Wireless in safety applications opportunities and challenges

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Taipei, Taiwan

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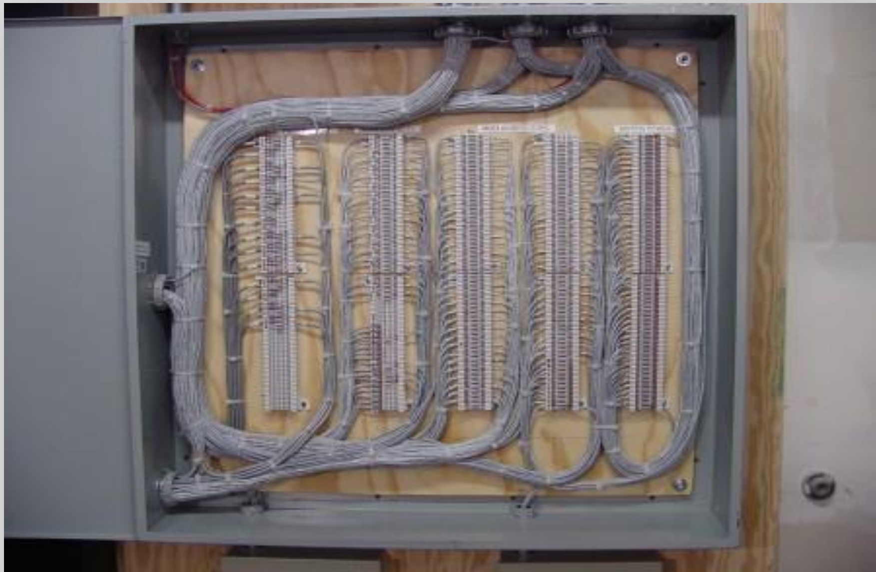
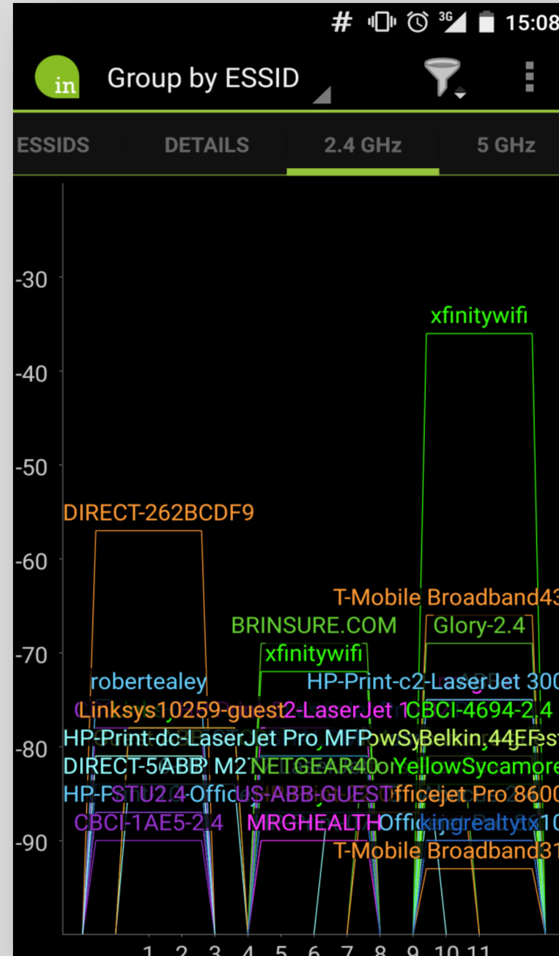
Wireless Technology
Pros and cons

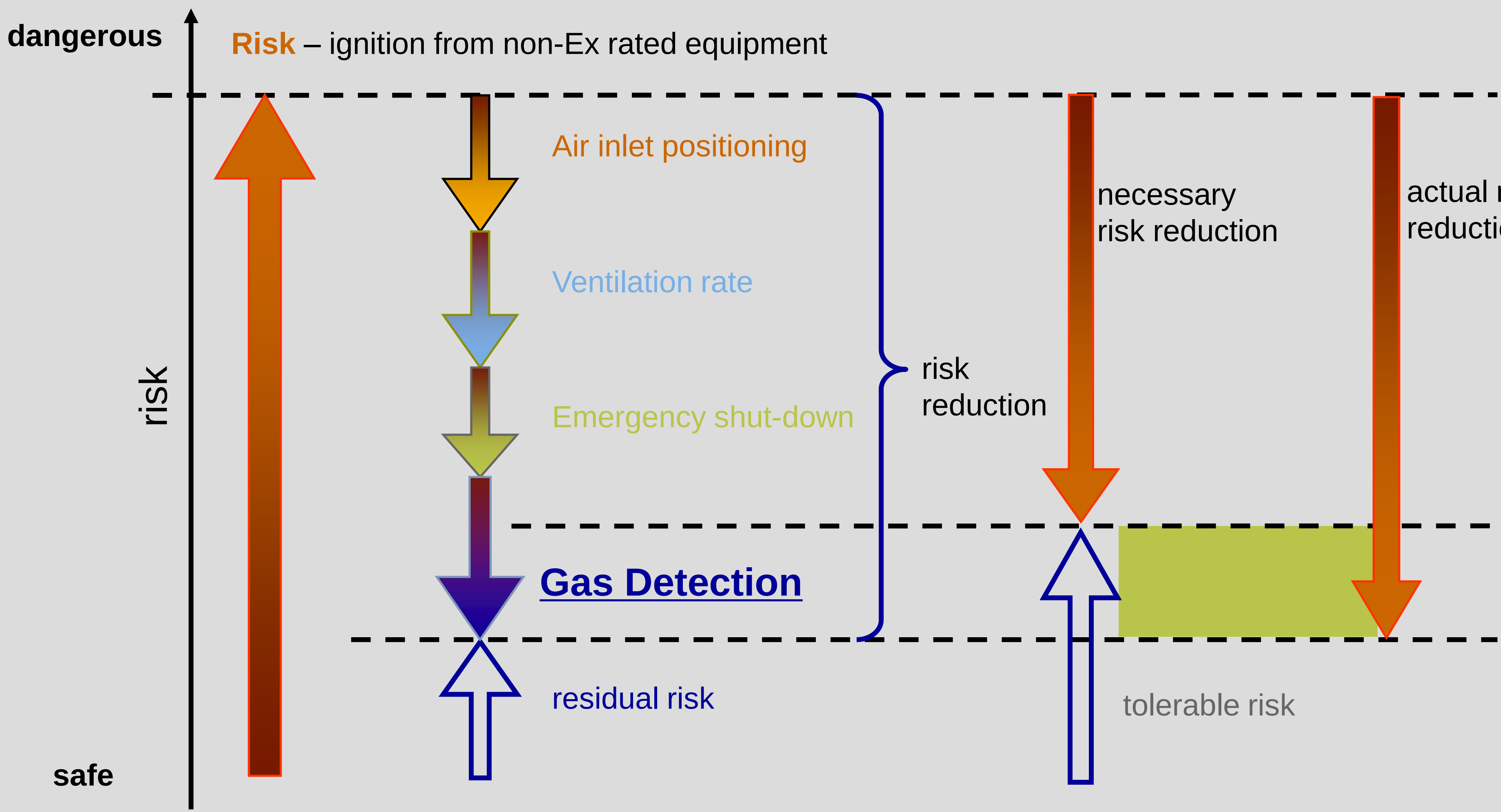


Wireless offers the possibility to **significantly save on cabling, engineering, documentation and labor** –

but wireless networks have to be very **carefully designed** to offer a comparable level of performance!



Why gas detection
A risk-related view



(Wireless) Gas Detectors in Safety Applications

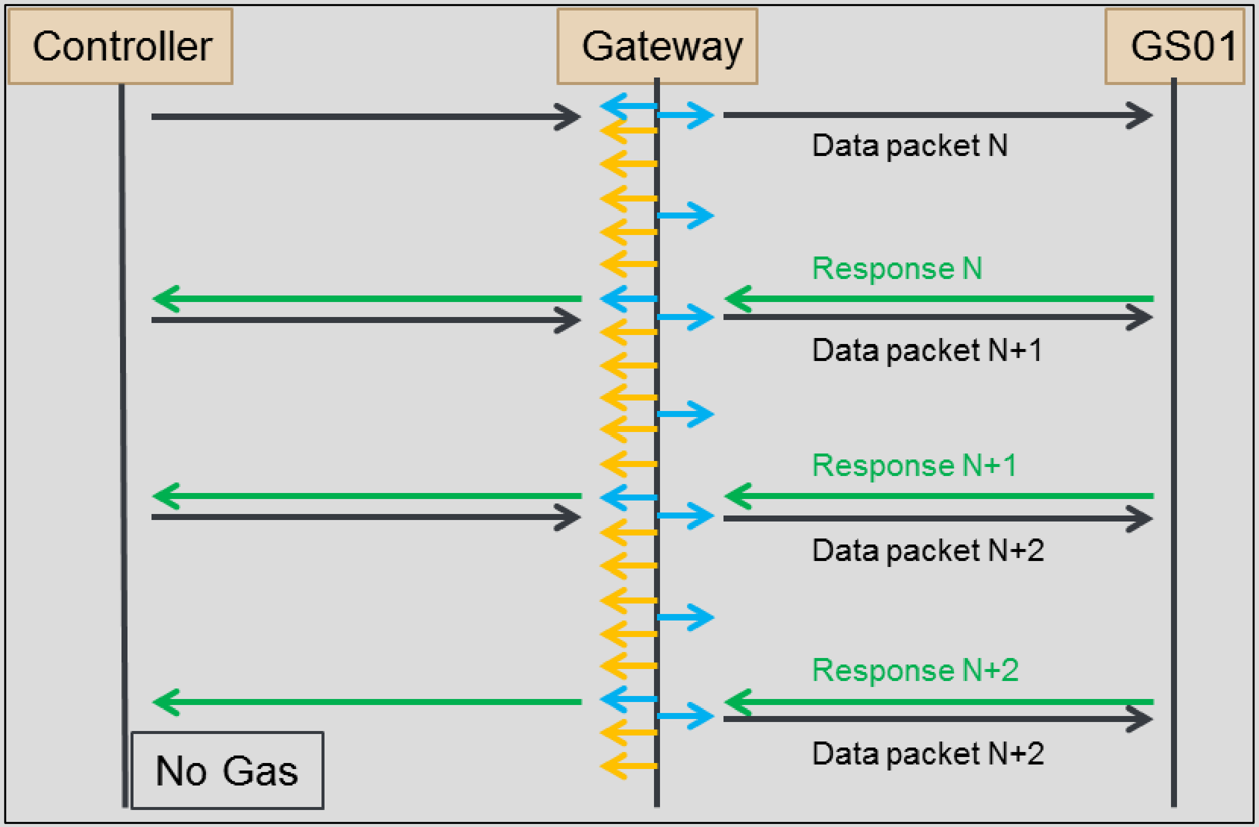
Design & performance criteria

- High availability
  - No lapse in detection coverage due to “blind” times or loss of packages
  - Communication patterns that allow for fast response times – **balanced with battery lifetime** for wireless applications
- High reliability
  - Reliable detection technology with no false alarms
  - Long maintenance intervals, little/no drift in between test intervals
  - Suitable for use in **SIL applications**

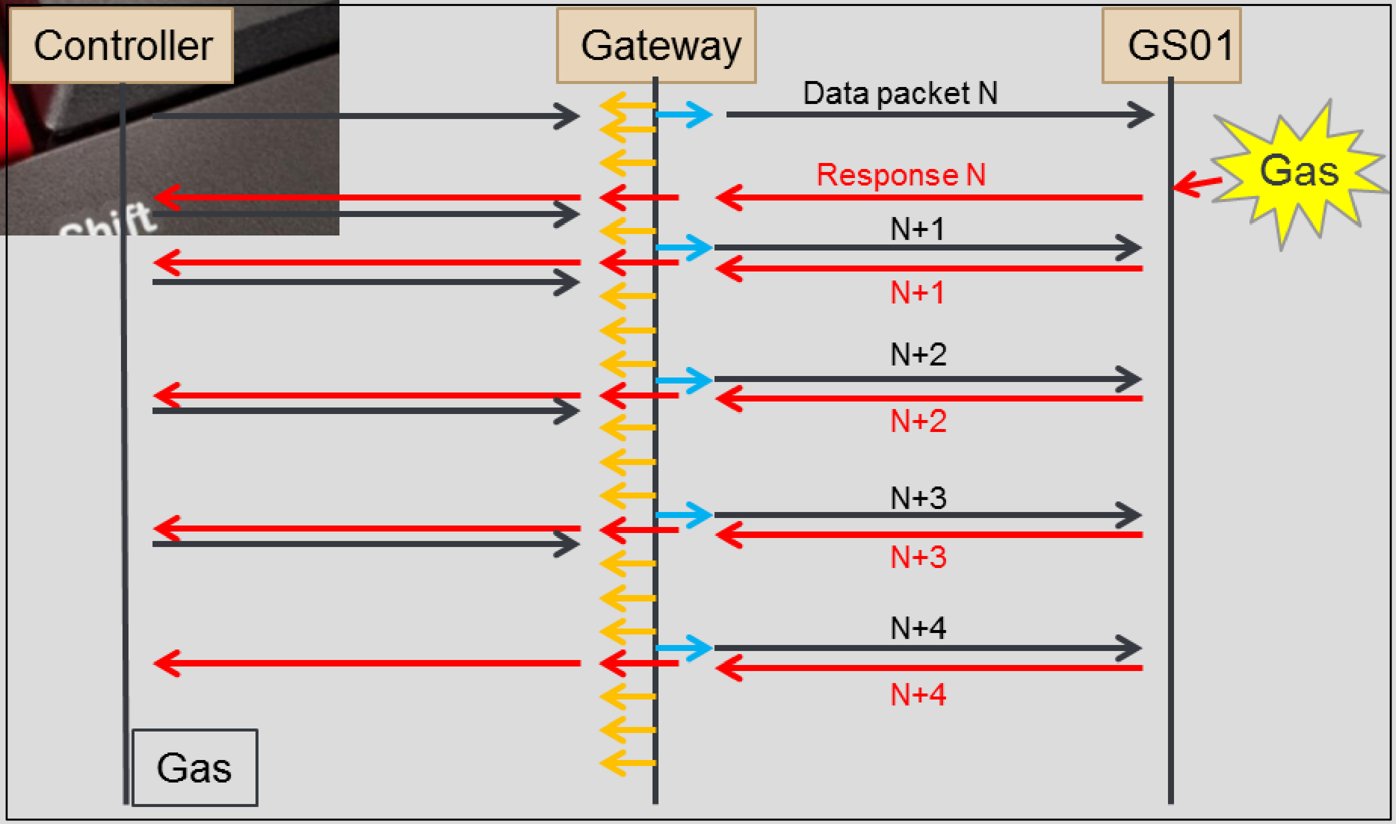
Wireless Networks in Safety Applications

Device communication patterns (1/2)

Balancing requirements for **long battery life** with **acceptable response time** – a trade-off?



Wireless Networks in Safety Applications
Device communication patterns (2/2)



Wireless Networks in Safety Applications

Criteria for network protocols (1/4)

- End-to-end **safety protocol according to IEC 61784-3** is required in SIL environments, which means that
    - Tunnelling/mapping of foreign safety related protocols such as PROFIsafe through the network is needed

- Quality of Service through limits for bandwidth, latency, and **priority** is ensured
- Integrity/**secure** (encrypted) wireless communication is provided
- Device **interoperability** supports communication of devices from multiple vendors in one network

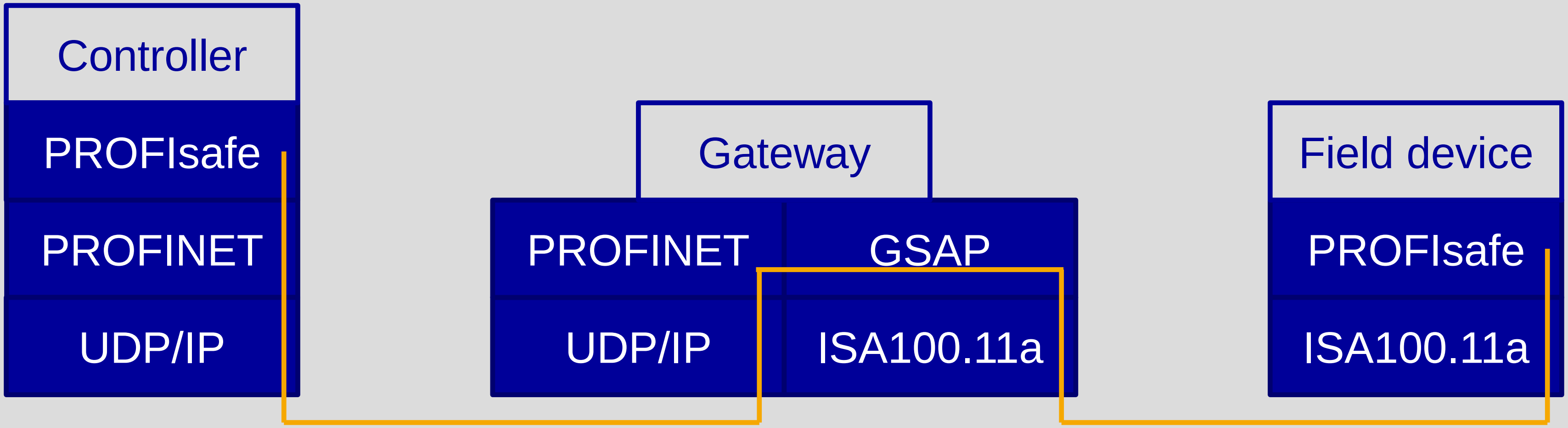
- ISA100.11a provides for all of this!

Wireless Networks in Safety Applications
Criteria for network protocols (2/4)

PROFIsafe is a safety related profile **defining application specific functionality** on top of the physical layer. PROFIsafe is SIL3 certified!

Black channel principle

- Independent of the communication method
- Covers the entire communication path from the sensor to the controller – the gateway needs to support PROFINET
- Protects for eventual failures in communication wrt to SIL capability



Wireless Networks in Safety Applications

Criteria for network protocols (3/4)

Error-handling mechanisms addressed by PROFIsafe: Safety-related protocols need to be able to mitigate a range of errors if used in SIL environments:

Failure/Remedy	Sequence Number	Time-out with Receipt	Codename for Sender and Receiver	Data Consistency Check
Repetition	X			
Deletion	X	X		
Insertion	X	X	X	
Resequencing	X			
Data Corruption				X
Delay		X		
Addressing			X	
Masquerade		X	X	X
Memory failure	X			

Only the combination of **ISA100.11a and PROFIsafe** currently allows us to implement all 4 mechanisms!

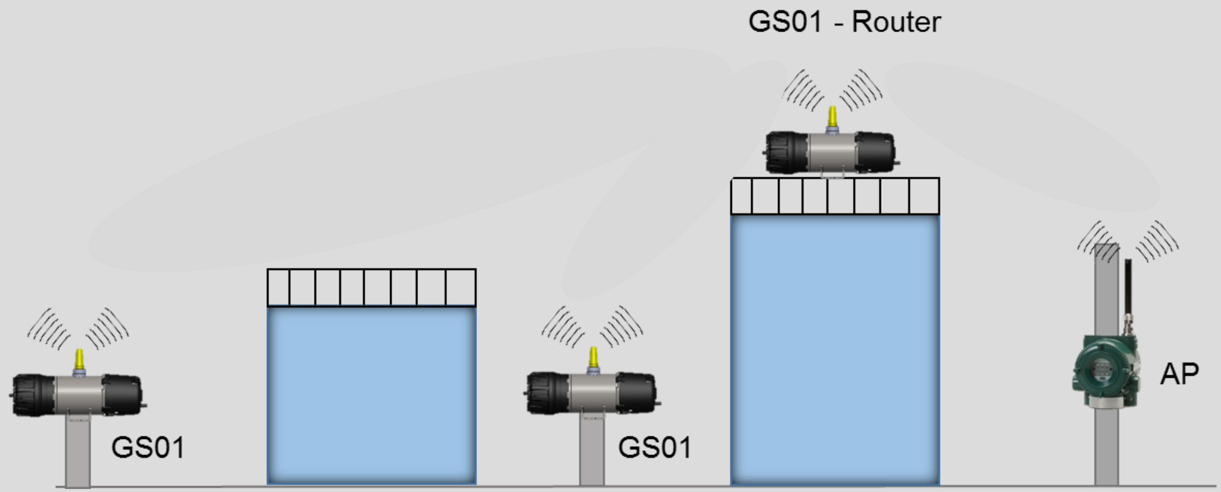
Wireless Networks in Safety Applications
Criteria for network protocols (4/4)

Quality of Service can give priority to packages from certain devices, service etc.

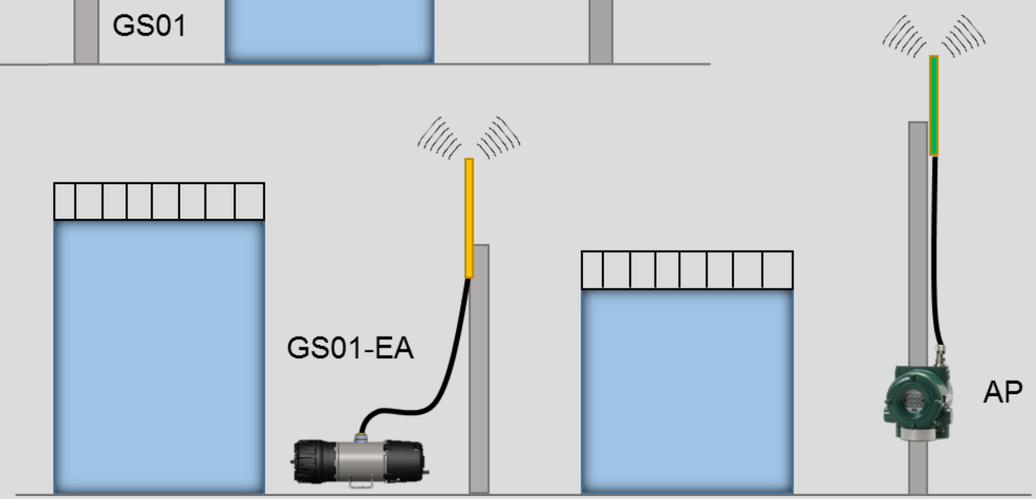
In safety-related applications, this can be used to **give priority/reserve bandwidth/ensure low latency** for safety-related packages as opposed to e.g. monitoring packages.

Wireless Networks in Safety Applications
Deployment environment

Even if we use a safety-related protocol, we still need a **reasonable level of control over the deployment environment** to ensure a high level of performance…



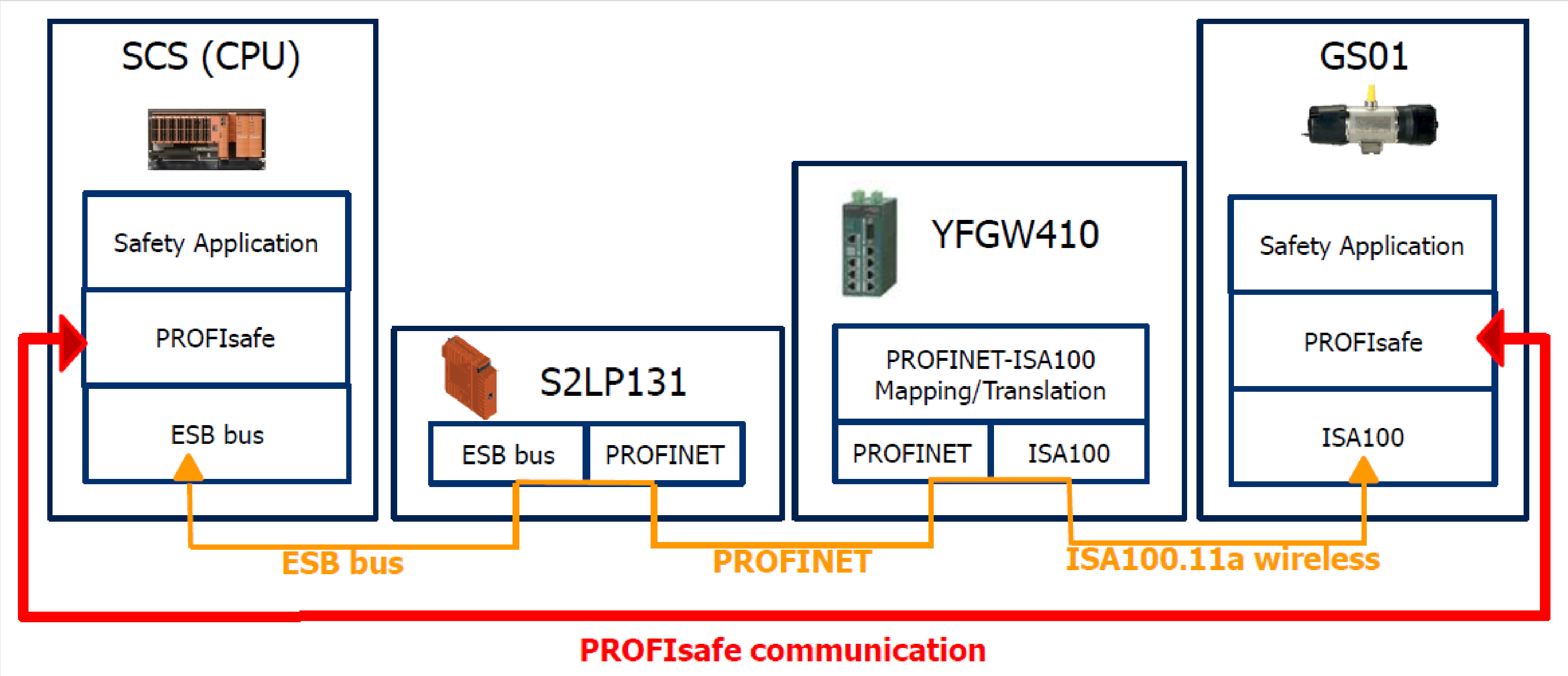
Practical solutions: Use of **routers** (within hop limit spec) or **extended antennas** (careful with attenuation though)



Wireless safety communication realization

Safety loop with SIL2 certified wireless gas detector

- Realized safety application between wireless combustible gas detector and ProSafe-RS



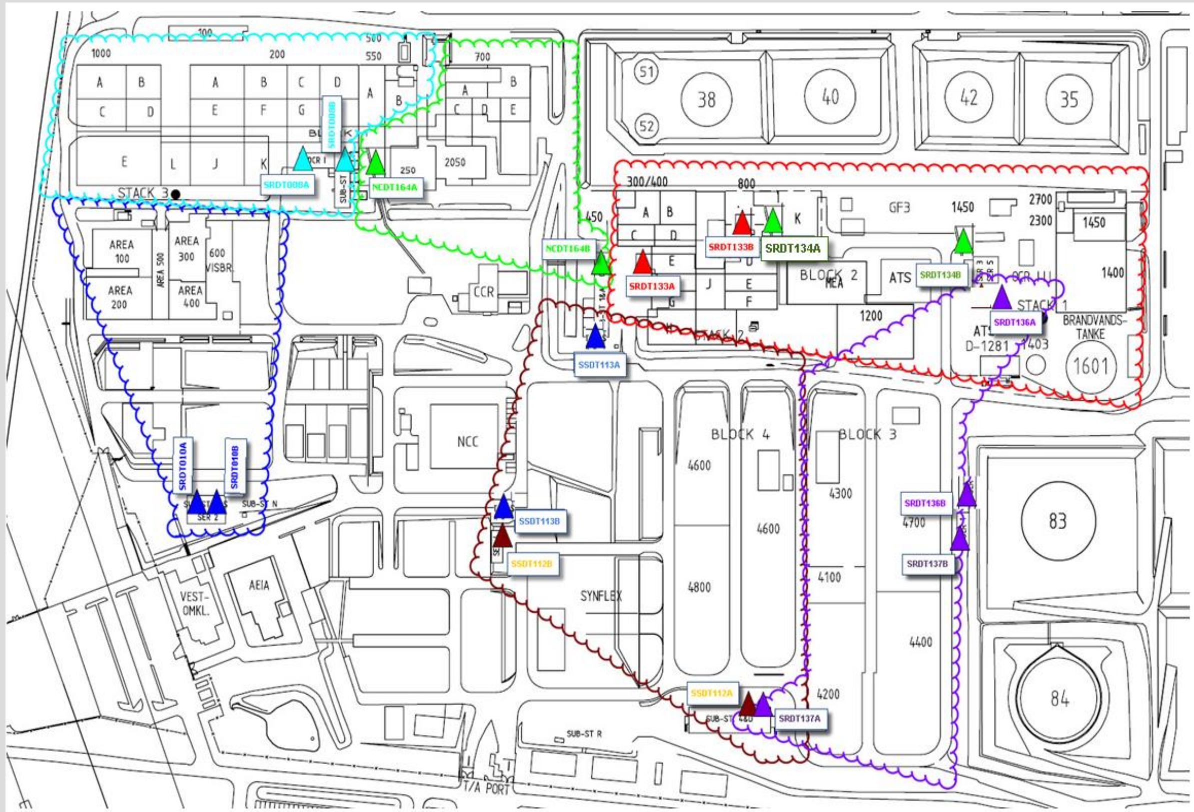
Case Study

Fill-in detectors for Kalundborg refinery

	CASE: ONSHORE/REFINERY
Client / Country	Statoil Refining / Denmark
Project / Facility	Fire & Gas Extension / Kalundborg Refinery
Process / Plant / Application	Fill-in detectors for 3 process areas after risk assessment determined inadequate coverage by current system
Equipment / Infrastructure	114 units GS01 / 8 units GS01-EA / Other detectors 3 Gateways / 18 Access Points / Siemens S7
SIL or Non-SIL	SIL2 capable
Main Challenges	Large, congested plant area. Enclosed spaces.
Key Notes / Key Sales Points	Cost reductions with wireless – initial cost was estimated to be around USD 20 mil. for HC and H2S detectors. With wireless hydrocarbon detectors, costs could be brought down to roughly USD 7 mil.

Case Study

Fill-in detectors for Kalundborg refinery



- Project was split into 3 phases (3 geographical areas)
- Placement of access points was based on existing knowledge for wireless on this site

Fill-in detectors for Kalundborg refinery

<u>Phase 1 Block 1</u>

<u>Detector locations</u>

Green = GS01

Purple = Other

Block 1 area has wireless challenges due to heavy machinery blocking communication.

Detectors with extened antenna was chosen to overcome this challenge.

Case Study
Site pictures from Kalundborg

Dual access points with good access to a majority of the detectors.

Detector with remote antenna

Case Study
Site pictures from Kalundborg

Control room display with gas detectors

Wireless gas detector in the field

Case Study

Summary of experiences from Kalundborg

- Planning of wireless infrastructure placement can largely be done by visual inspection, but local circumstances can give surprises
- It is better to have some extra infrastructure and instruments installed or ready for use in case challenges occur during commissioning.
- Wireless technology increases the flexibility in placing and moving of equipment
- Expanding with additional instruments on wireless installations is very easy
- Using wireless for safety is a step change for any organization starting to use this. Local competence and understanding of wireless should therefore be developed

- We would have chosen wireless again today. Wireless is the future.

Dräger

Thank you for your attention.

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