



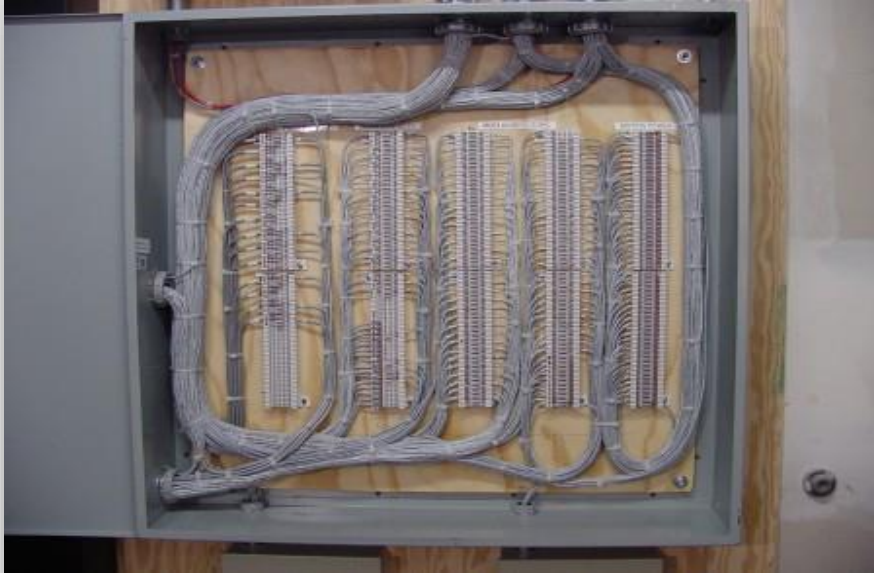
# Wireless gas detection; opportunities and challenges as experienced in design and in the field

Rotterdam, 09/27/2016, Jorgen Svare, Head of Operations GasSecure



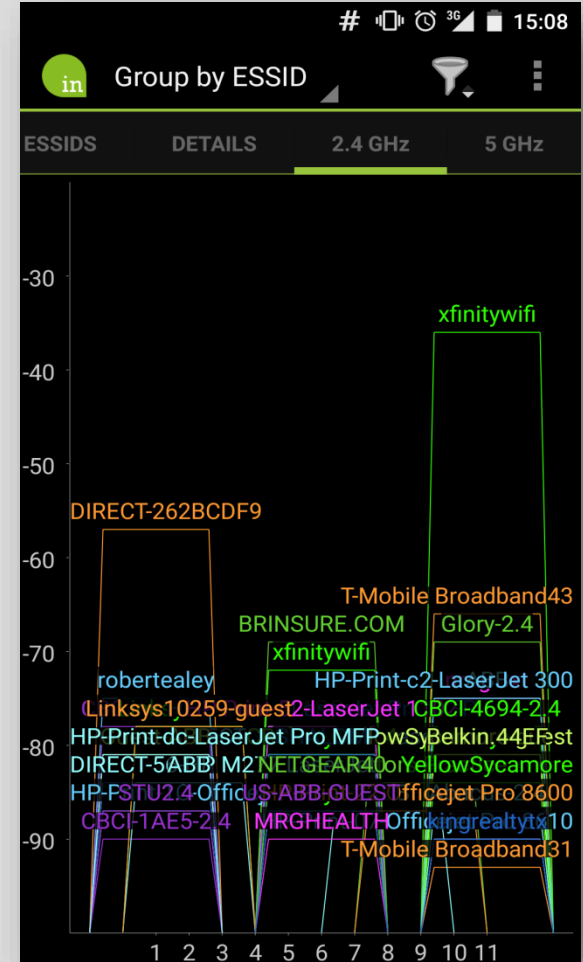
# Wireless Technology

## Pros and cons



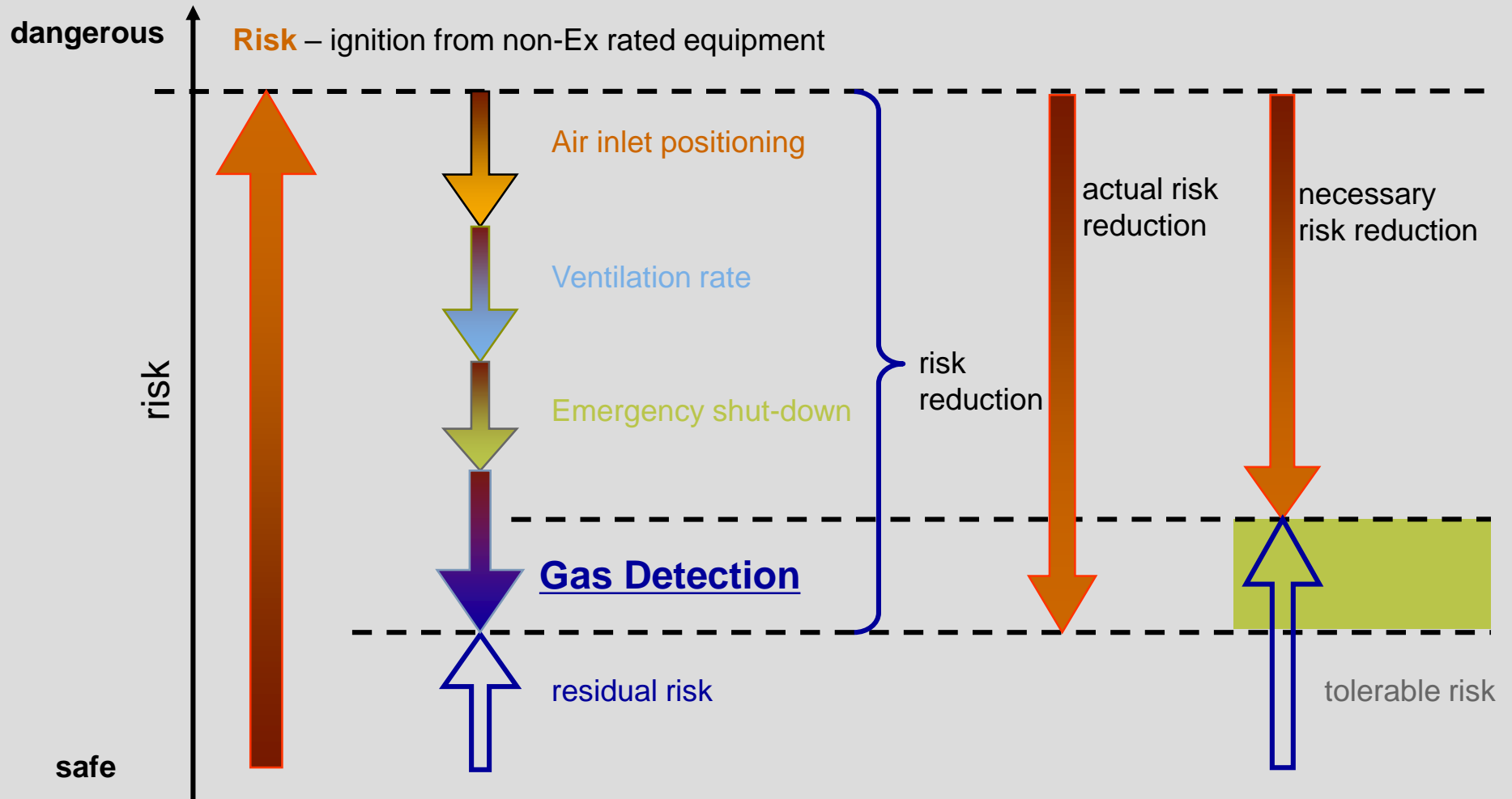
Wireless offers the possibility to **significantly save on cabling, engineering, documentation and labor** –

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

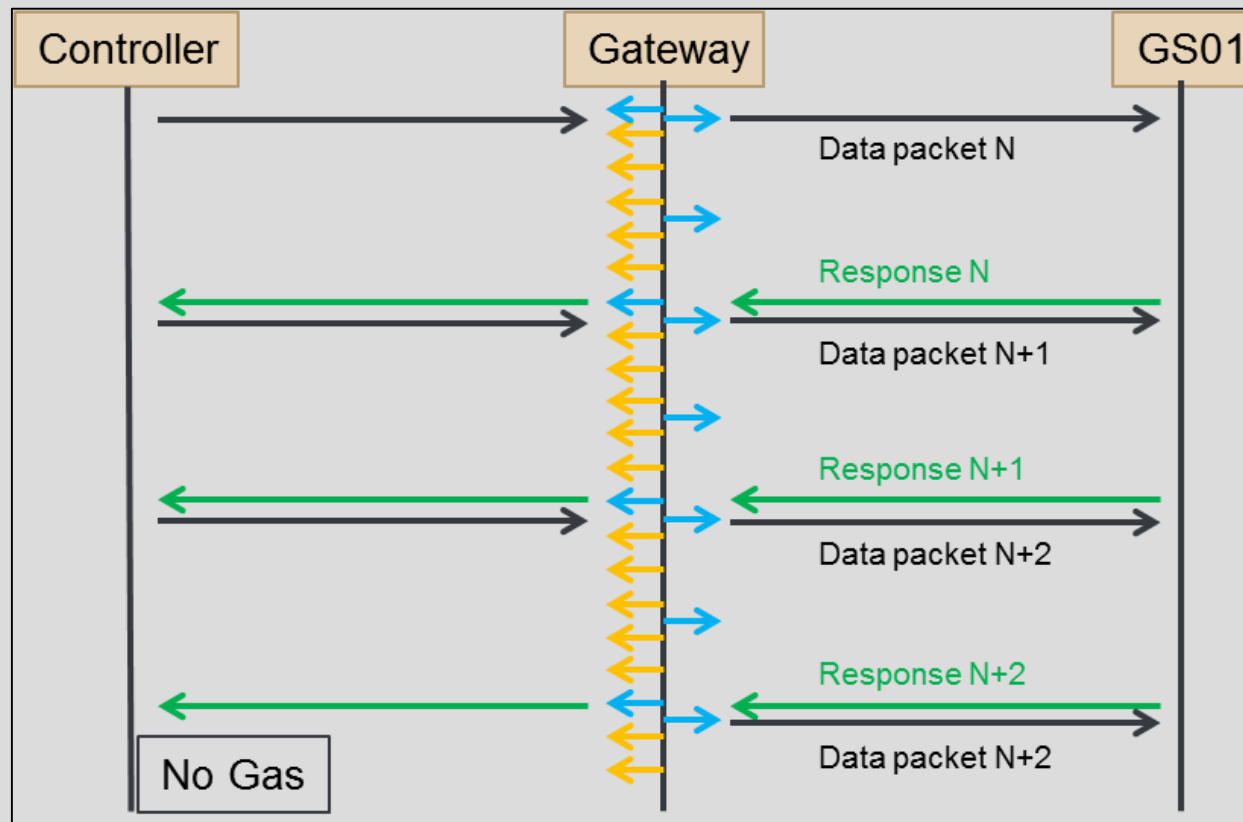
## Design & performance criteria

- 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

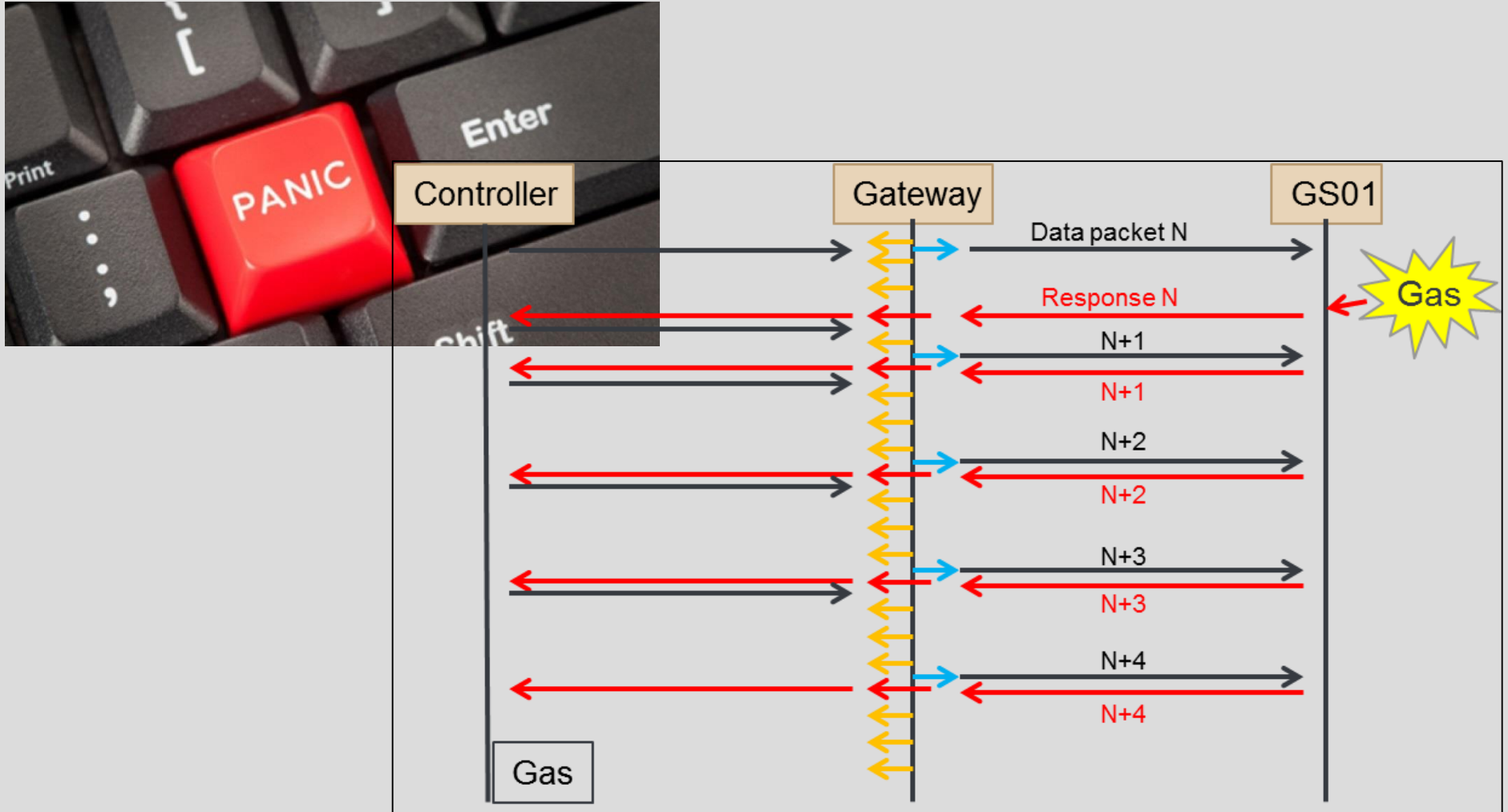
## Device communication patterns (1/2)

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 PROFI-safe 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!

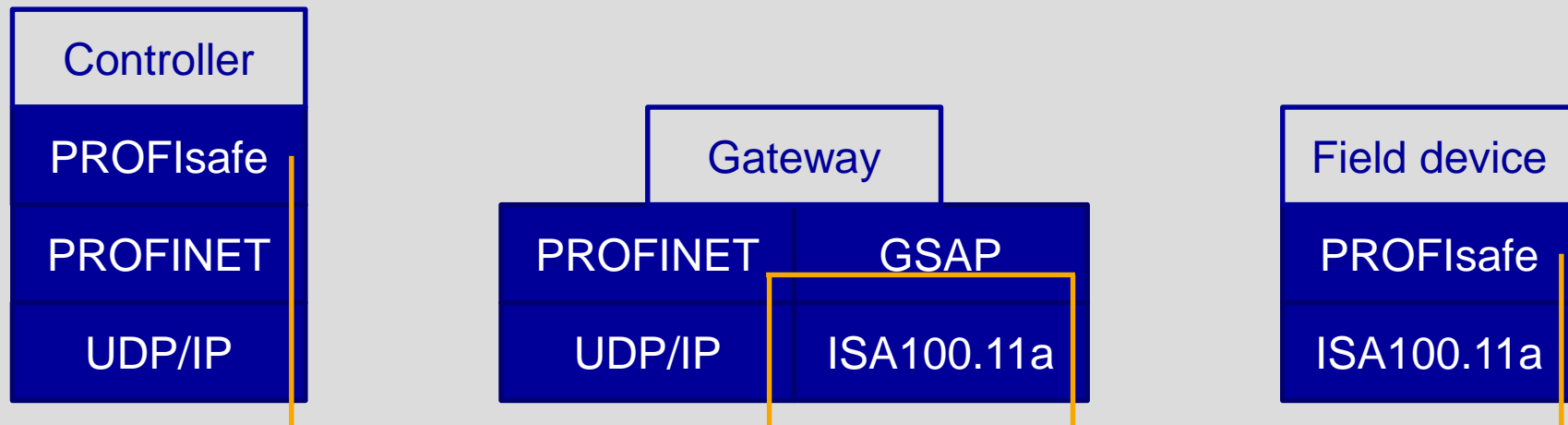
# Wireless Networks in Safety Applications

## 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.



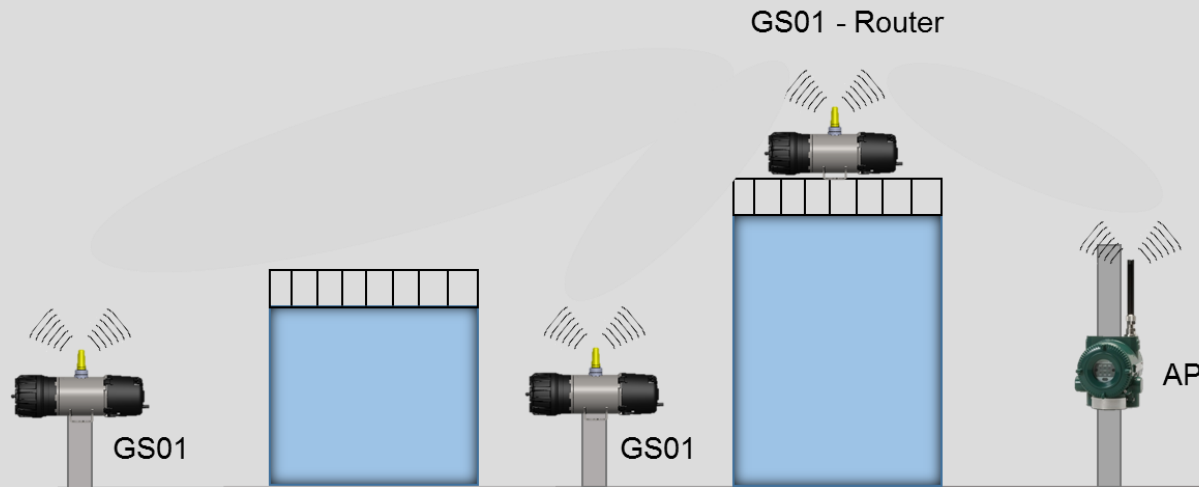
In safety-related applications, this can be used to **give priority/reserve bandwidth/ensure low latency** for safety-related packages as opposed to e.g. monitoring packages.



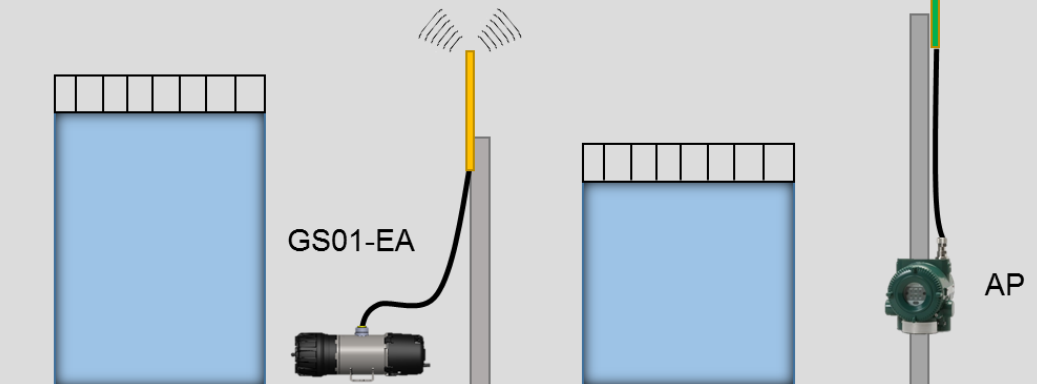
# Wireless Networks in Safety Applications

## 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)



# Case Study

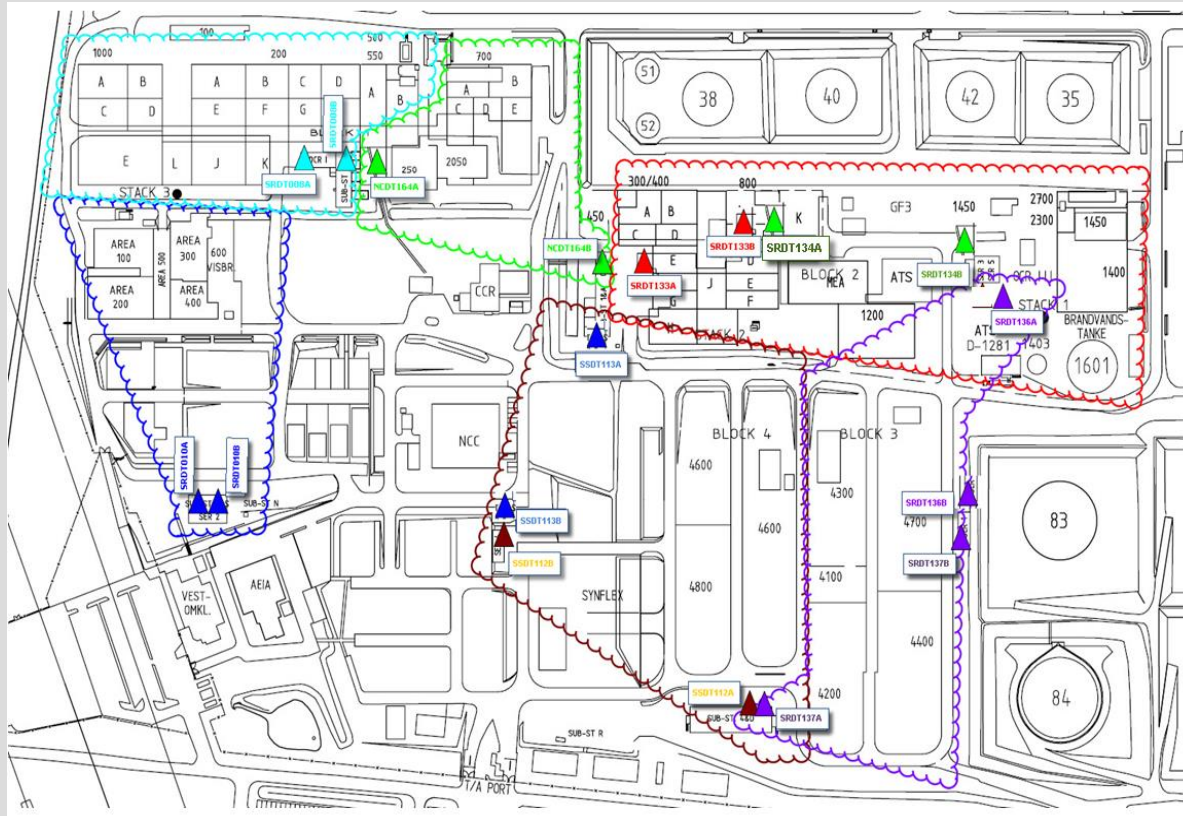
## Fill-in detectors for Kalundborg refinery

### 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

# Case Study

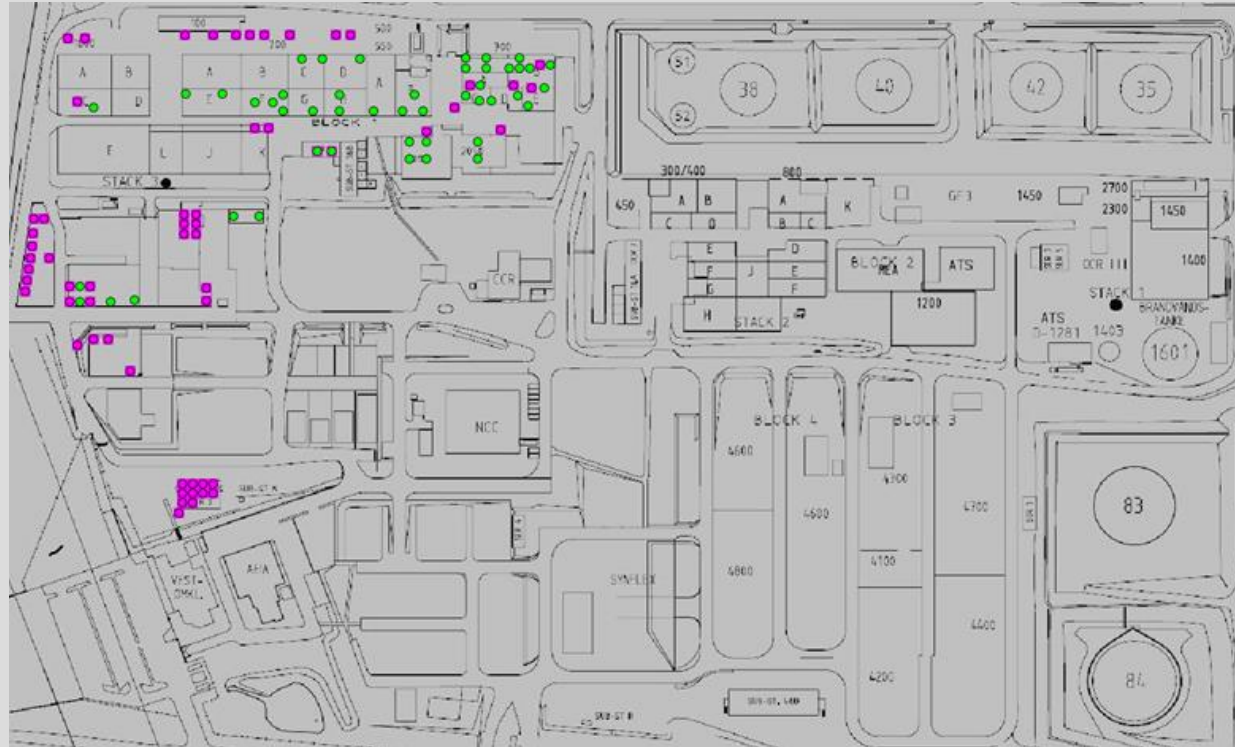
## Fill-in detectors for Kalundborg refinery

### Phase 1 Block 1

### Detector locations

**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

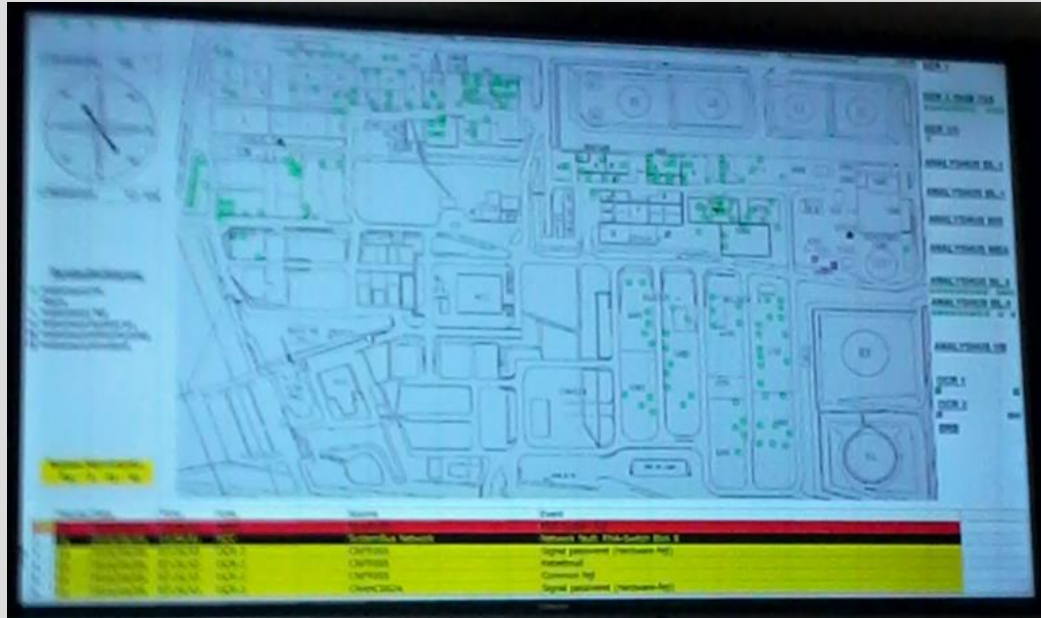


Dual access points with good access to a majority of the detectors.



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”.**

Niels Herløv

Senior Engineer Electrical safety and operation

TPO KAL EA

Statoil Refining Denmark A/S

**Thank you for  
your attention.**

Jorgen Svare  
Head of Operations - GasSecure  
[jorgen.svare@gassecure.com](mailto:jorgen.svare@gassecure.com)