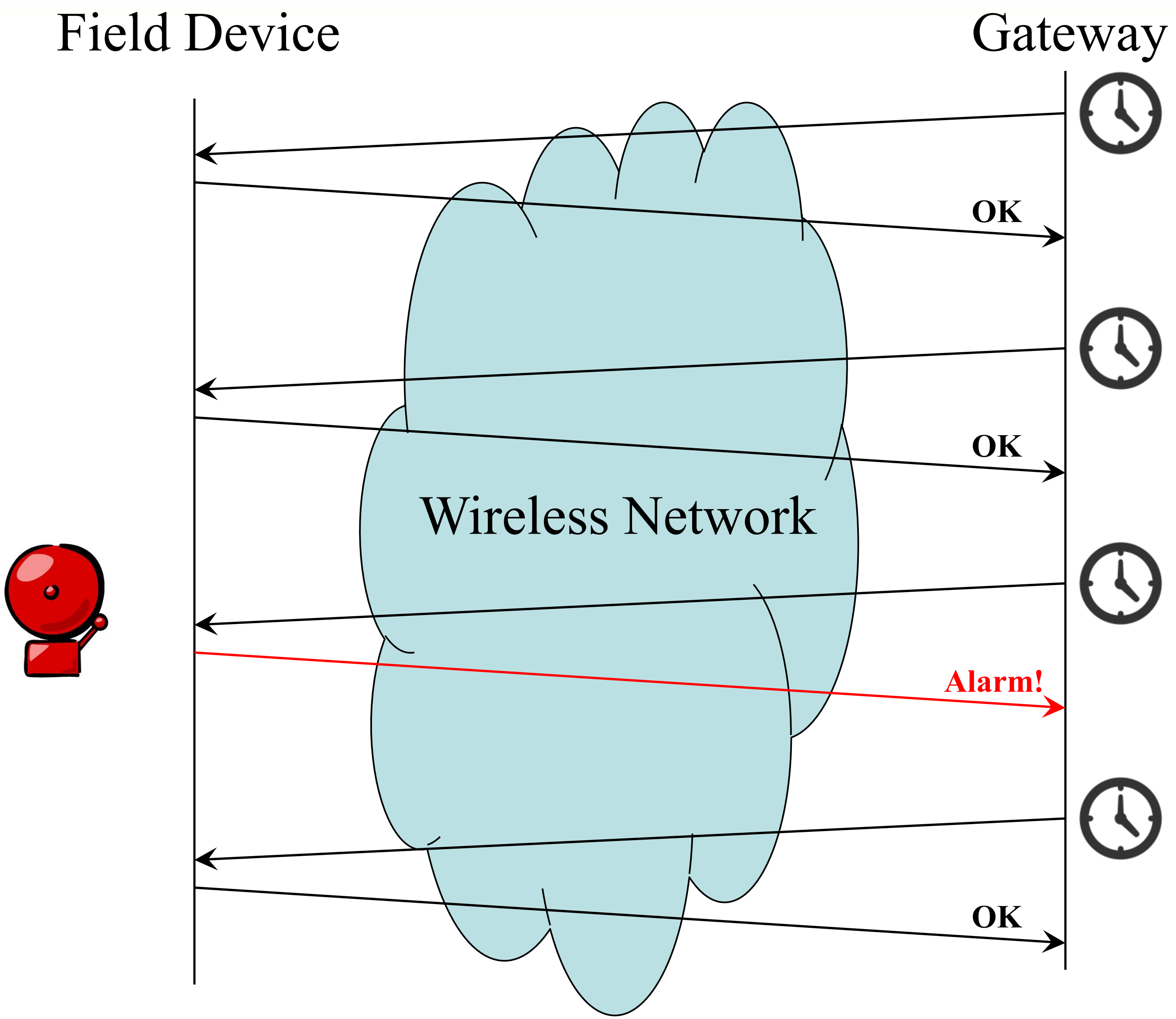
# Publication




Wireless publications are commonly acknowledged hop-to-hop, but not end-to-end.

Rely on field device's clock for timestamp, freshness, etc.

# Request-Response

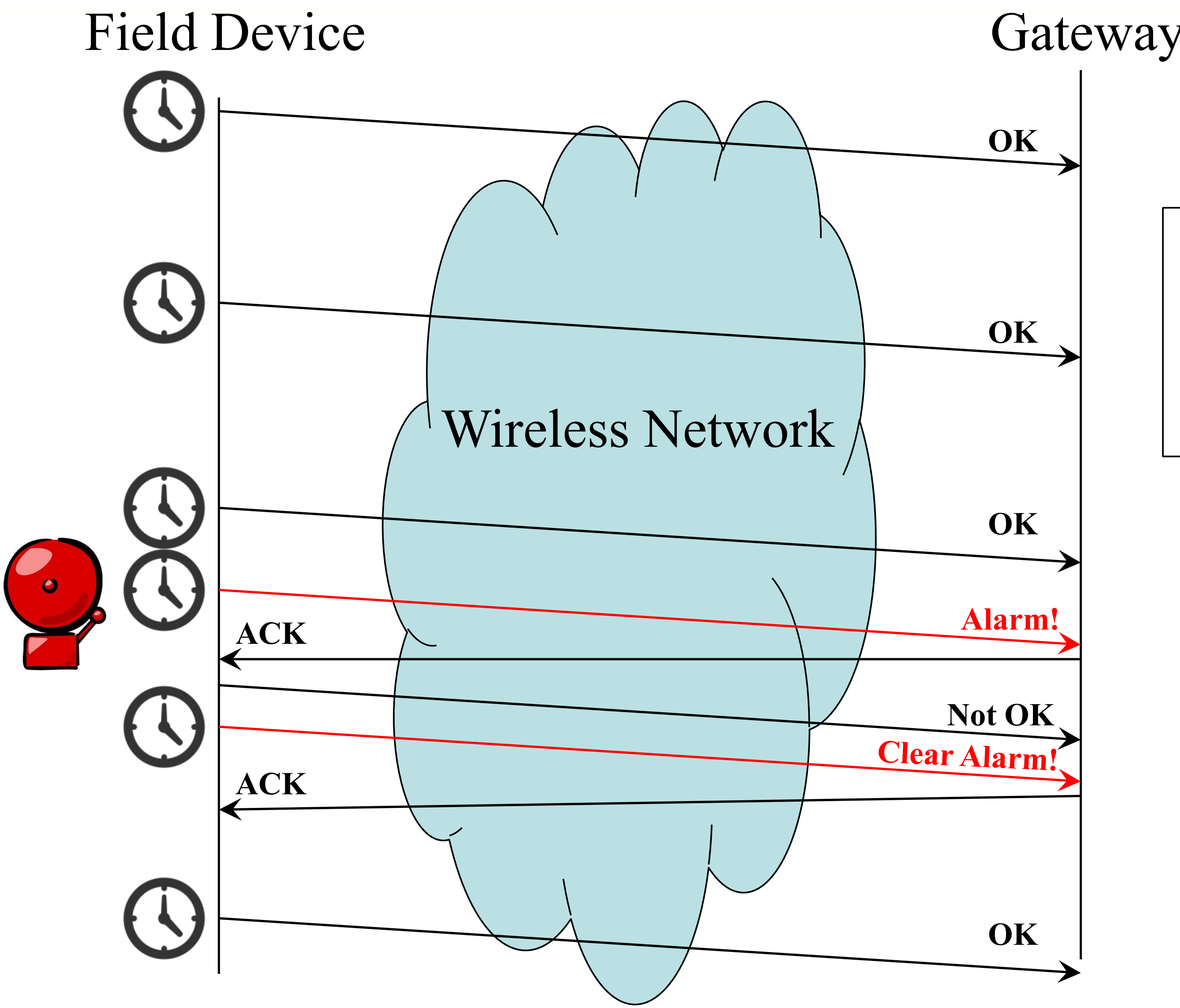



Wireless may be considered a black channel.

Timestamp, freshness, etc are based on interrogation clock in this diagram.

Another example of request-response will be shown in a case study later in this presentation.

# Hybrid (Example)




Publish heartbeat periodically.

Alarms are transmitted immediately. Acknowledged by gateway to squelch re-transmission.

# Network Design
# Common Best Practices

*"… it is critical to closely adhere to manufacturer's best practices when designing and laying out a wireless sensor network."*

- Conservative communication range
- Reporting Rates
  - *Device and router battery capacity*
  - *Wireless channel capacity*
  - *Infrastructure capacity*
- Centrally located infrastructure
- Control hop depth
- Path redundancy (Infrastructure and/or mesh)
- Avoid bottlenecks
- Use network layout and simulation tools
- Documentation!!!

Design network with plenty of margin, and monitor that margin carefully.

***Derived from ISA84 WG8 draft.***

# Security Matrix

| | Authentication | Verification | | Encryption | Access Control | Key Management |
|---|---|---|---|---|---|---|
| | | Integrity Check | Time | | | |
| **Sniffing** | | | ✓ | ✓ | | ✓ |
| **Tampering** | | ✓ | ✓ | | | ✓ |
| **Spoofing** | ✓ | | ✓ | ✓ | ✓ | |
| **Replay Attack** | | ✓ | ✓ | | | ✓ |
| **Routing Attack** | ✓ | | | ✓ | ✓ | ✓ |
| **DoS Attack** | See Next Slide | | | | | |

Authentication, Integrity Check, TAI, and Encryption are generally features of an interoperable communication standard such as ISA100 Wireless. User should not be able to disable or mis-apply these features.

Access Control and Key Management generally involve adherence to manufacturer's best practices.

***Similar table is in ISA84 WG8 draft.***

# Denial of Service

Radio standards and implementations should apply a variety of techniques to operate reliably in the presence of interference.

- *Unintentional interference ≈ coexistence*
- *Intentional interference ≈ denial of service attack*

Common strategies

- *Spread spectrum modulation*
- *Multipath routing*
- *Channel blacklisting*
- *LBT Disable (Listen Before Talk)*
    - *LBT may be required due to regulations, policies, or coexistence with other systems*
    - *LBT is configurable in ISA100 Wireless*
    - *Regulations and/or policies may allow LBT to be disabled only at reduced power*
- *Diagnostics!!!*
    - *For example, LBT backoff counts*
- *Proven in Use*

# Some Other Considerations

Gateway-Host Communications

- *Use well-known standards for Gateway-Host communications*
- *Security considerations for Gateway (ISA99)*

Human Interface

- *General ISA84 considerations, e.g. alarm management*
- *Large numbers of wireless devices may raise concerns about alarm floods*

Battery Management

- *Battery life should exceed instrument's natural service interval*
- *Avoid network configurations and processes that randomize battery life*

Data Quality Diagnostics

- *Early detection and prevention of stale data conditions*
- *Include information about health & timeliness of wireless sensor data*
- *General device diagnostics (e.g. NAMUR 107)*

Network Diagnostics

- *Include ample margin in the wireless design.*
- *Real-time recovery from reduced margin, while meeting availability targets.*
- *Diagnostics, HMI, processes for systematic loss of margin.*

# Four Case Studies

***GasSecure***

- Tank Farm Gas Monitoring
- Gas Detection, Safety System Integration (SIL-2 example)

Carsten Buschmann
Dräger Safety AG

Software Engineer
Research & Development
Gas Detection Instruments

***Honeywell***

- Time Critical Perimeter Monitoring
- Tank Farm Safety Compliance

Tim LeFevre
Honeywell Process Solutions

Global Marketing Manager
Safety Systems

GAS SECURE

A Dräger Company

Dräger

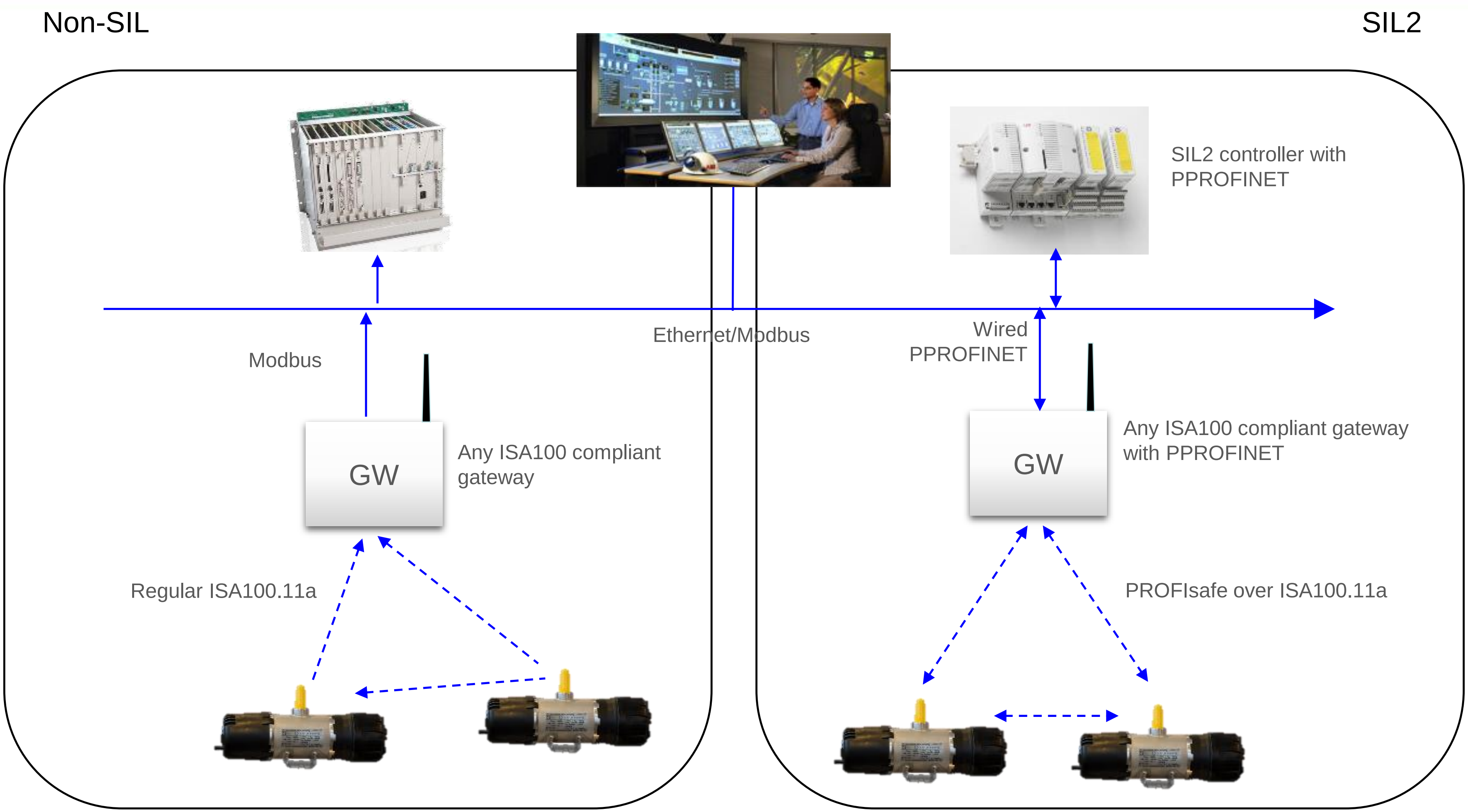
ISA

# Wireless Gas Detection Systems in the Context of Safety Critical Applications

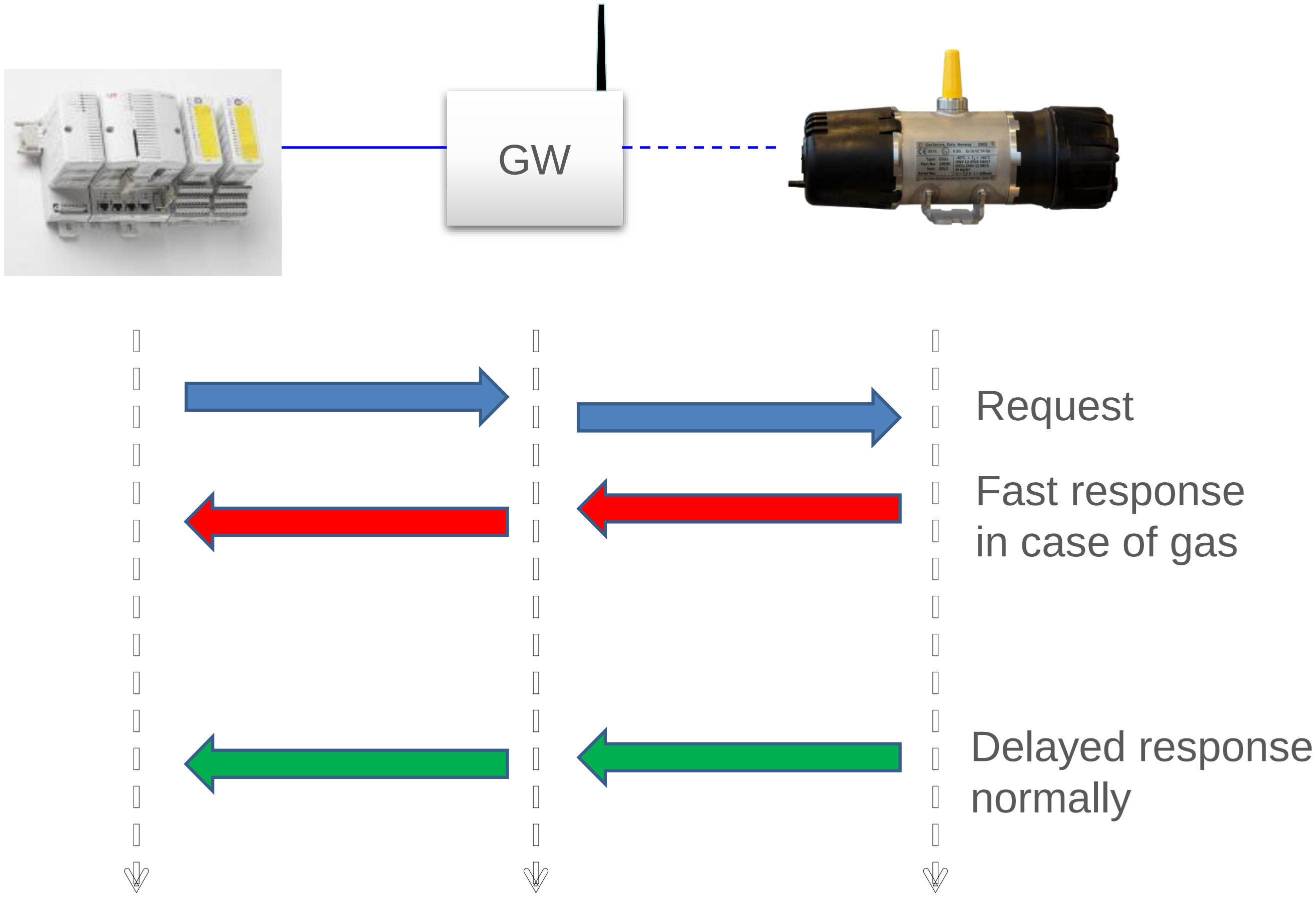
## SIL2 and Non-SIL Application Case Studies

Process Safety and Control Symposium, Houston, Nov 11th 2015, Dr. Carsten Buschmann

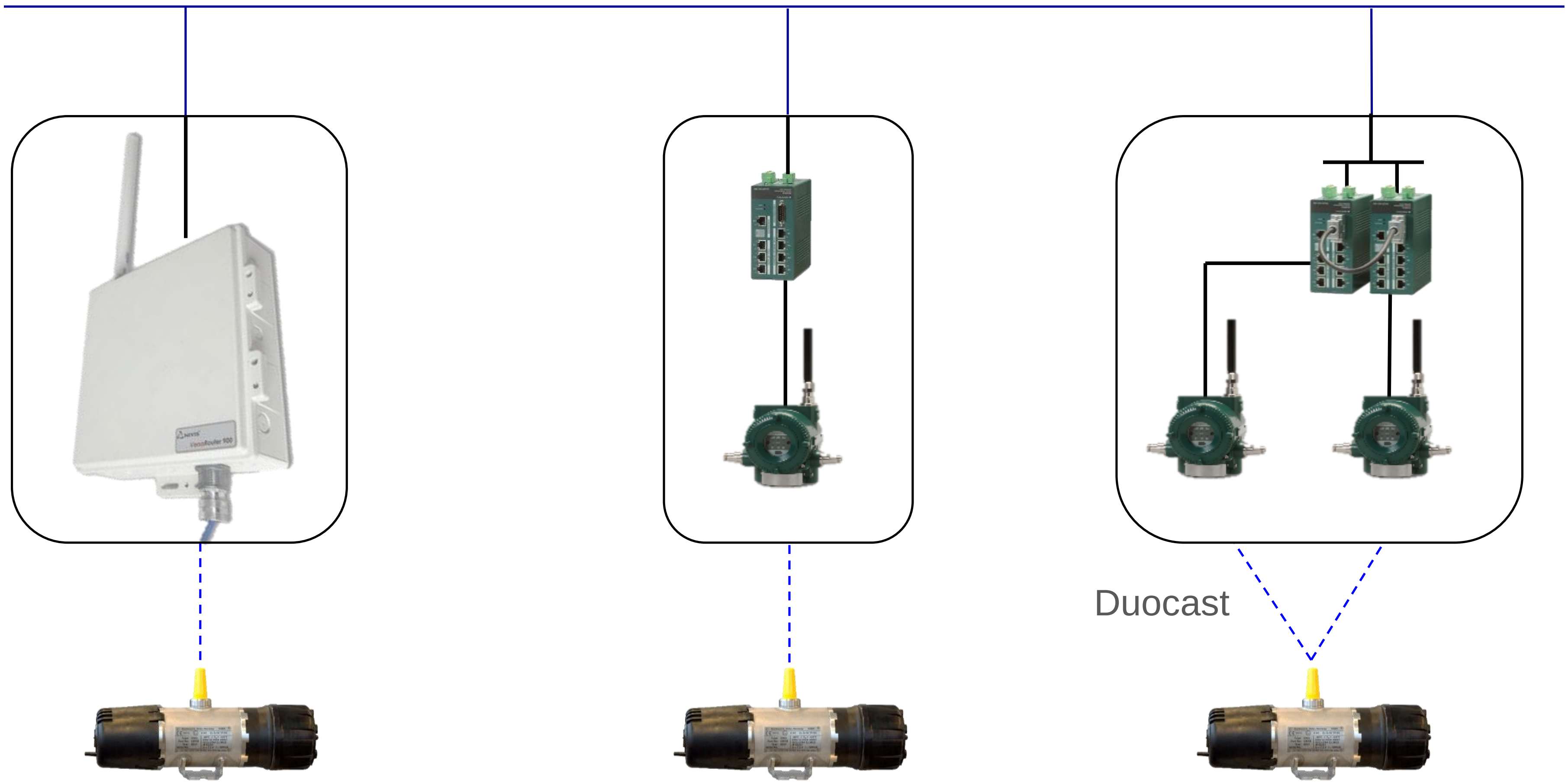
# SIL2 Compliant Systems on Top of Standard Wireless Protocols



# Bandwidth Reserved for Fast Response



# Wireless System Options

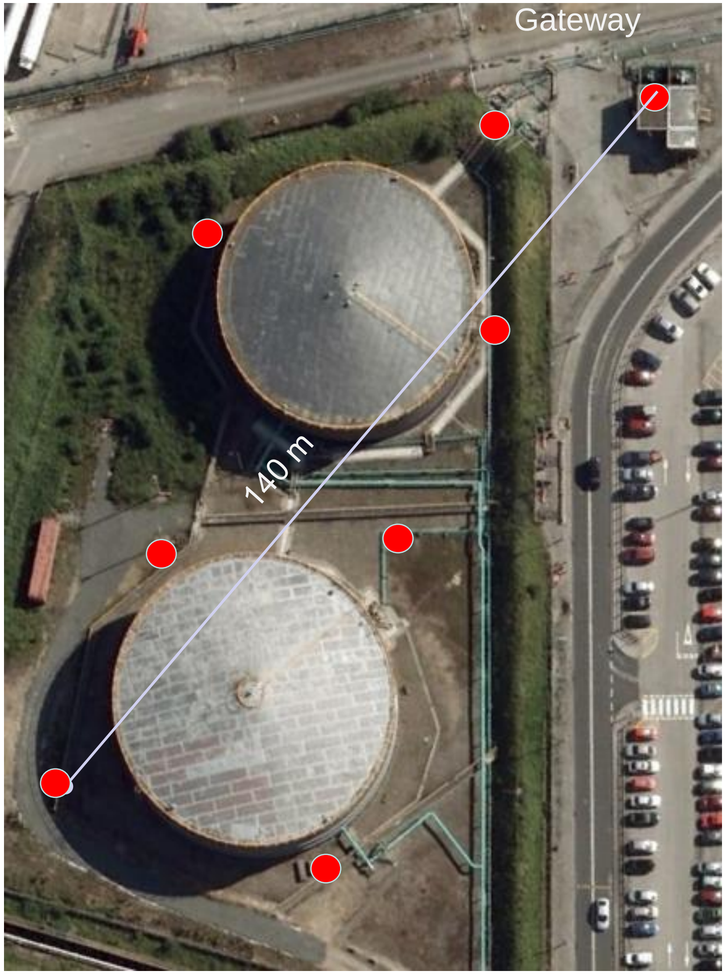


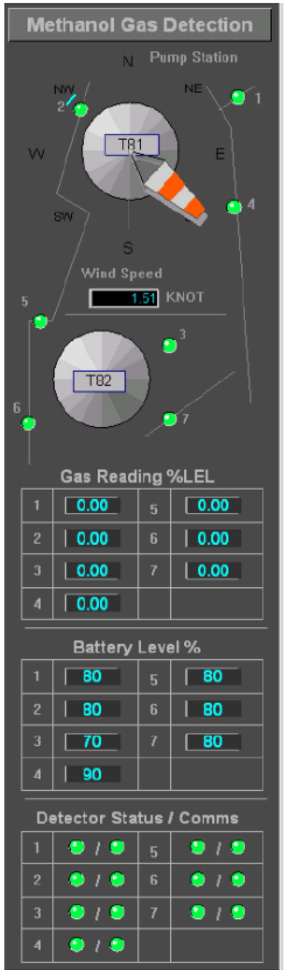
GAS SECURE
A Dräger Company

# Remote Tank Farm Gas Monitoring System

- Installed: March 2013
- 7 Detectors
- 1 Gateway

- Highlights:
  - Remote area
  - Very easy installation (half day)
  - Integration to Honeywell TDC 3000



# Gas Detection with Executive Actions and Integration into Safety System

Upgrade Project

- Replace wired combustible detectors
- 73 units GasSecure GS01
- Integrated into Siemens S7 control system
- Sixteen fire zones
- 90-95% reduction in installation time
- 80% cost saving compared to wired

# Typical GS01 Detector Placement

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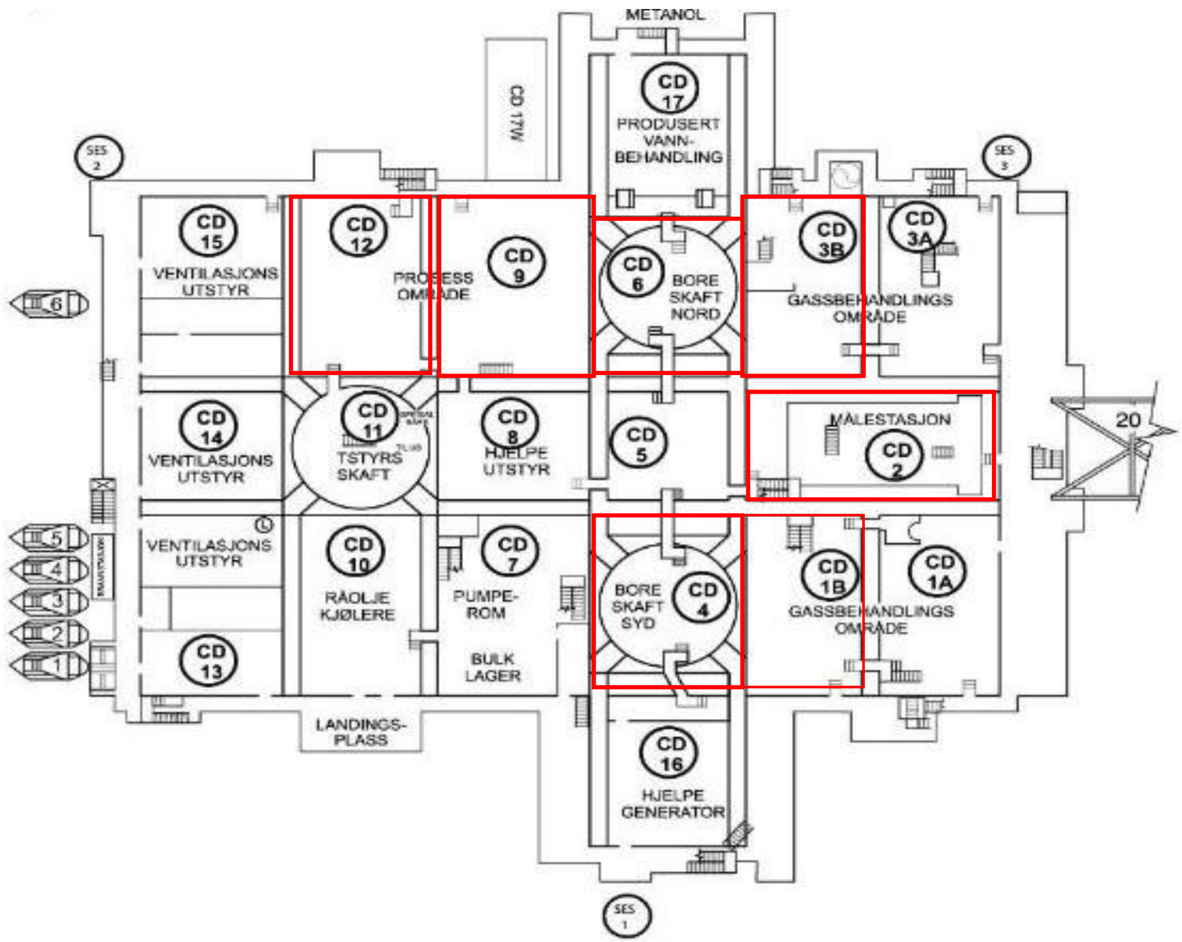
# Enclosed Fire Zones with one Gateway per Zone

## Layout – Cellar Deck (Fire Zones)

| | |
|---|---|
| CD1B | = 3 GS01 |
| CD2 | = 2 GS01 |
| CD3B | = 7 GS01 |
| CD4/M8 | = 8 GS01 |
| CD6/M6 | = 5 GS01 |
| CD9 | = 9 GS01 |
| CD12 | = 10 GS01 |



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# Study by EPC Showed Significant Savings with Wireless

| Description | Conventional Solution | Wireless Solution |
|---|---|---|
| Wired Detector, IR Line | 23 | 9 |
| Wired Detector, IR Point | 45 | 8 |
| Wireless Detector, IR Point | 0 | 67 |
| Wireless Router | 0 | 10 |
| Removal Catalytic | 0 | 3 |
| New Multicore Cable | 1720 m | 0 m |
| New Field Cable | 3545 m | 1370 m |
| Field Cable Removal | 0 m | 60 m |
| Junction Boxes | 6 | 0 |
| Cable Tray | 641 m | 164 m |
| Cables through MCT | 31 | 2 |

# Wireless Detectors Increase Safety with Higher Coverage and Reduce System Costs by 60-80%

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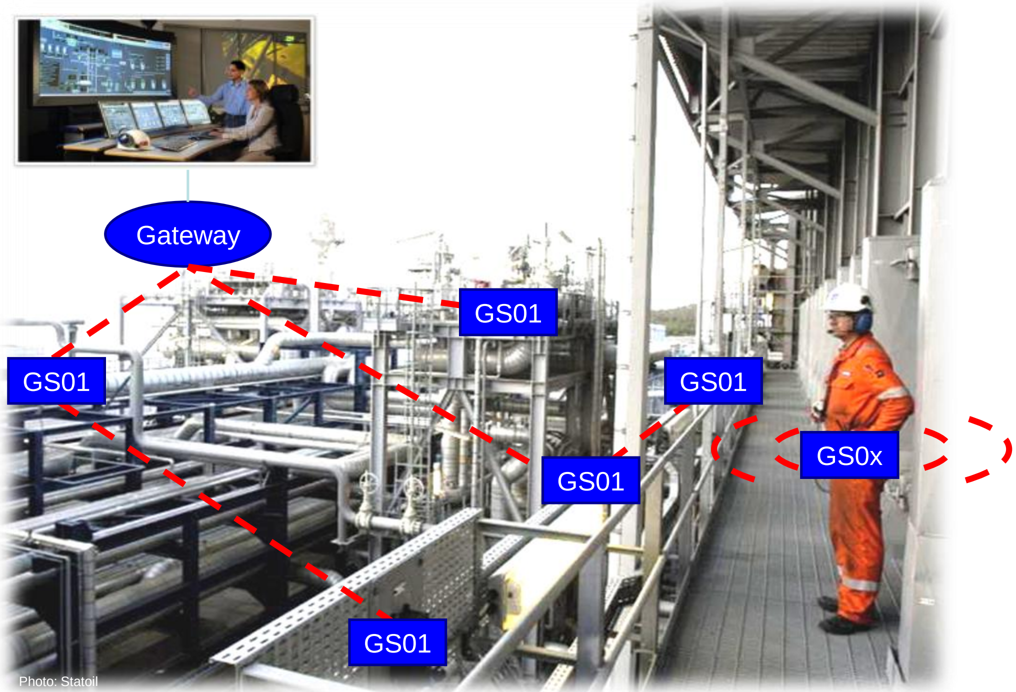
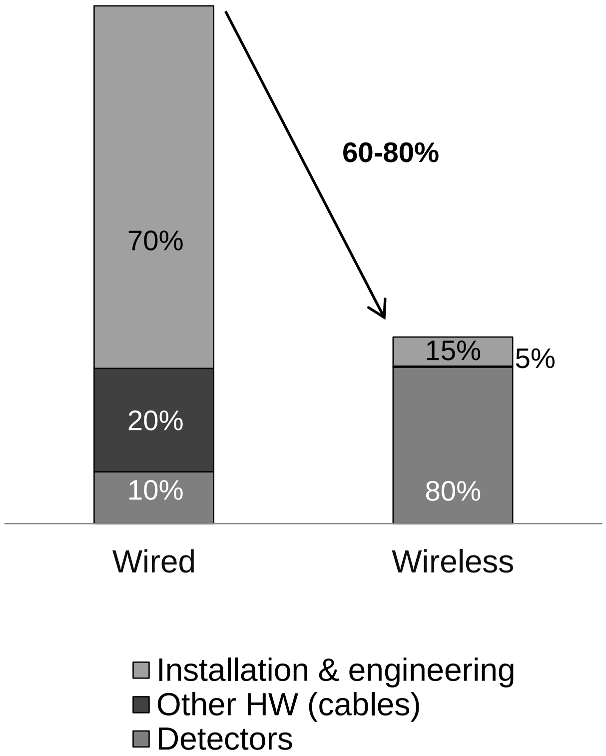
## Easy installation, increased flexibility…




## …and reduced system costs



# Thank you for your attention.

**Dr. Carsten Buschmann**

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Setting the Standard for Automation™

# Adoption of Wireless for Safety Case Studies

ISA100 Wireless

Honeywell OneWireless$^{TM}$

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# Tim LeFevre - Honeywell

- 25+ year career working for major suppliers of process control (DCS/PLC), safety, and instrumentation.
- Consulted with clients around the world on the best practices of implementing systems designs that meet ISA, IEC, and NFPA standards.
- As Global Customer Marketing Manager for Honeywell based in Houston, TX, Mr. LeFevre strives to make customers aware of innovative solutions that have been implemented around the world.

# Case Study 1
# Perimeter Monitoring – Time Critical

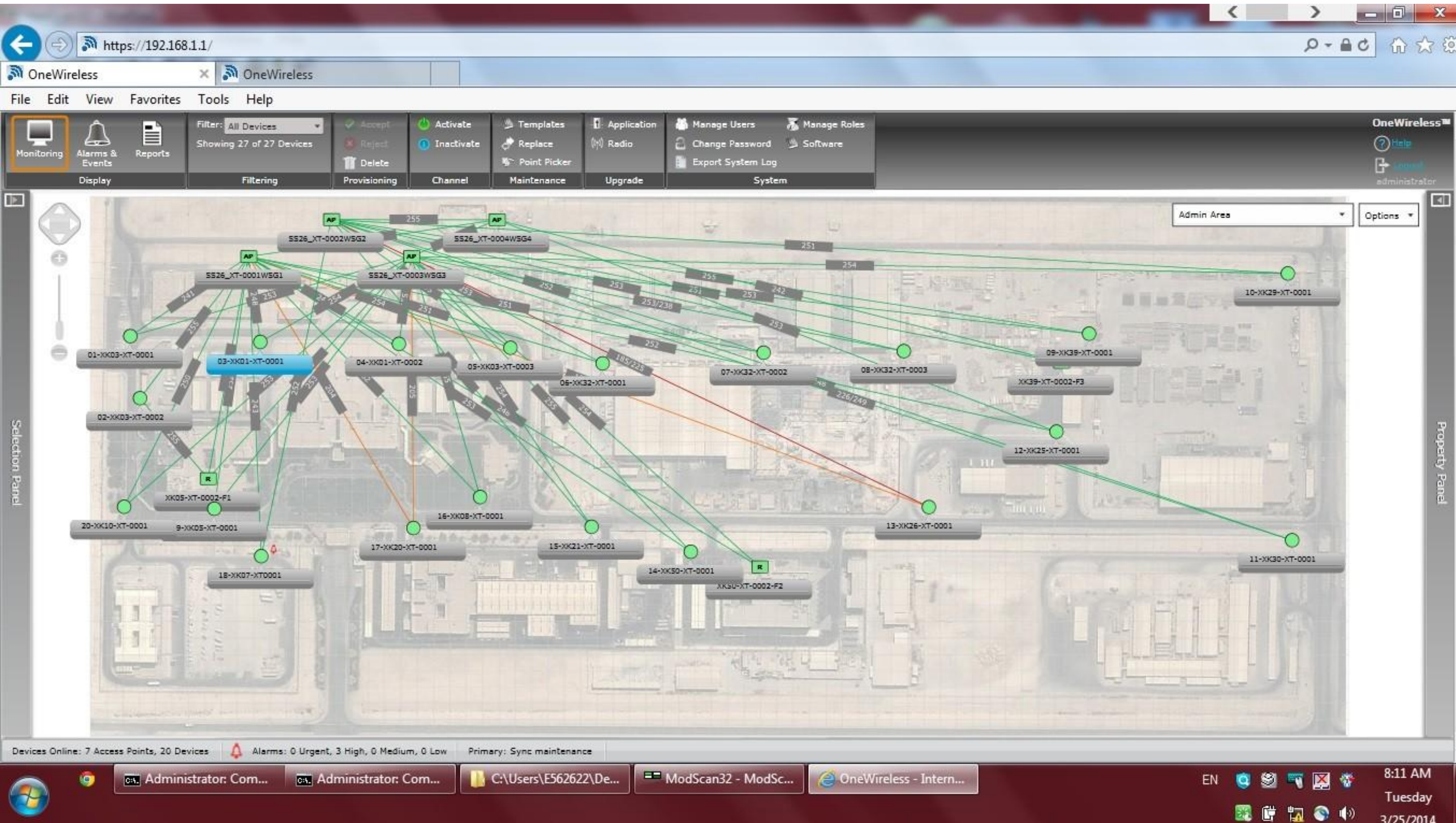
## LNG Facility in Middle East - Brownfield

| | |
|---|---|
| **Challenges** | • Alarming system for detection of gas leaks without extensive cabling.<br>• Meet 3 seconds alarm requirement. |
| **Solution** | • FDAP based ISA100 Wireless network with XYR6000 Universal Transmitters and solar power panels. |
| **Results** | • Improved site safety system within budget.<br>• 3 seconds alarming requirement met.<br>• Compliance to government regulations for HSE. |

# Project FAT Results

- FAT successfully completed March 2014.
- The wireless solution consistently delivered an activation time of 2.9 seconds with the horns and beacons activating simultaneously.
- The system met and exceeded the stringent customer requirement of 3 seconds.
- The customer put the system through rigorous tests that were beyond the scope of the FAT, to display redundancy, fail-over and network stability.
- The wireless system withstood all their tests and attempts to show flaws and displayed its resilience and ruggedness.
- The system has been installed and commissioned at the customer site in June 2014

# Network Topology Screenshot



# Case Study 2
# Meeting Safety Compliance

## Tank Farms across India - Brownfield

**Challenges**

- Secondary level tank gauging to meet safety compliance - M B Lal recommendations
- 49 locations spread out around the country
- Require end to end solution within budget

**Solution**

- Honeywell Enraf Flexline ISA100 with OneWireless Network using FDAPs
- Total 90 FDAPs, 98 WDMs and over 550 Enraf FlexLine ISA100 Wireless radar gauges being deployed across the 49 locations

**Results**

- Compliance within budget and project schedule
- Consistent deployment across all sites
- Comprehensive solution to meet requirement

# Wireless for Tank Gauging

## SmartRadar FlexLine

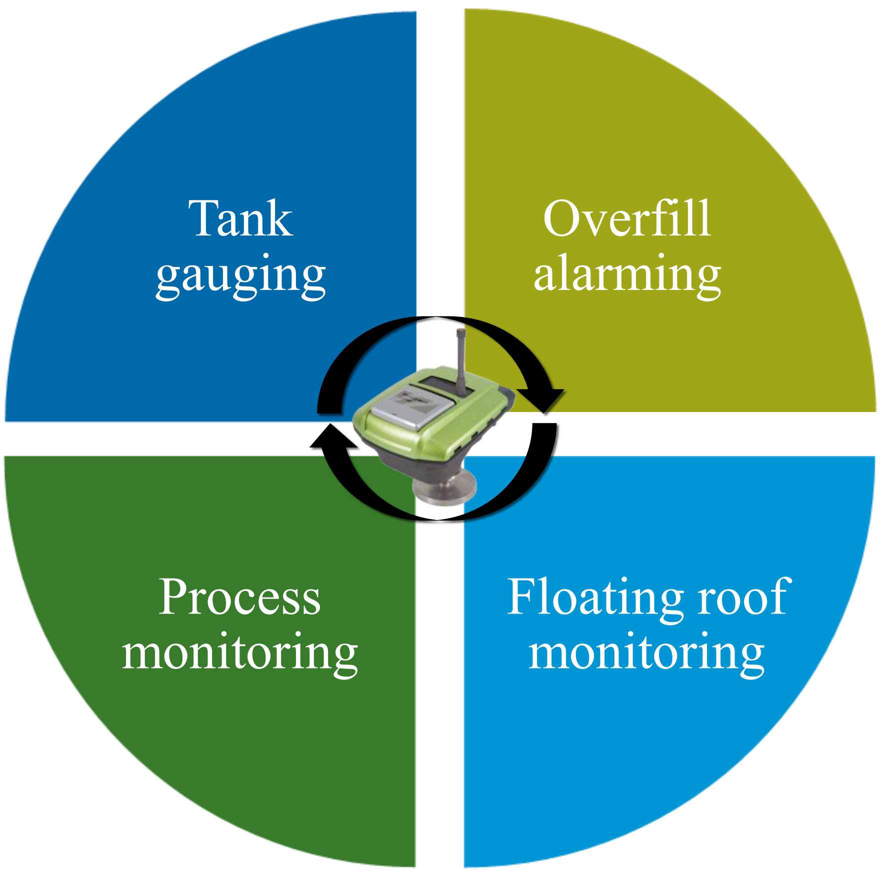
- Meshing capability
- Seamless integration with Entis Pro / Engauge / CIU
- Suitable for custody transfer (W&M approved)
- Highest accuracy over 75m (250 feet)
- Also transmits other local tank measurements over ISA100 Wireless
- Software upgrade over the air
- Provisioning over the air
- Safety Integrity Level: SIL2 certified

## Wireless Field Interface

- Able to connect existing gauging equipment to ISA100 Wireless network
- Zone1 capable hub
- Support for 854, 97x, 873, 811 GPU, 877 indicator
- Seamless integration with Entis Pro / Engauge / CIU
- Freedom of selecting appropriate gauge (Radar or Servo)

ISA 100 WIRELESS

# OneWireless Terminal Solution

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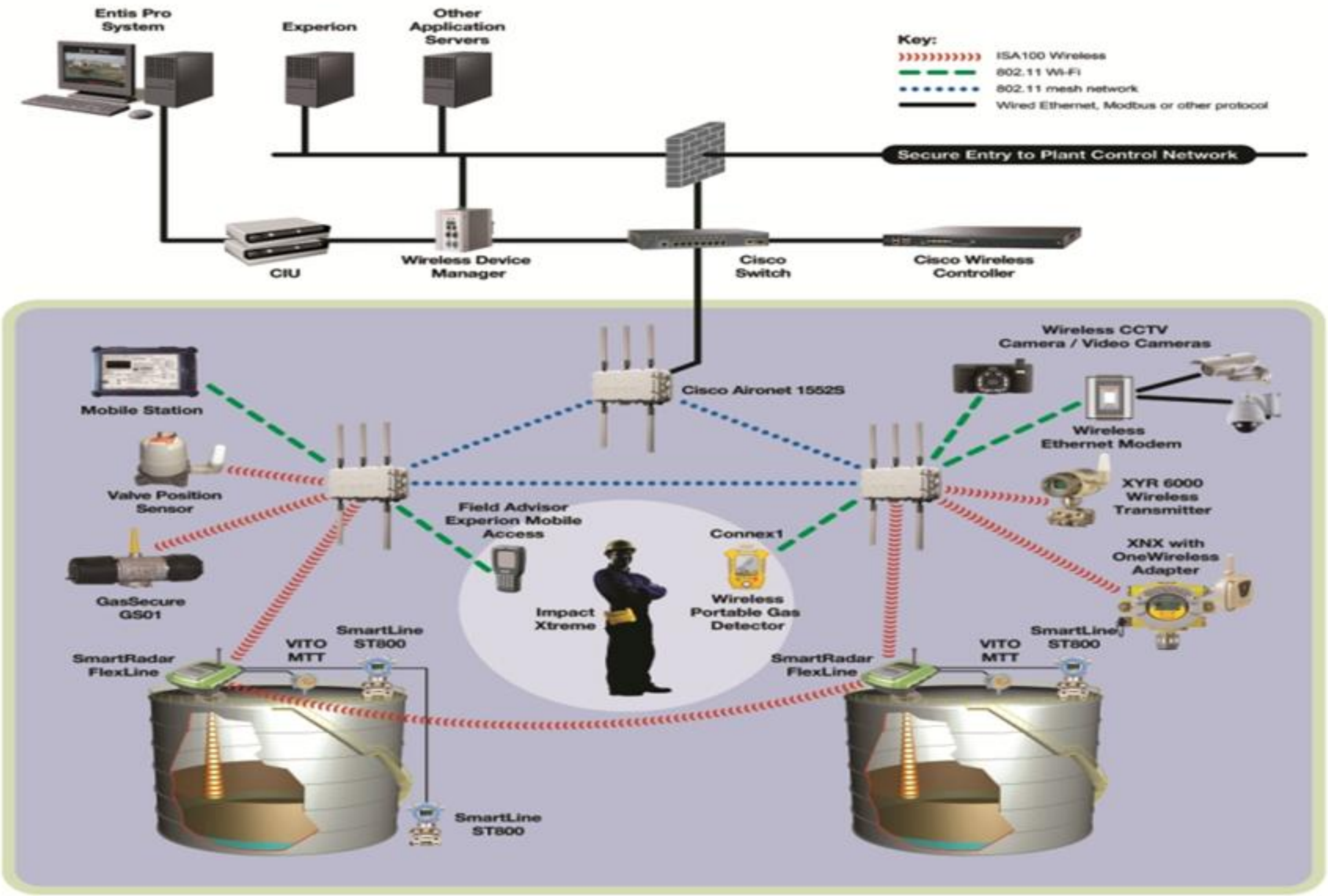
- Gas Leak Monitoring
- Safety Shower Monitoring
- Vibration Monitoring
- Valve Position Monitoring
- Personnel Safety Monitoring
- Mobile Applications
- Remote Area & Perimeter Video Monitoring

**Wireless applications beyond tank gauging**

# Architecture



# Wireless Devices Used

- Enraf SmartRadar FlexLine
- Enraf AlarmScout
- OneWireless Network
- ISA100 Field Instruments

# Wireless Devices Used

- OneWireless Adaptor
- Field Advisor
- GasSecure GS01
- Honeywell Analytics XNX


# Summary

- Case Study 1: Solar powered gas leak detection. With ISA100 Wireless, Honeywell was able to meet the “near real-time” alarm requirement of 3 sec to comply with government regulations.

- Case Study 2: Improve safety with secondary tank gauging. Multiple brownfield locations, difficult to wire. ISA100 enables  Honeywell Enraf to communicate wirelessly.

- With ISA100 Wireless Standard, Honeywell is able to design and integrate a wide range of devices including other wireless manufacturers devices.

# Observations

- International customers implementing wireless as part of their safety solutions. Using wireless for alarming to an operator.
- Interest in SIL 2 rated devices, but not required yet for wireless applications. Seeing manufacturers move towards SIL2 certification of wireless devices.
- In some cases customers are taking on some of the implementation of wireless installations. Requires good project management and flexibility by supplier.
- Supplier must be able to demonstrate reliability, robustness and performance of system during FAT.
- Once installed, many customers are expanding their systems to add additional devices.
- Software tools help to monitor the system and devices.


# For Your Attention!