Safety and alarming applications using ISA100 Wireless
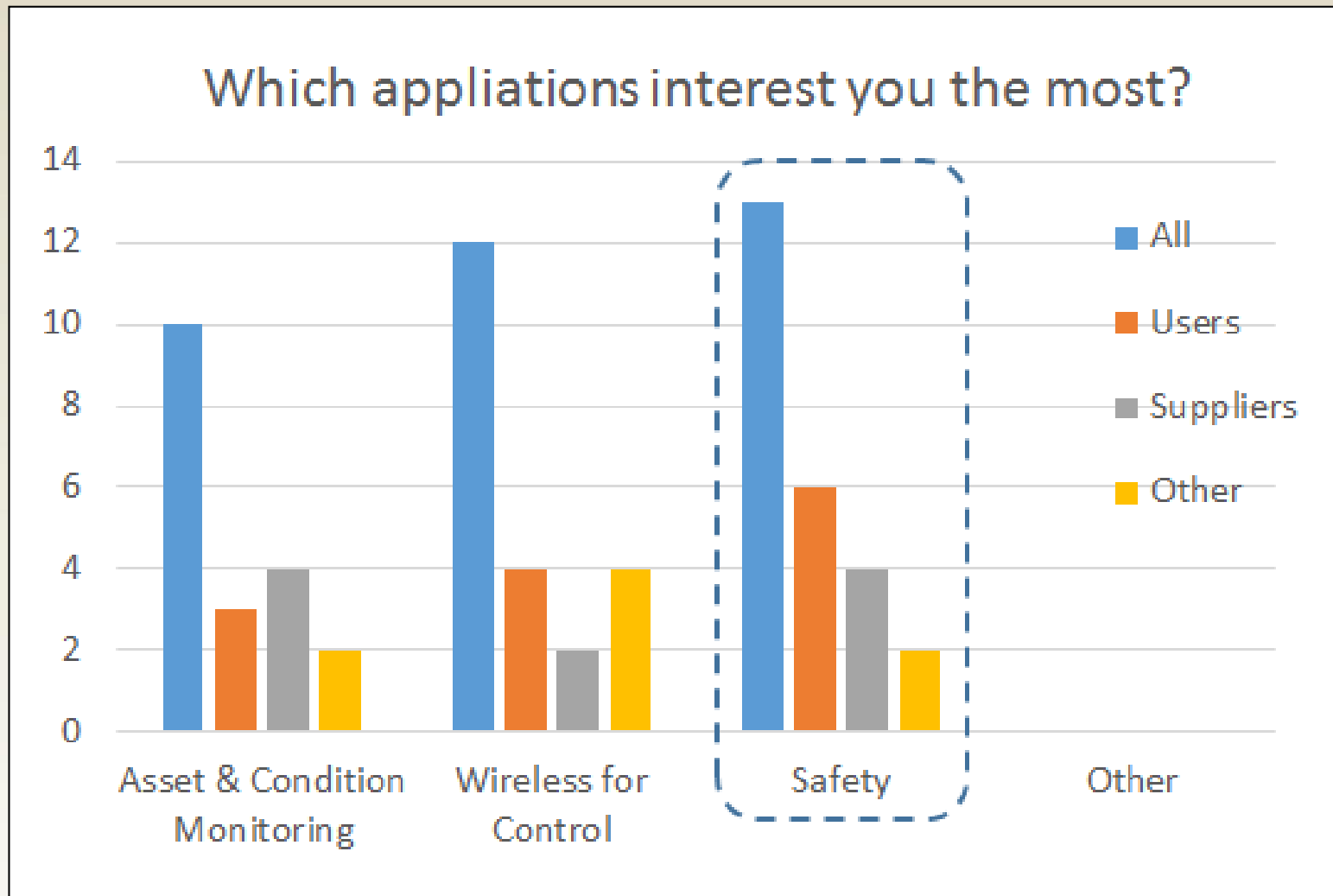
Yokogawa Electric Corporation
Toshi Hasegawa

Today's topics

1) Review WCI end use survey

2) Motivation of wireless for plant safety

3) Benefits of wireless

4) Key requirements
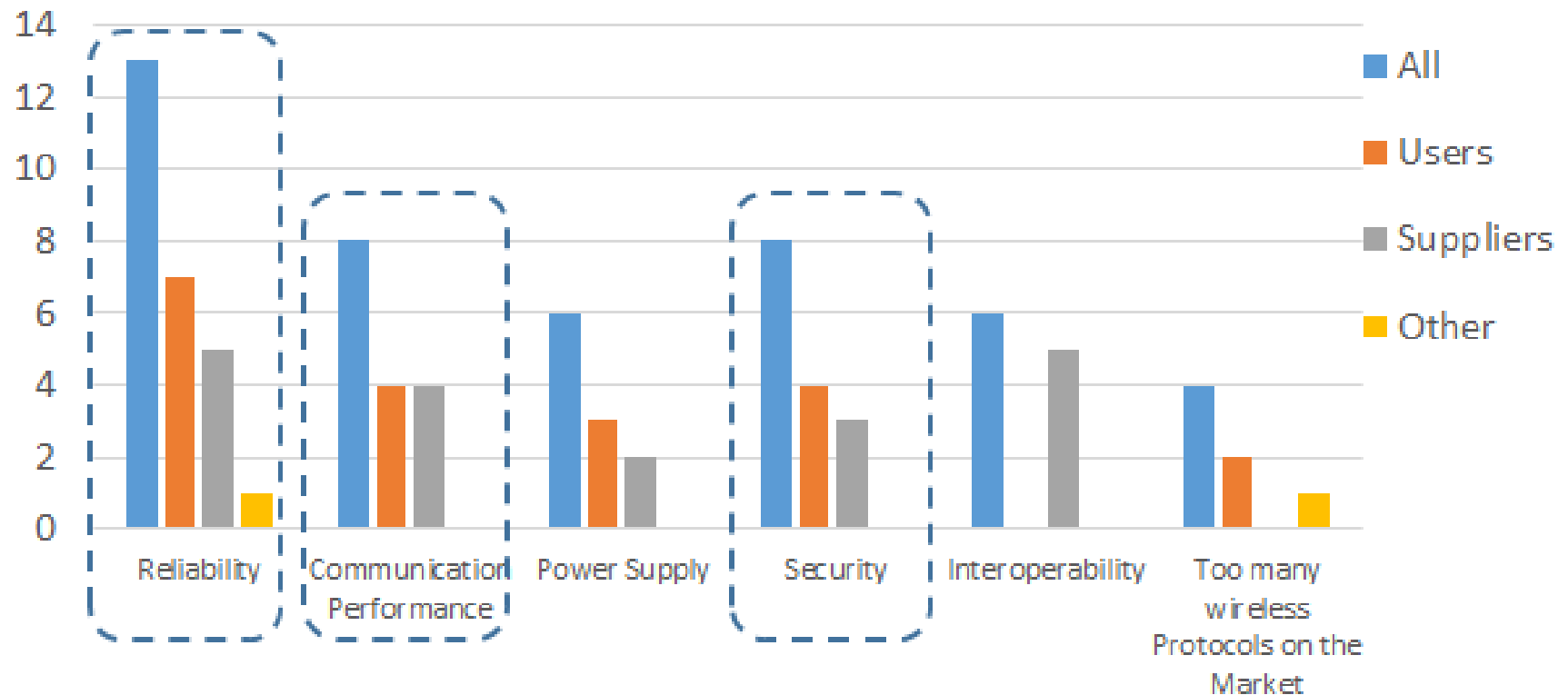
5) ISA100 Wireless solutions

6) Applications

7) Summary

Review WCI end user survey

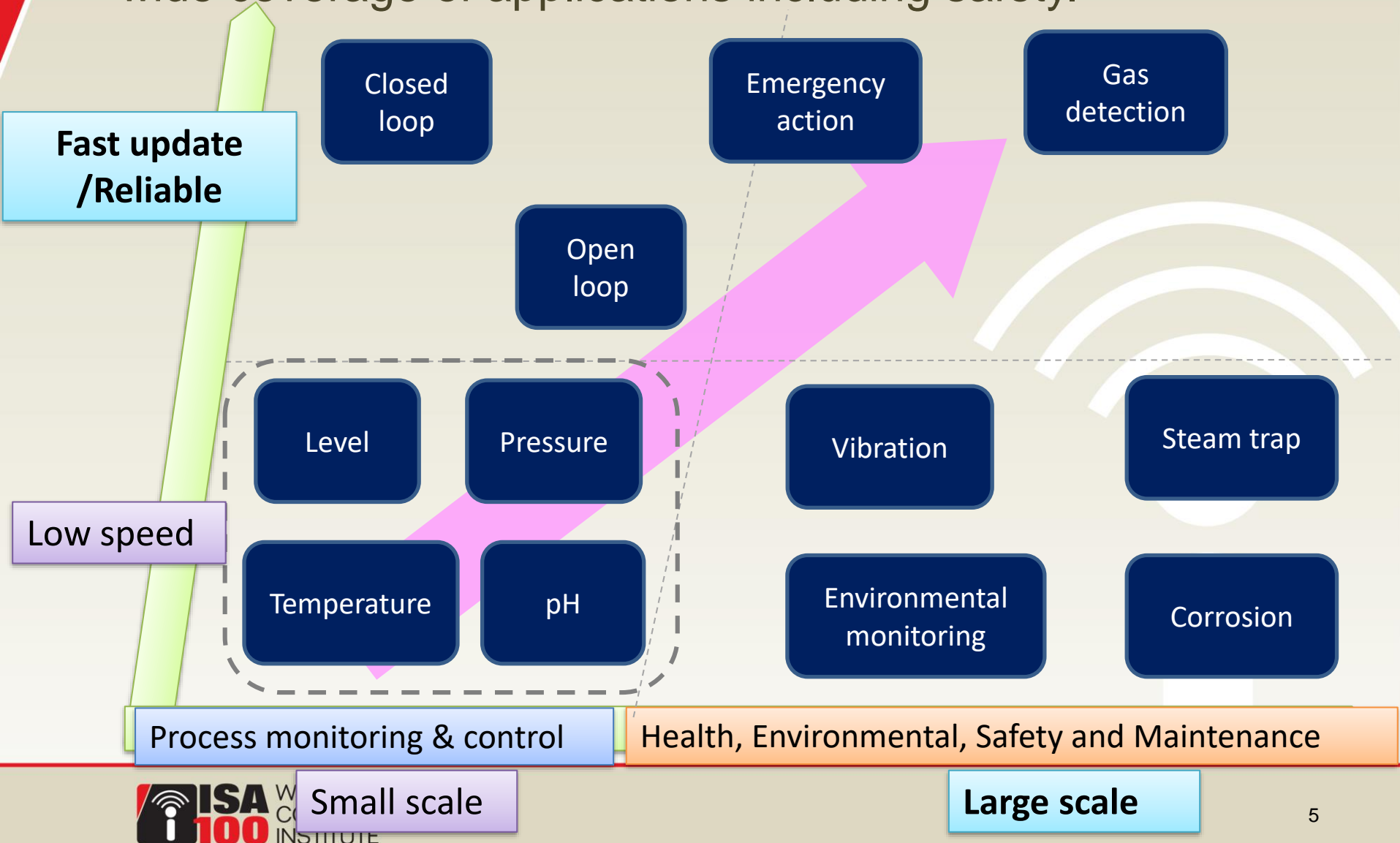Which appliations interest you the most?

Review WCI end user survey

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.

Fast update /Reliable

Low speed

| Closed loop | | Emergency action | Gas detection |

Open loop

Level | Pressure | Vibration | Steam trap

Temperature | pH | Environmental monitoring | Corrosion

Process monitoring & control

Health, Environmental, Safety and Maintenance

Small scale

Large scale

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.

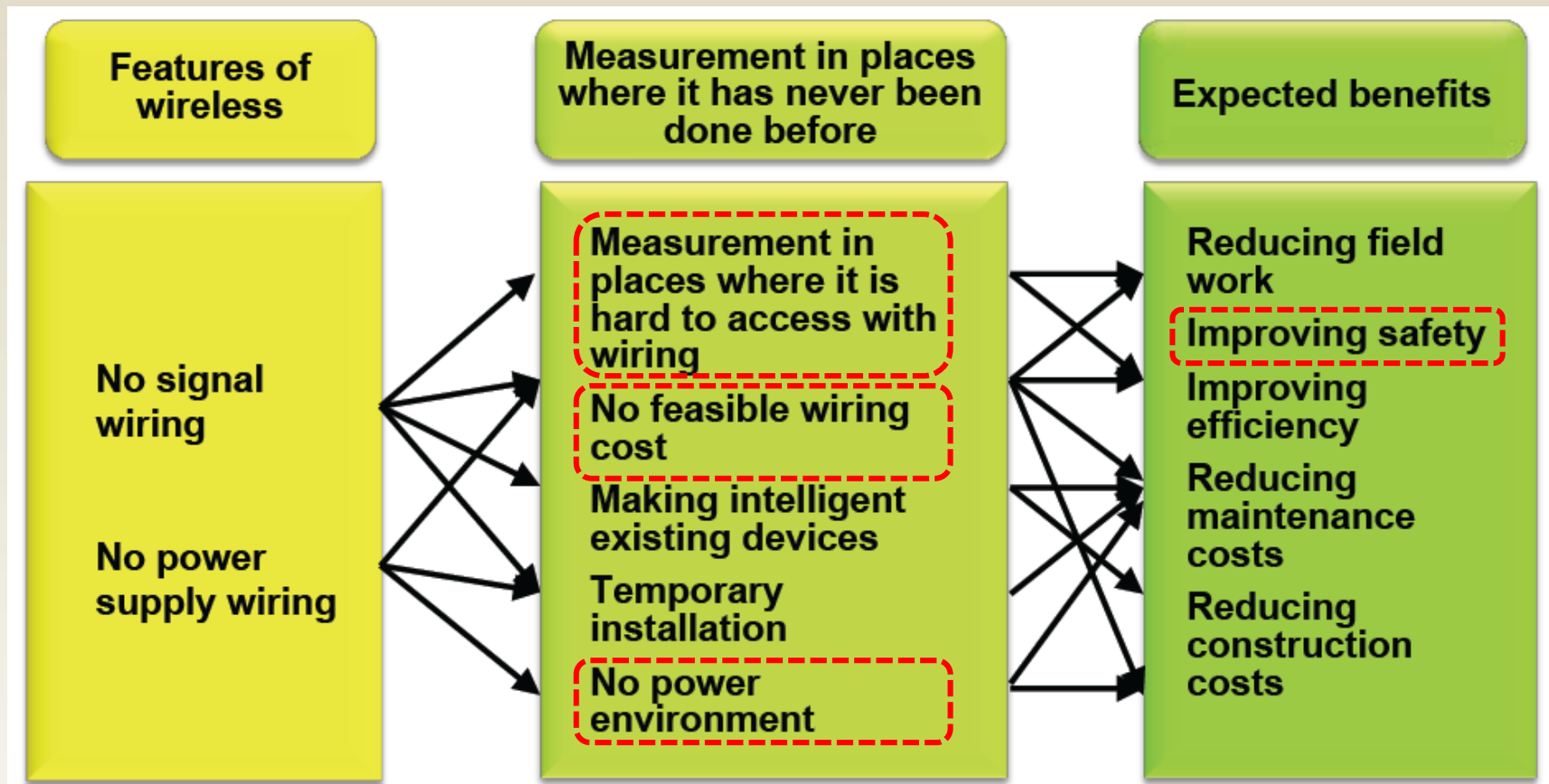Gas explosion
→ Plant wide monitoring

Tsunami disaster
→ Predictive monitoring

Fire of floating-roof tank
→ 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?
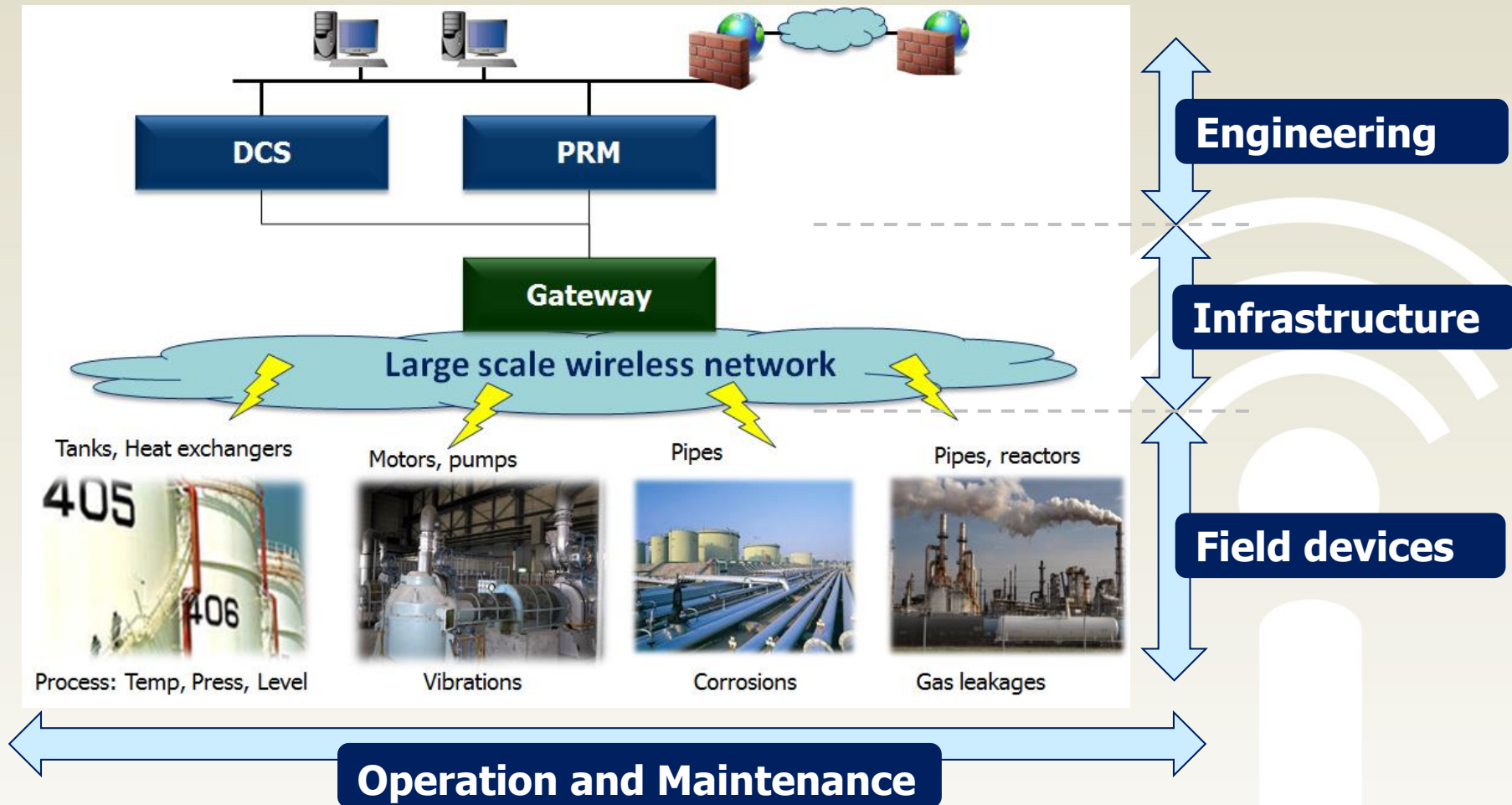
ISA100 Wireless is ready for safety applications
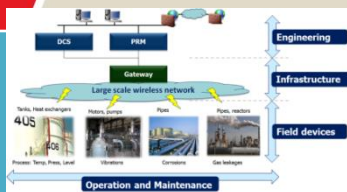
|	Robust communication	Emergency action	Plant wide coverage
Field devices	-Channel hopping -**DuoCast** com -Mesh network -Retry -CCA compliant to EN 300 328 v.1.8.1. -AES 128 encryption	-TDMA: Time slot com -**Publish/Subscribe** -**QoS management** Uplink / Downlink -Star topology -Safety layer on the top of ISA100 stack	-**Long range** com 600m (line of sight), 5km with 15dBi Ant -Remote antenna -Multi hopping
Wireless Infrastructure	-**Redundant Gateway and Access point** -Ch Black listing for coexistence with Wi-Fi	-**Backbone highway** Ethernet, Opt-Fiber , Sky Mesh NW to **minimize latency**	-**Multiple access points** for scalable NW -500 devices /GW -**Interoperability**
Engineering	-**Flexible network engineering** for **deterministic com**	-GW high side I/F to **support Safety protocol**	-**Flexible NW design** -Sky Mesh NW planning concept
Operation & Maintenance	-**Monitoring PER/RSSI** and com routes -Predictable Battery life	-**Satisfy IEC60079-29-1** performance requirement	-**Easy expansion of sub networks** by adding access points

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
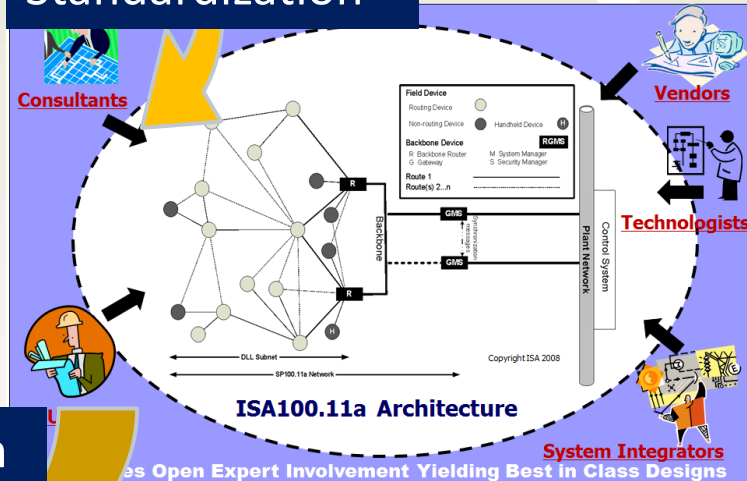- Energy monitoring
- Environmental
- etc.
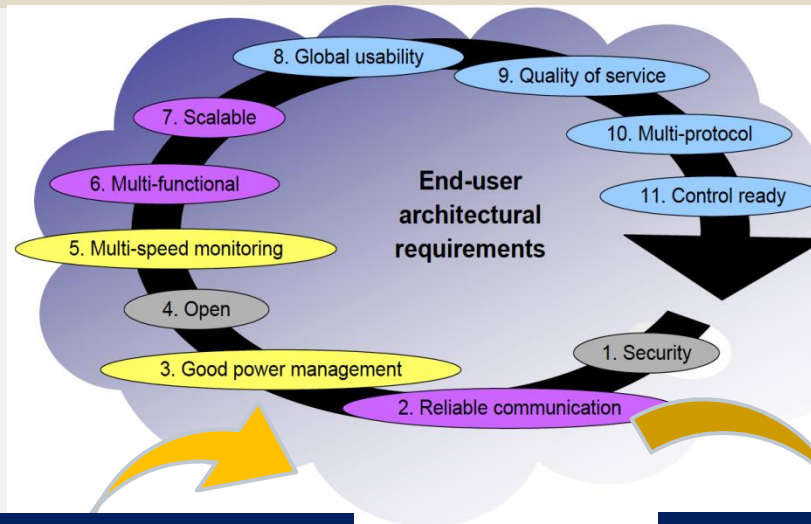
Breakthrough Technologies :

- 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
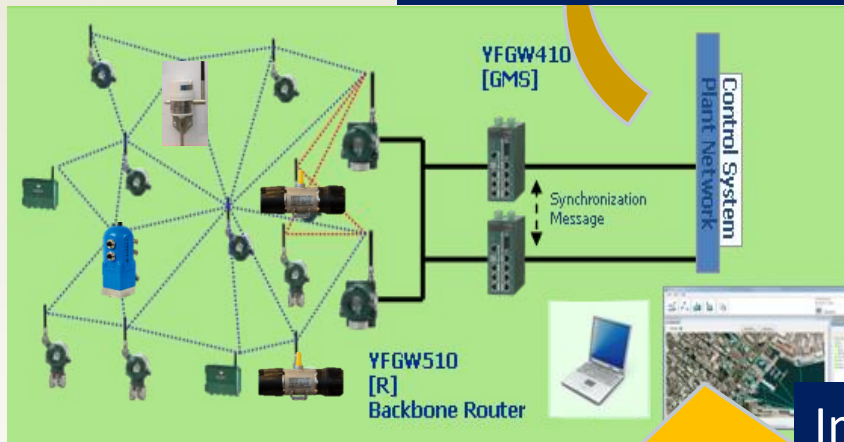
Standardization

Implementation

Assure multivendor interoperability
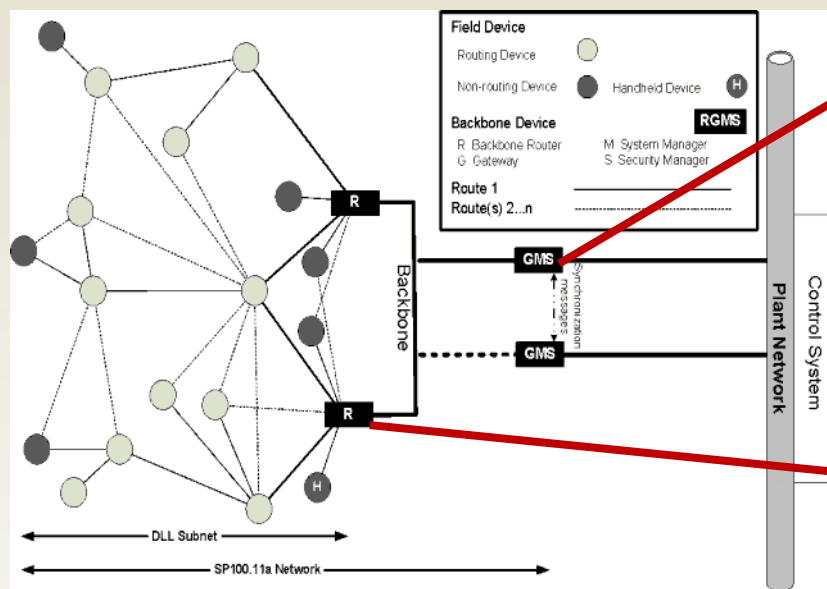- ISA100 compliance test
- Developing Implementation specifications
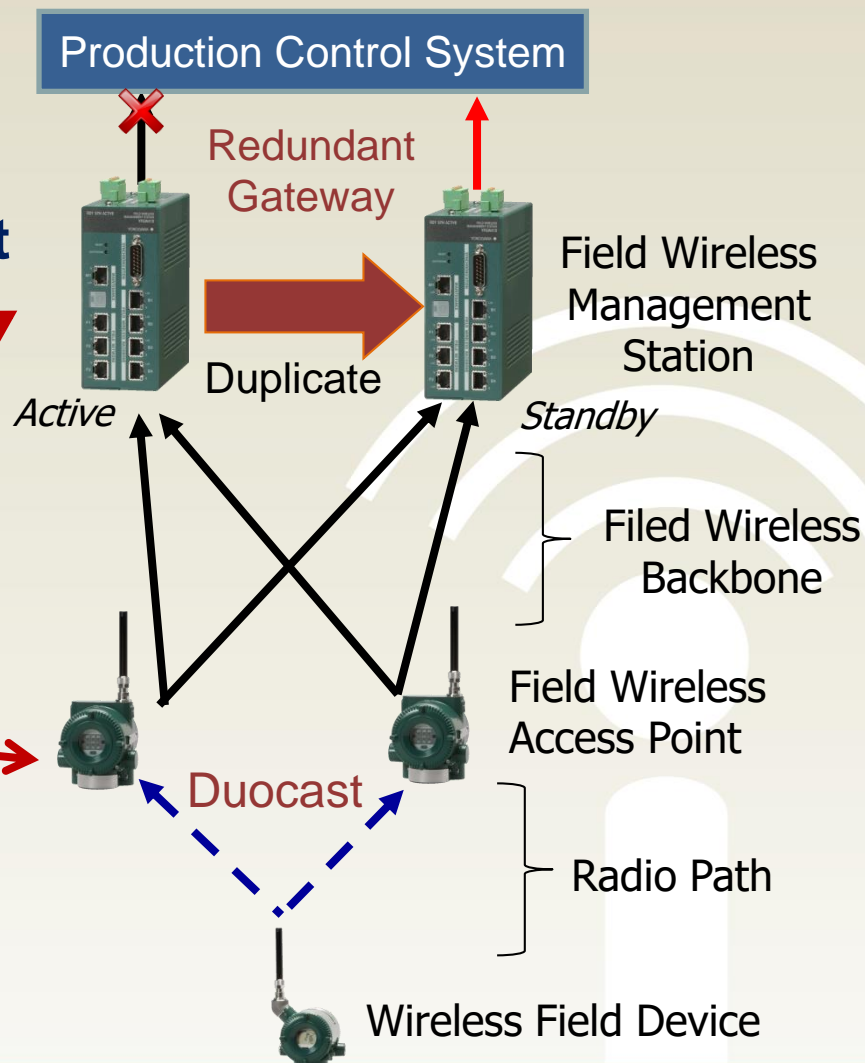
ISA100 Wireless key implementations

Reliability

Fault Tolerance

⬇

Redundant Gateway and Duocast


ISA100 Wireless Architecture

Production Control System

Redundant Gateway

Duplicate

Active

Standby

Field Wireless Management Station

Filed Wireless Backbone

Field Wireless Access Point

Duocast

Radio Path

Wireless Field Device

Timeliness

- **TDMA:** **Time Division Multiple Access**
- **Publish / Subscribe:** **Periodic data transmission**
- **The "Sky Mesh" : Network planning concept**
  1) **Deterministic communication with <u>short latency</u>** (minimizing hops)
  2) Reliable communication with **redundant paths,** Predictable battery life
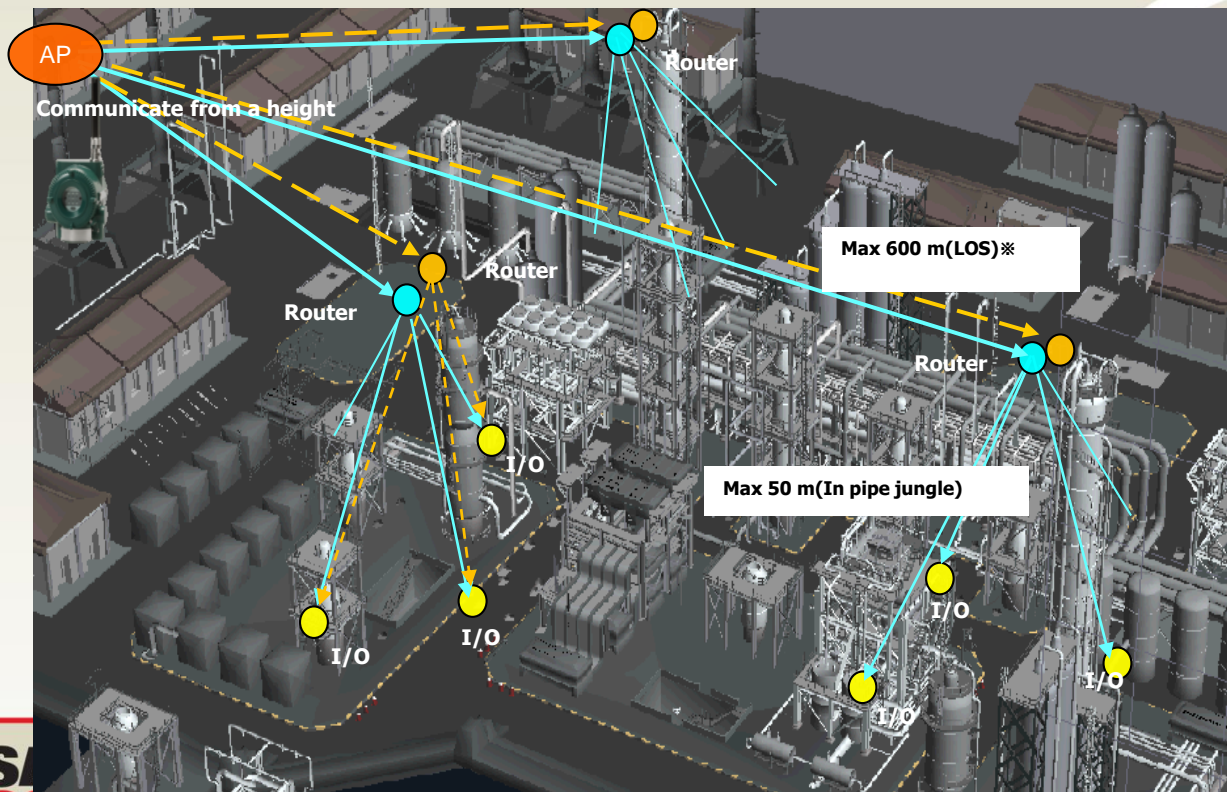
Scalability

Plant wide large scale wireless infrastructure

Process Overview Graphics
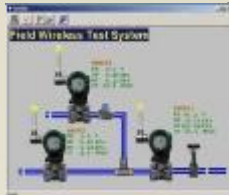
Field Control Station

ISA100 Full Functional

Redundant Gateway 1 sec Switchover

Management Station

Field Wireless Access Point
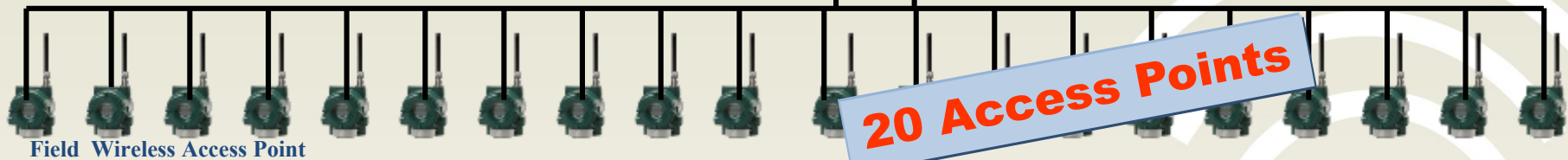
20 Access Points

500 devices@5sec update
200 devices@1sec update

SIL2 compliant

World first SIL2 Gas detection system

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

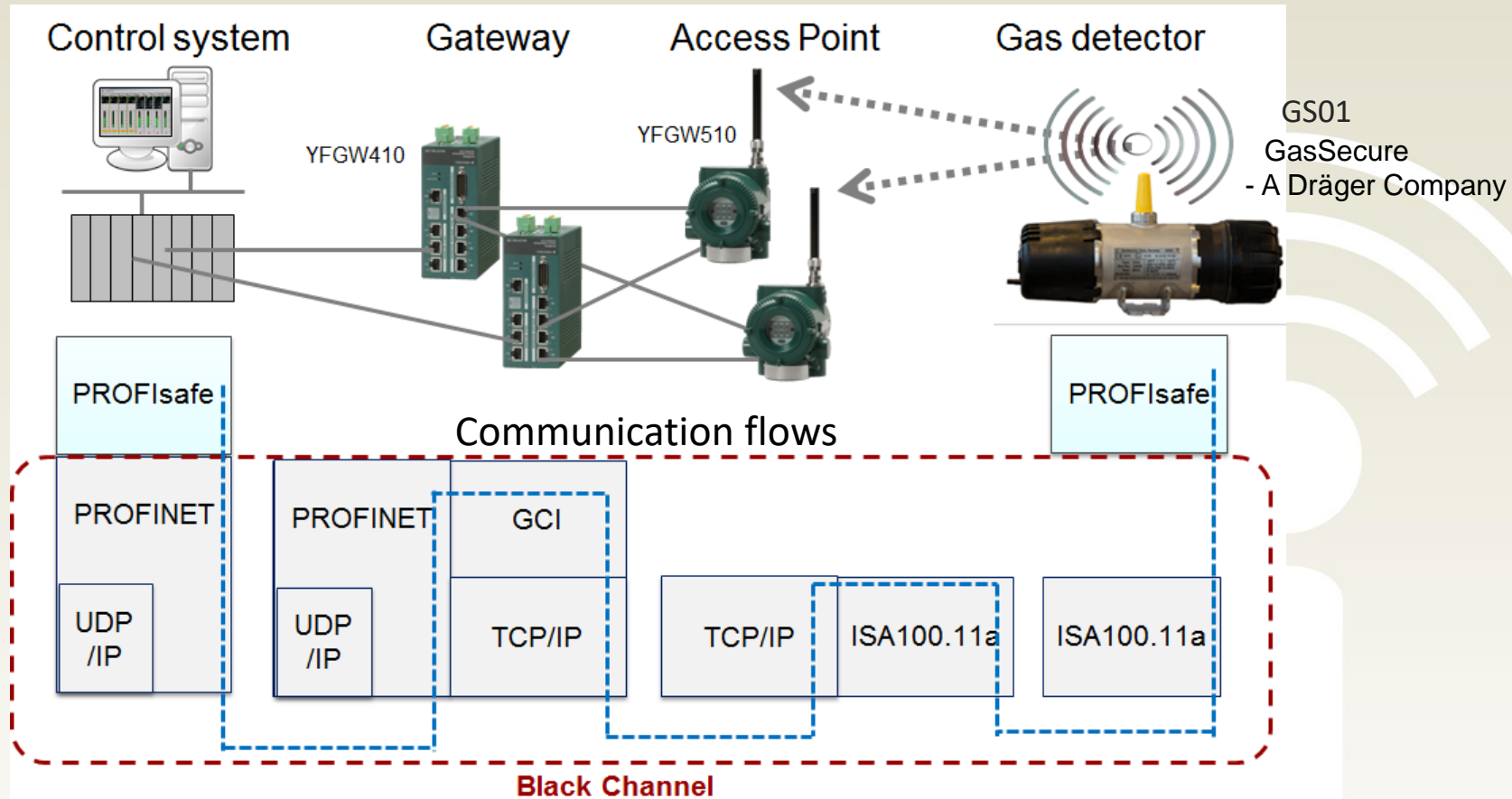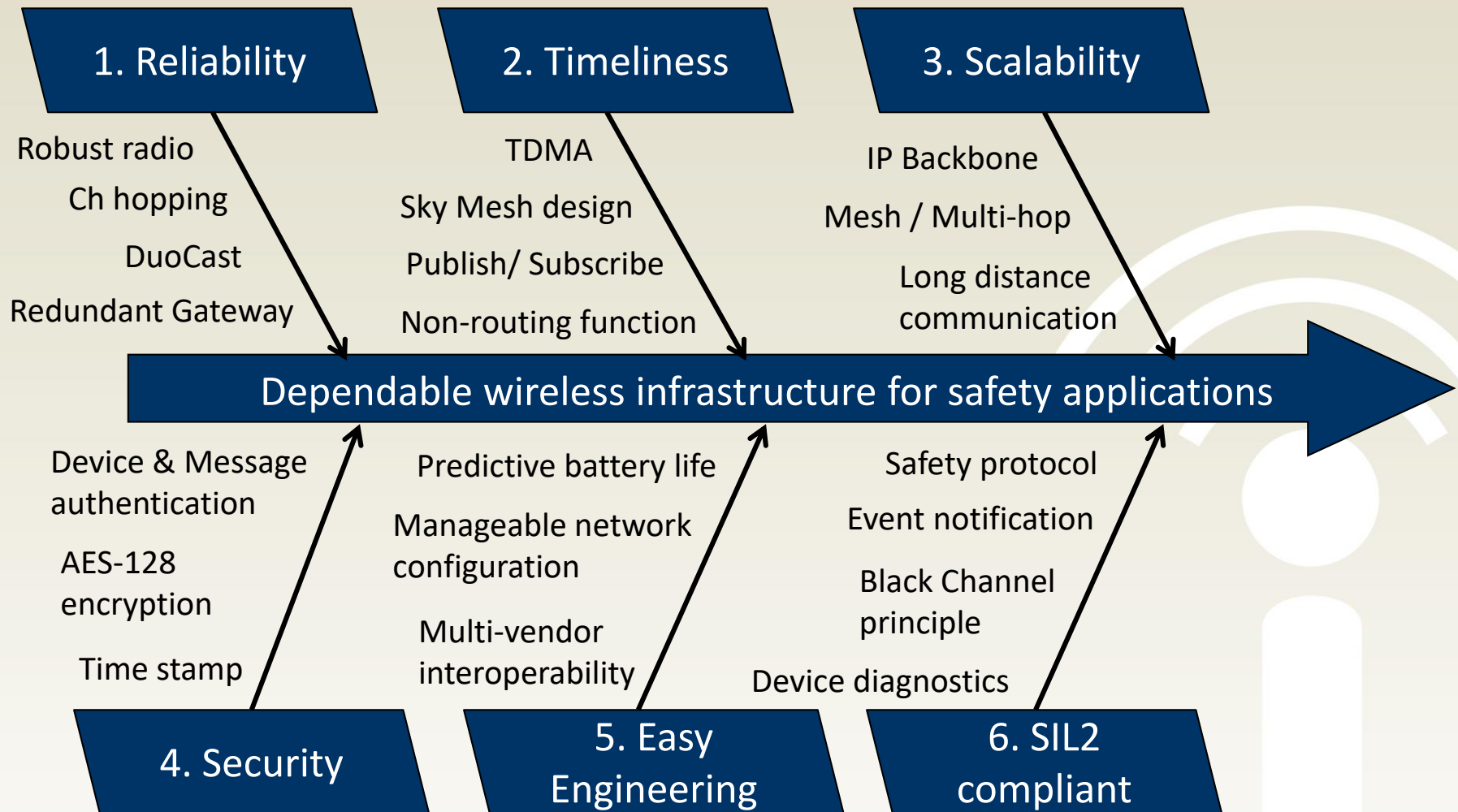# Key implementations for dependable wireless infrastructure

1. Reliability	2. Timeliness	3. Scalability

Robust radio

Ch hopping

DuoCast

Redundant Gateway

TDMA

Sky Mesh design

Publish/ Subscribe

Non-routing function

IP Backbone

Mesh / Multi-hop

Long distance communication

Dependable wireless infrastructure for safety applications

Device & Message authentication

AES-128 encryption

Time stamp

Predictive battery life

Manageable network configuration

Multi-vendor interoperability

Safety protocol

Event notification

Black Channel principle

Device diagnostics

4. Security	5. Easy Engineering	6. SIL2 compliant

Applications

Gas explosion
→ Plant wide monitoring

Tsunami disaster
→ Predictive monitoring

Fire of floating-roof tank
→ Emergency shutdown

Short latency

Long range

Downlink QoS
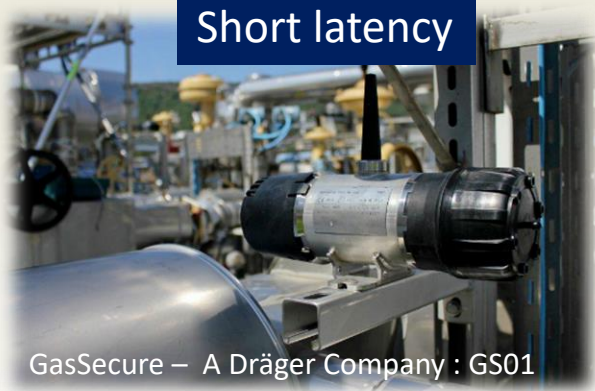
GasSecure – A Dräger Company : GS01

World first SIL2 compliant ISA100 Wireless Gas detector
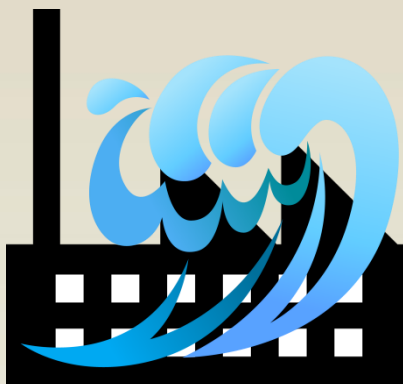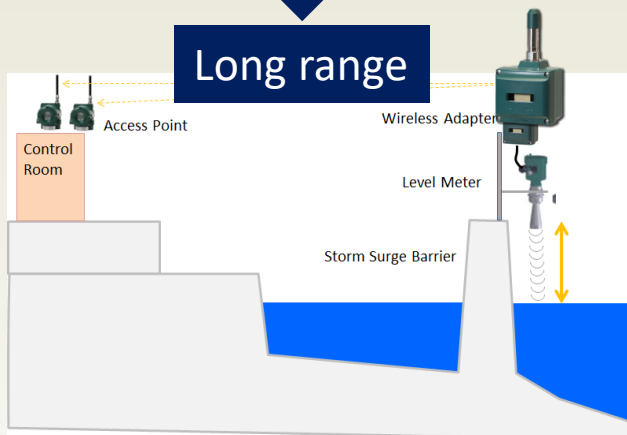
Tsunami warning system ISA100 adapter + level meter
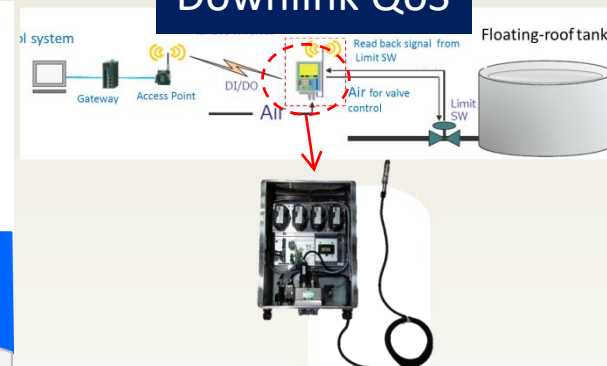
Remote valve control ISA100 DI/DO box

ISA 100 WIRELESS COMPLIANCE INSTITUTE

Safe plant operation

Gas leak detection

SIL certified

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

Field Testing of Long Distance ISA100 Wireless Transmitter and Wireless Gas Detector
DEIC/DE/P&E/TG
Ali Azizan Maamor

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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

18

http://www.isa100wci.org/en-US/Documents/Presentations/PETRONAS-ARC-Orlando-Gas-detector-Wireless-Experie

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

Another use cases

■ **Process monitoring**

➢ Temperature, Pressure, level, pH → Periodic data update, High availability, Low latency

■ **Asset condition monitoring**

➢ Vibration, Corrosion, Leakage → Plant wide scalability, Number of nodes, Large data siz

■ **Safety alarm & Emergency action**

➢ Gas leak, Emergency shutoff valve, Tsunami warning → High reliability, Low latency

Temperature monitoring for improving productivity	Vibration analysis for predictive maintenance	Gas leakage detection for safe plant operation

ISA 100 WIRELESS COMPLIANCE INSTITUTE
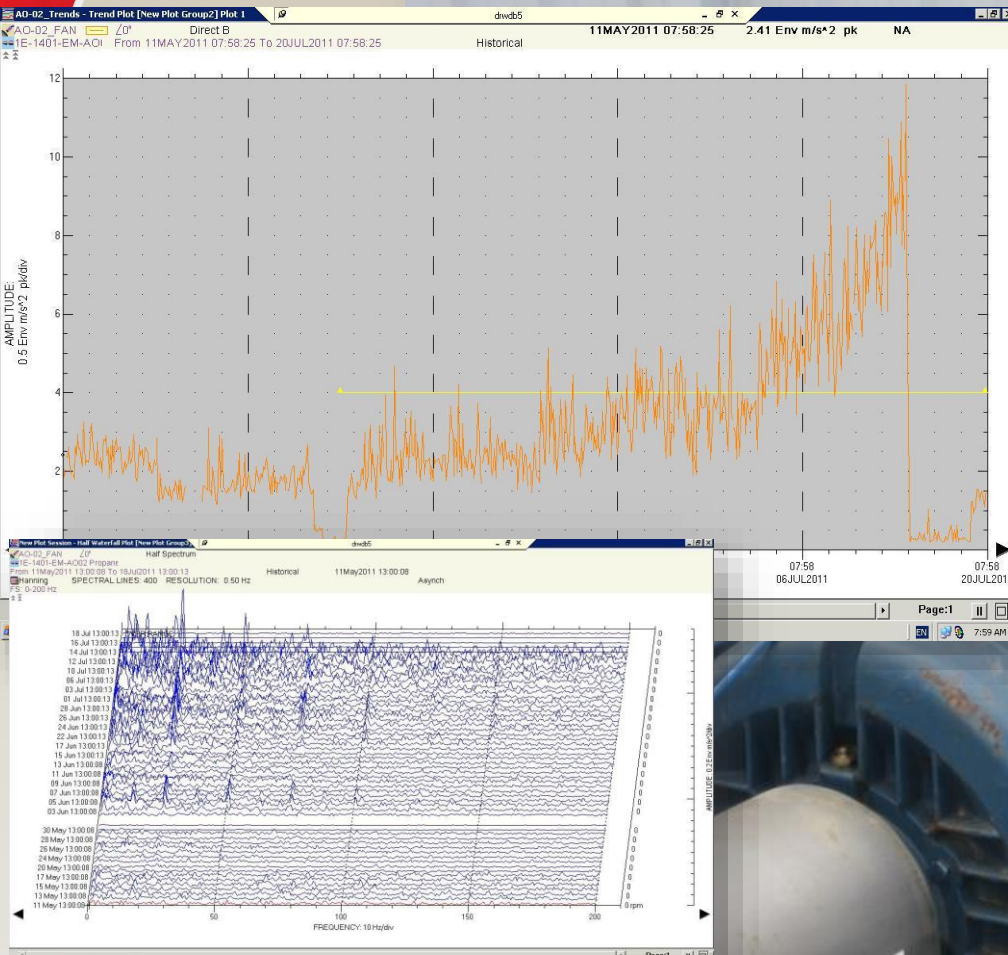
Reduce field patrols

Tank level monitoring

Optimized operation

Heat exchanger monitoring

Predictive maintenance

Vibration monitoring

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 on the **ISA100 Wireless**

Thank you for your attention

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100