

**Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)**

**Submission Title:** Application requirements and proposed solutions

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**Re:** IEEE P802.15.SG4a Call For Applications, see 15-07-0936-00-004e-call-applications-tg4e.doc

**Abstract:** Requirements of factory automation and proposed solution

**Purpose:** Provide P802.15.4 application for Process automation and Factory automation

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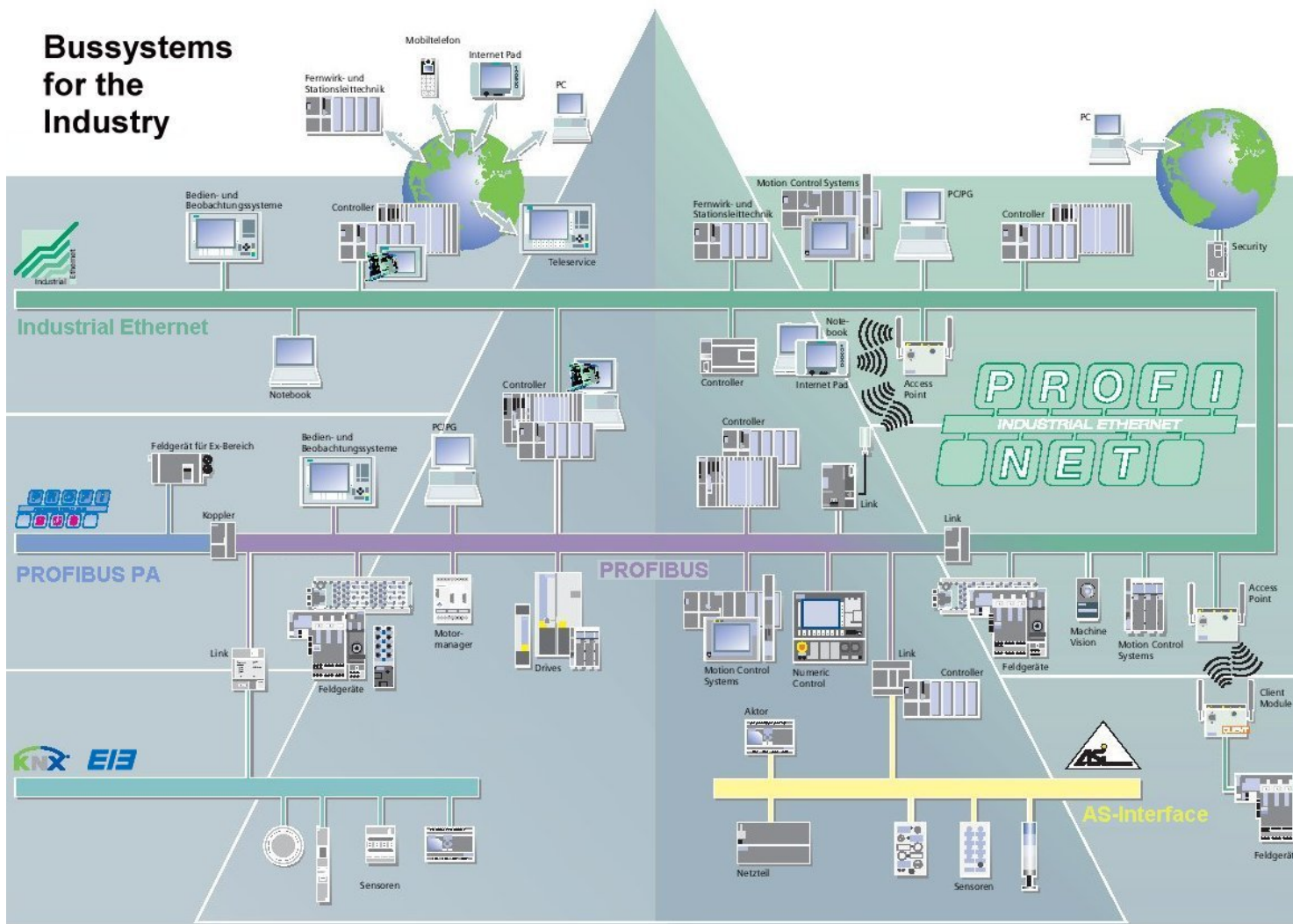
# .4e application

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**March 18, 2008**

**Orlando**

# Integration of wireless in wired infrastructure



Manufacturing Execution System

MES, SCADA,  
Monitoring

Controller

Remote I/O

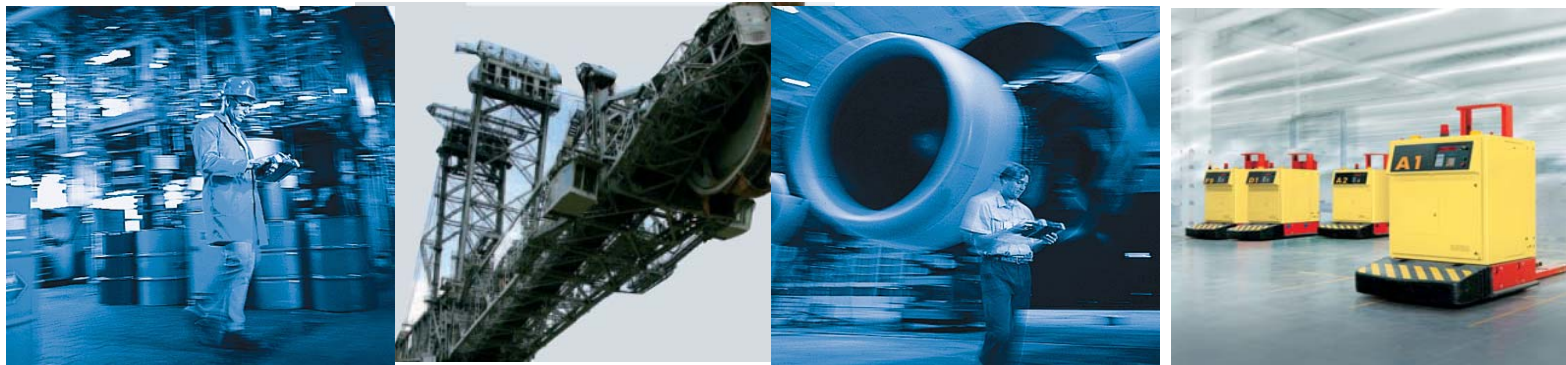
Networking  
components

Field Devices

Sensors+  
Actors  
(Factory  
Automation)

# Industrial Wireless LAN (IWLAN) enables industrial mobile Communication

- Industrial Mobile Communication



## Reliable

Cyclic data transmission  
(Deterministic, low latency)  
Redundancy  
Control of radio link  
Stable radio link

## Robust

Metal housing with high environmental protection class  
Protection against vibration and shock  
Extended Temperature range

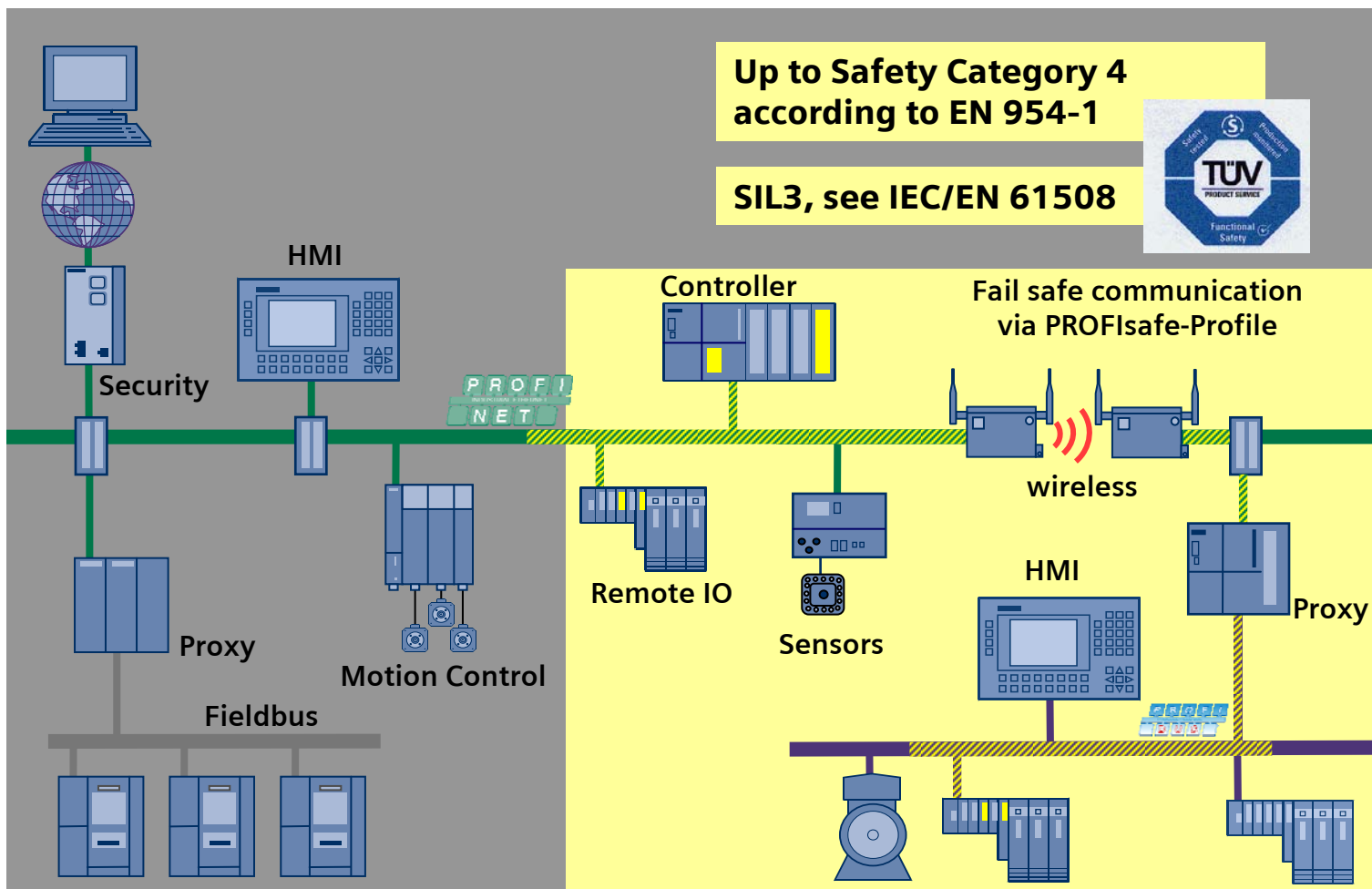
## Secure

Easy configuration  
Access control (Authentication)  
Encryption, etc.

## Safe

Safety communication even on the same medium as non-safety related communication

# IWLAN Reaction times allow even a fail safe communication via PROFI-safe



**Wireless – even in safety applications!**

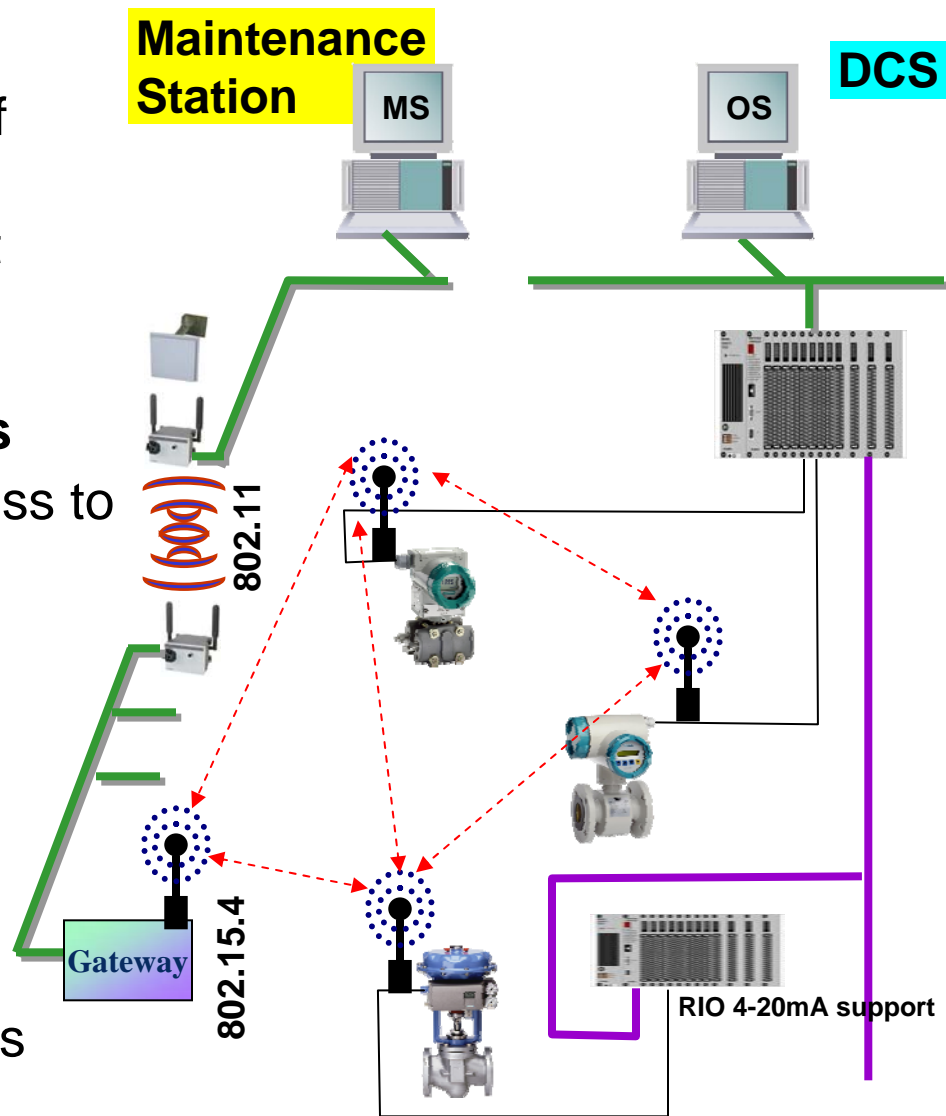
## 2. Use Cases – How can wireless meet current customers' requirements

### Use Cases are

- No. 1: Asset management
- No. 2: Increase process information by additional sensors for monitoring
- No. 3: Wireless field device in control
- No. 4: All wireless field devices in one network

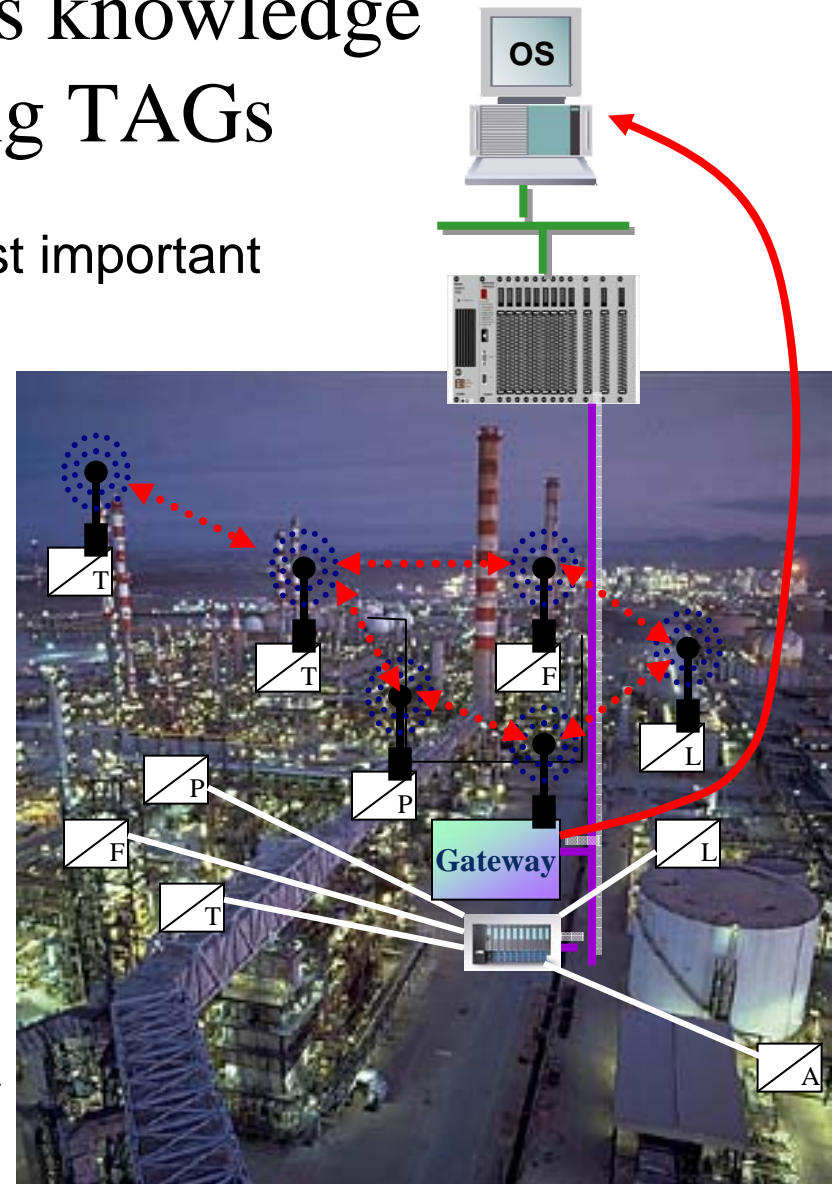
# Use Case 1 Asset Management

- **Current situation**
  - Modern field devices have lots of diagnostics data
  - These data are available in most cases only per costly on-site inspection
- **How wireless supports customers**
  - Wireless units allow central access to field devices
- **Customers benefits**
  - No changes, only add-ons
  - Higher plant availability
  - Predictive instead of preventive maintenance reduces costs
  - Quick Return of Invest
  - Wireless even in backbone buses (also in following use cases)



# Use Case 2- Increase process knowledge by additional monitoring TAGs

- **Current Situation**
    - Due to high installation costs only most important field devices are installed
  - **How wireless supports customers**
    - Due to lower total cost of ownership (TCO) users can add additional wireless measurement points
  - **Customers benefits**
    - Higher performance ...
    - Better product quality ...
    - Less energy and material input ...
    - Increased productivity ...
- through enhanced process knowledge via additional monitoring field devices

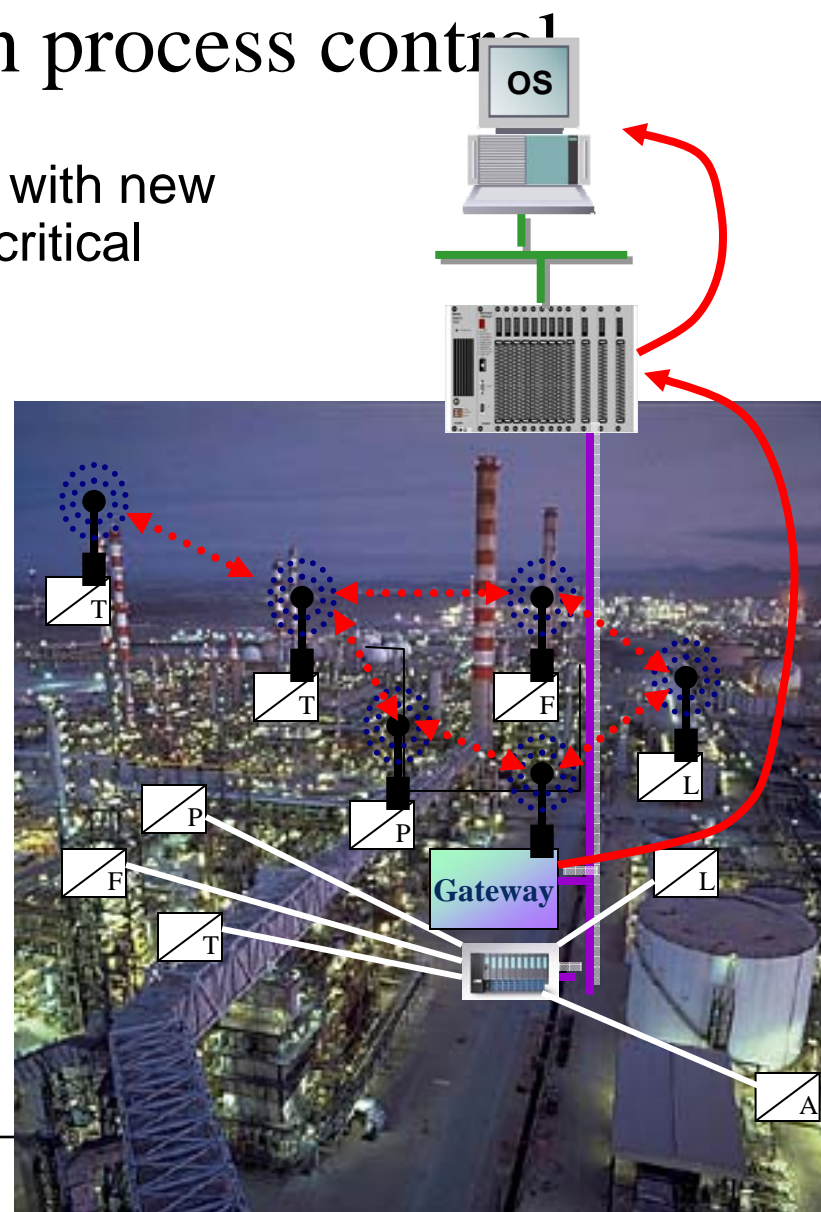




# Use Case 3

## Wireless field devices in process control

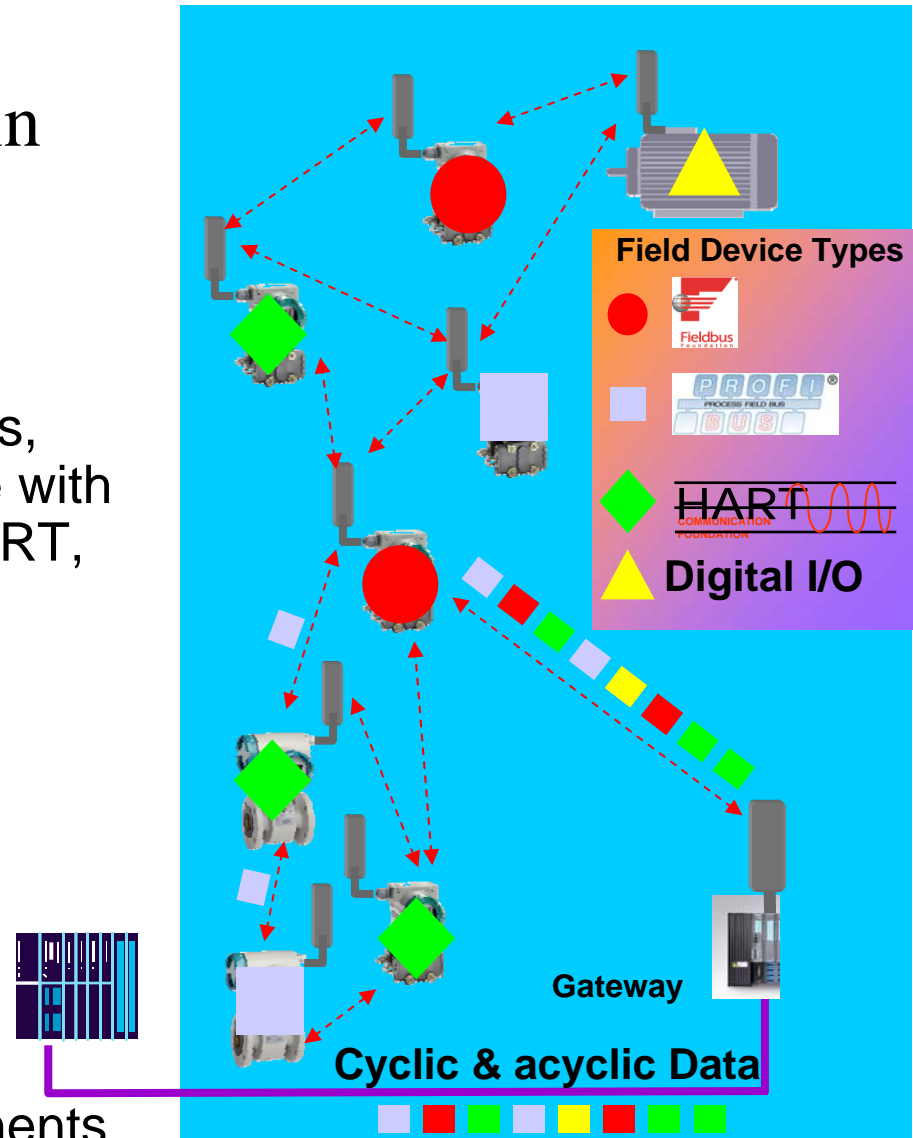
- **Current Situation**
  - Customers wants to have experience with new technology before using it in mission critical applications
- **How wireless supports customers**
  - After getting experience with wireless field devices in monitoring applications a user may add wireless devices in control
- **Customers benefits**
  - Same wireless technology for monitoring and control
  - Change from monitoring to control results in no new invest, just add an existing/new wireless device into control strategy



# Use Case 4

## All Wireless Field Devices in One Network

- **Current Situation**
  - Customers have a rich set of tools, templates, standards, experience with device out of 1+ classes (e.g. HART, PROFIBUS, FF)
- **How wireless supports customers**
  - Wireless devices can be easily integrated in this unchanged environment
- **Customers benefits**
  - No new device types
  - No additional training
  - No additional networking components like routers



### 3. Resulting technical / commercial requirements

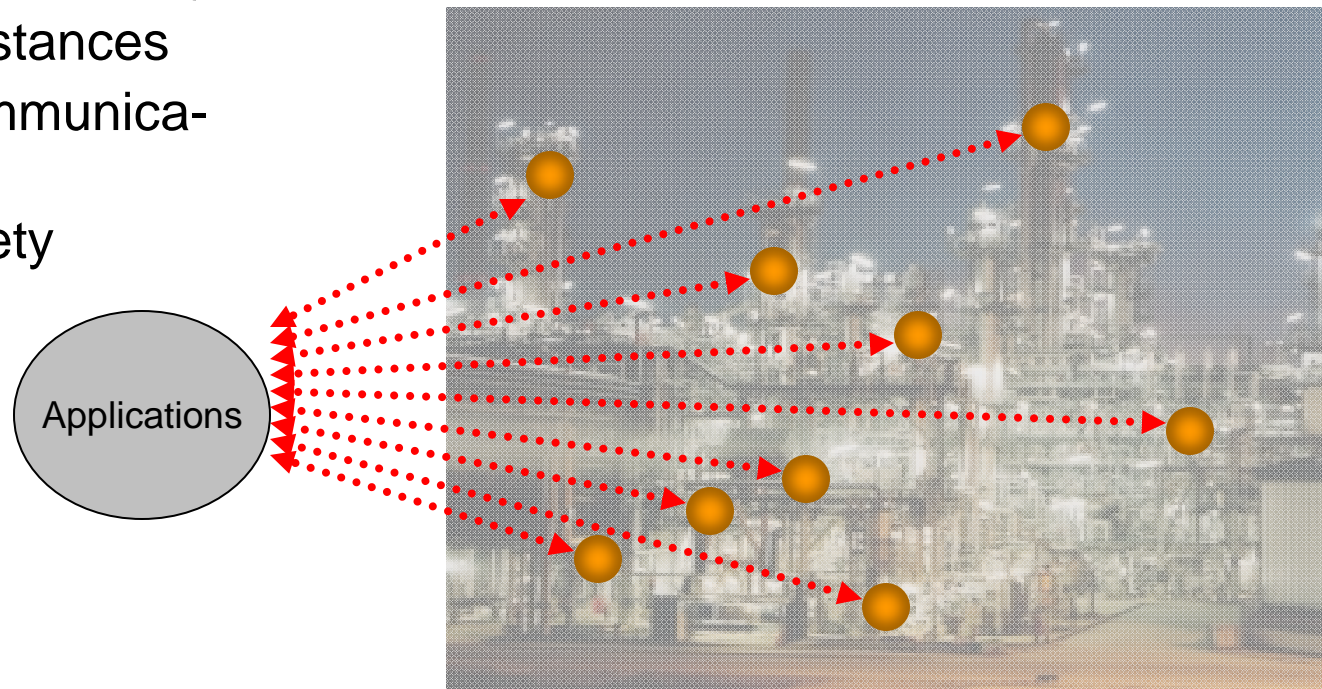
- Two major types of Applications
  - Process Automation
  - Factory Automation
- Stability against noisy Environment
- Use of Standard Radio Technologies for monitoring and control
- Simplicity
- Minimize Lifecycle Costs & Easy Integration in existing automation solutions
- Secure operation with wireless technology

# Two major types of Applications

## Process Automation

### Requirements from process automation

- high number of devices in one wireless cell
- moderate performance requirements (latency times 500+ ms)
- relative long distances
- Redundant communication paths
- Functional Safety

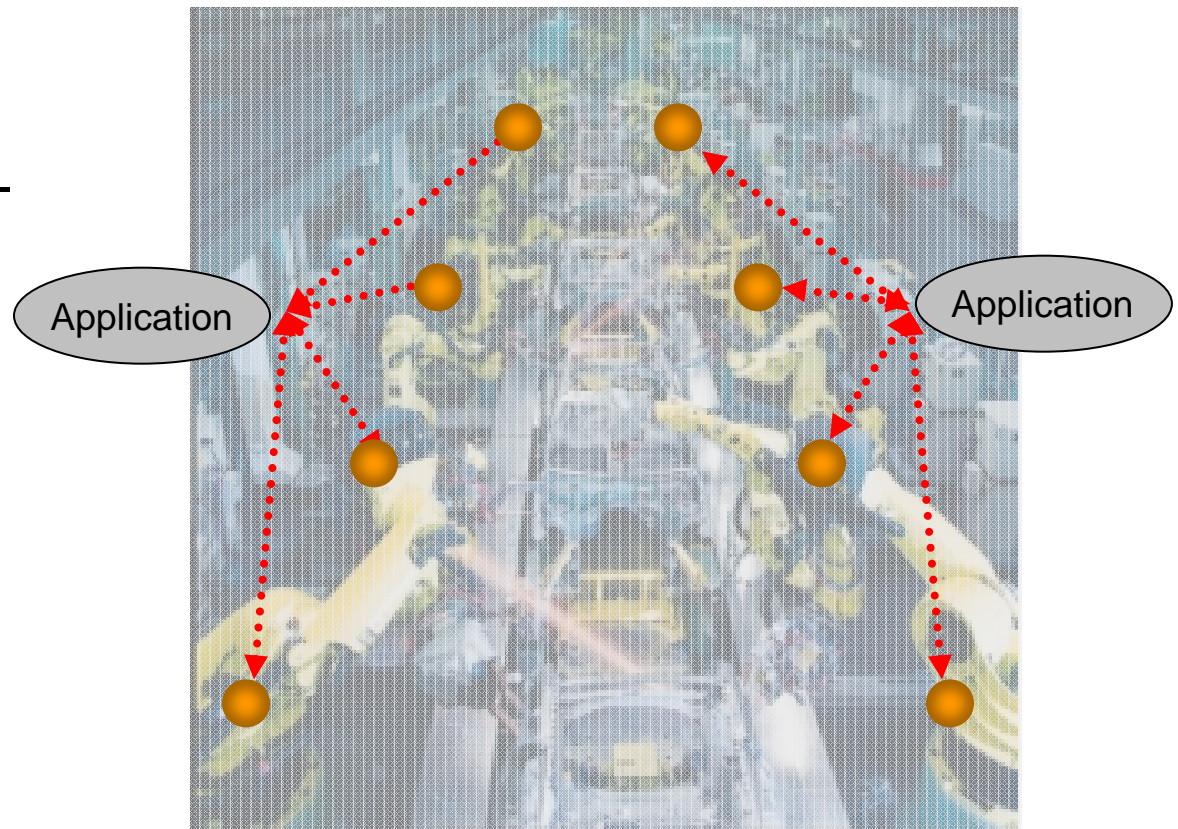


# Two major types of Applications

## Factory Automation

### Requirements from factory automation

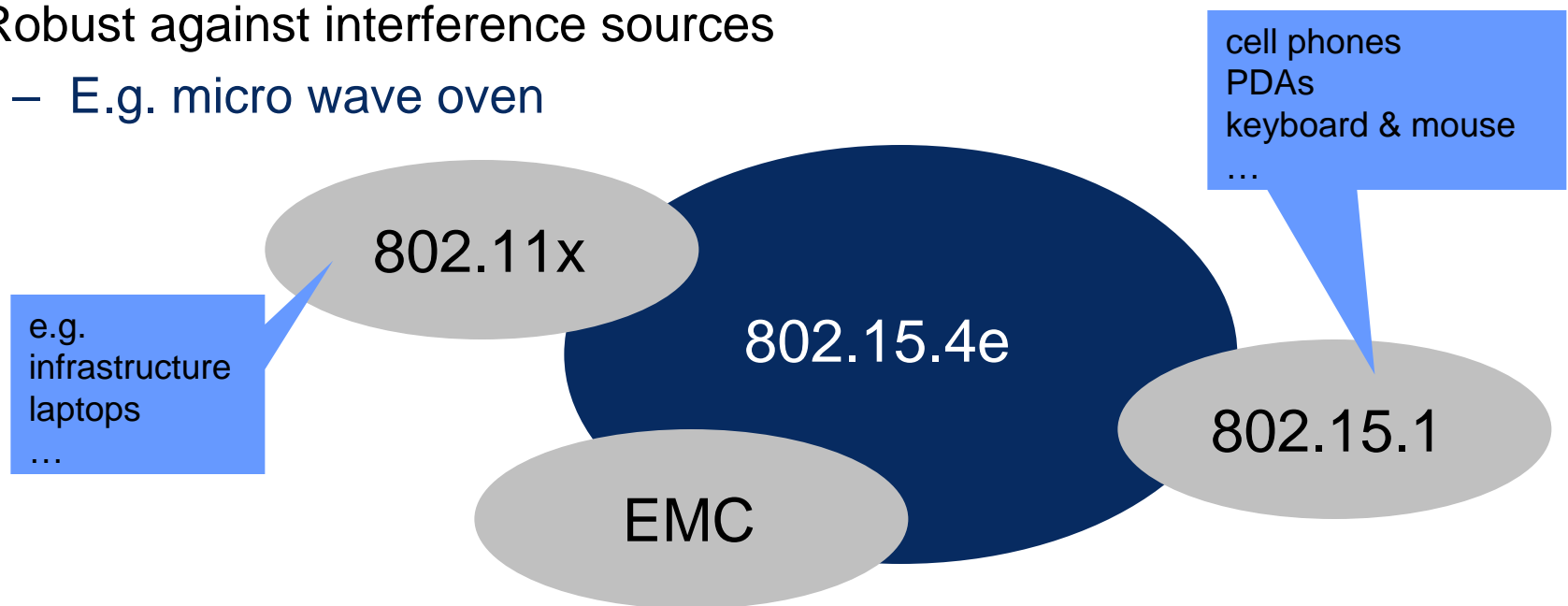
- smaller number of devices in one wireless cell
- high performance requirements (latency times < 10 ms)
- relative short distances
- Redundant communication paths
- Functional Safety



# Stability against noisy Environment

## Robust Communication over the air

- Coexistence with other wireless technologies, e.g.
  - IEEE 802.11 (WLAN)
  - IEEE 802.15.1 (Bluetooth)
  - Future specifications
- Robust against interference sources
  - E.g. micro wave oven

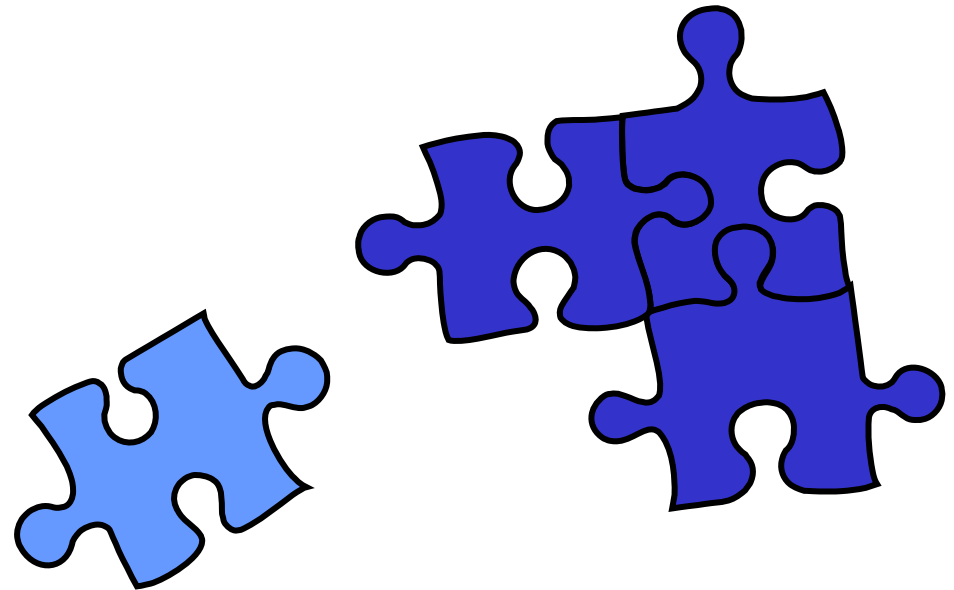


# Use of Standard Radio Technologies for monitoring and control

- Interoperability from an end-user's perspective
  - Free choice of supplier, e.g. for field devices
  - Devices from different suppliers run in the same wireless network
  
- Interoperability from an supplier's perspective
  - More than one chip vendors for wireless components
  - Cheap wireless components (e.g. ASICs)
  - Wide-spread technology

# Simplicity

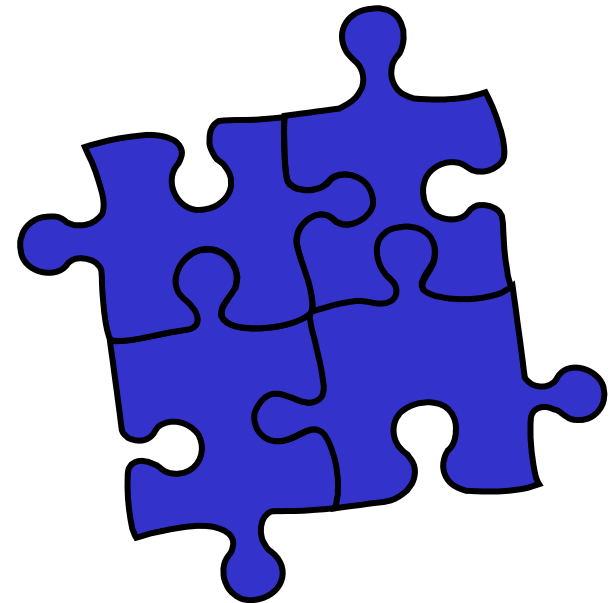
- Easy installation without special tools, e.g. for site surveys, and without special training
- Simple expandability of the network by new devices
- Simple network management
- Common infrastructure (unique radio technology)
- Minimum number of infrastructural networking components





# Simplicity

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# Minimize Lifecycle Costs & Easy Integration in existing automation solutions

- Minimum Lifecycle Costs
  - Battery life time 5+ years
    - Excessive and configurable usage of sleep modes
    - low power consumption of the radio
  - Self- configuring networks
  - Self- Healing networks
- Easy wireless integration in existing automation solutions
  - Used tools
  - Used templates
  - Industry and Customer standards

should be able to be used by customers, e.g. for integration and parameterization of HART, PROFIBUS and FF devices

# Secure operation with wireless technology

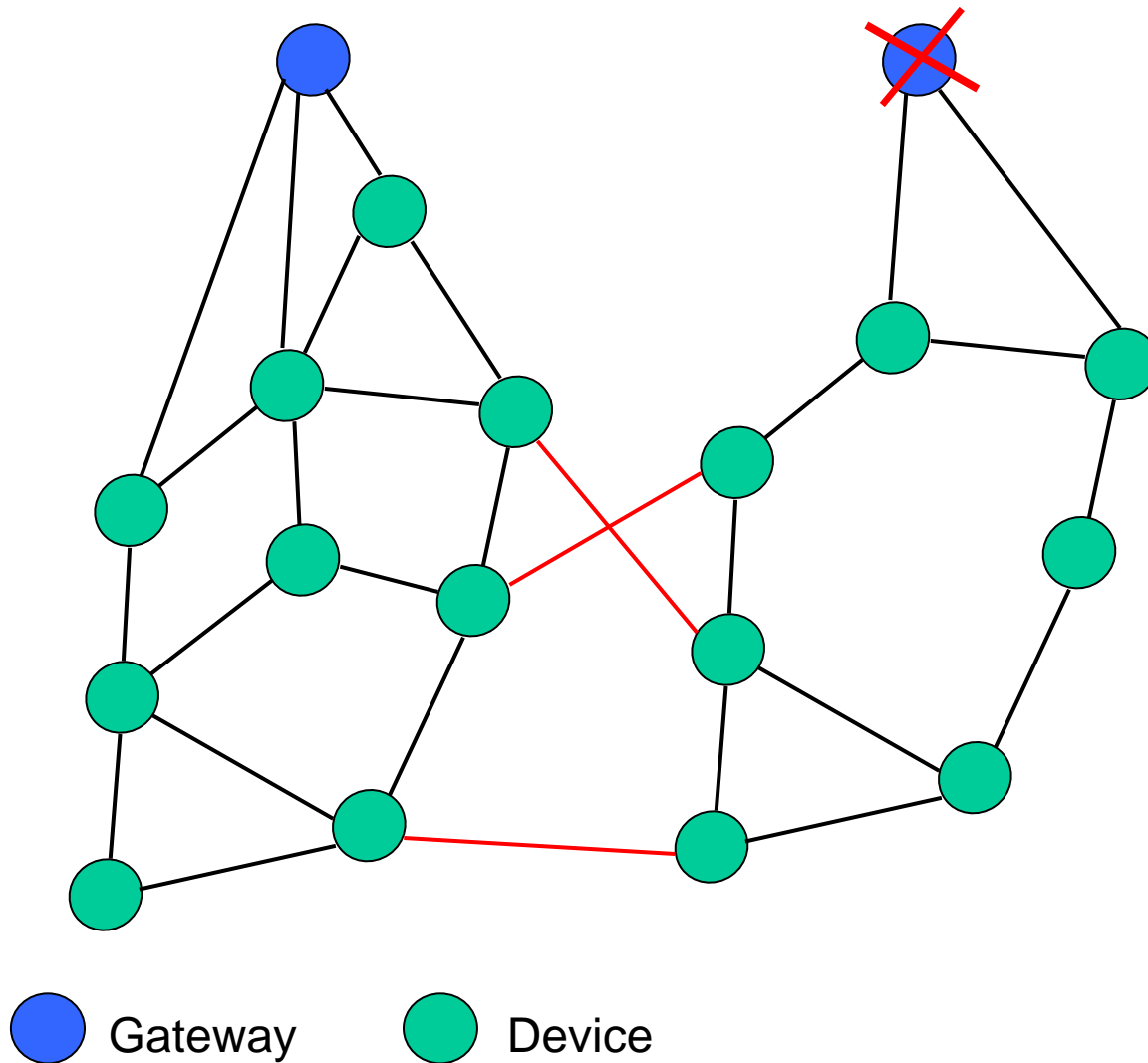
Security Properties	Definition
Authorization	The protection of devices or system resources against unauthorized access.
Authentication	Assurance of the identity of a device or a system resource.
Availability	The property of a device, a system or a system resource being accessible and usable upon demand by an authorized system entity, according to performance specifications for the system; i.e., a system is available if it provides services according to the system design whenever users request them
Confidentiality	Assurance that information is not disclosed to unauthorized individuals, processes, or devices.
Data Integrity	Property that data has not been changed, destroyed, or lost in an accidental manner.
Data Authenticity	Assurance that the origin and/or the source of data are correctly identified.

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## 4. Siemens' proposal baseline

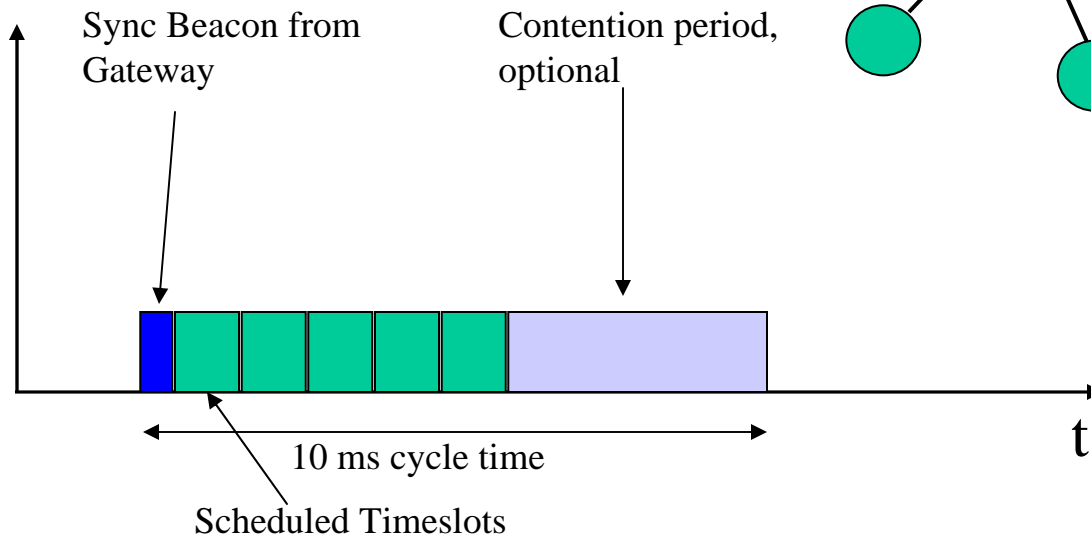
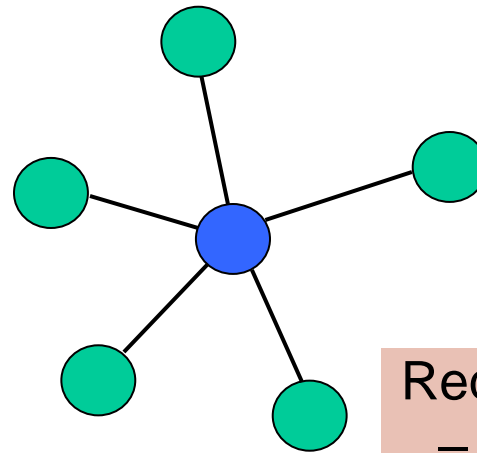
- Meshed Networking (TDMA)
- High Performance (TDMA)
- Frequency Agility
- IEEE 802.15.4 on 2.4 GHz Band
- Coexistence with IEEE 802.11
- Wireless Backbone based on IEEE 802.11 and IEC 61784-2, CP 3/4 (PROFINet Conformance Class A wireless)
- Security

# Meshed Networking



- Requirements are
- Reliability & Robustness
  - Huge Coverage
  - Simplicity
  - Self-organizing
  - Self healing
  - Long distances

# High Performance is met by Star Topology

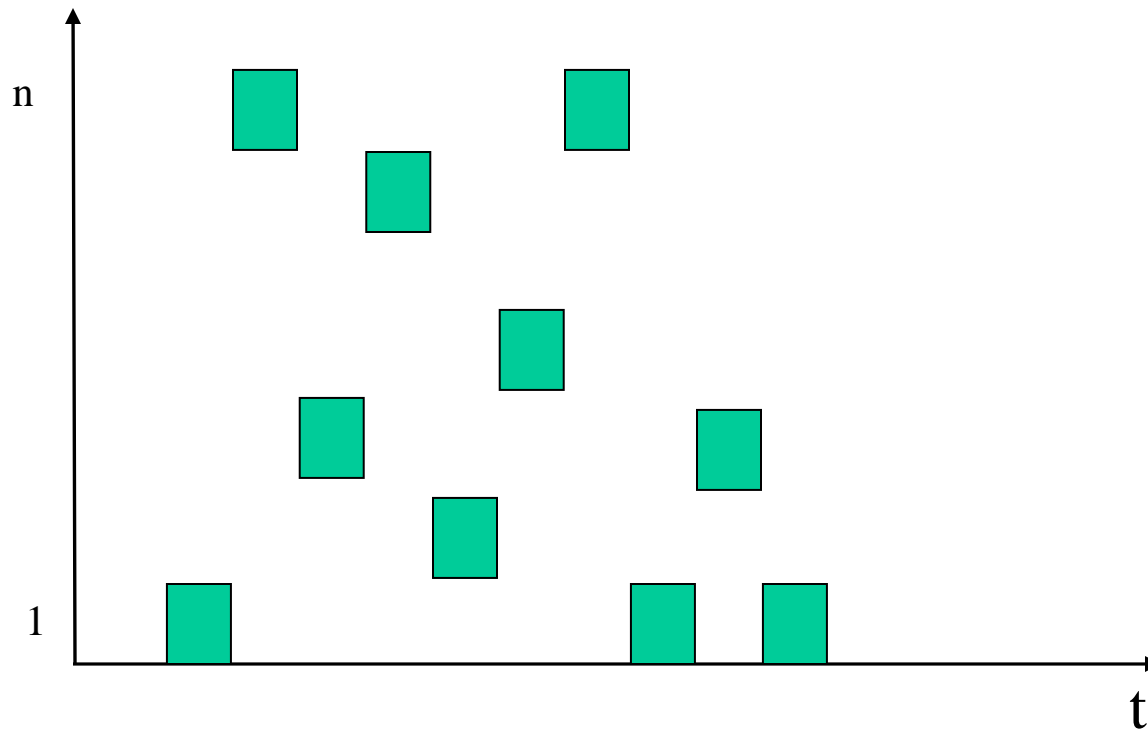


- Requirements are
- TDMA based
  - fulfils the req. from factory automation
  - deterministic behavior
  - required for high performance cyclic communication
  - allows acyclic traffic (contention period)



# Frequency Agility to enable robustness and availability

Frequency



Frequency usage over time for one dedicated link

Requirements are

- Robustness against interferences
- Availability of the network

# IEEE 802.15.4 on 2.4 GHz Band

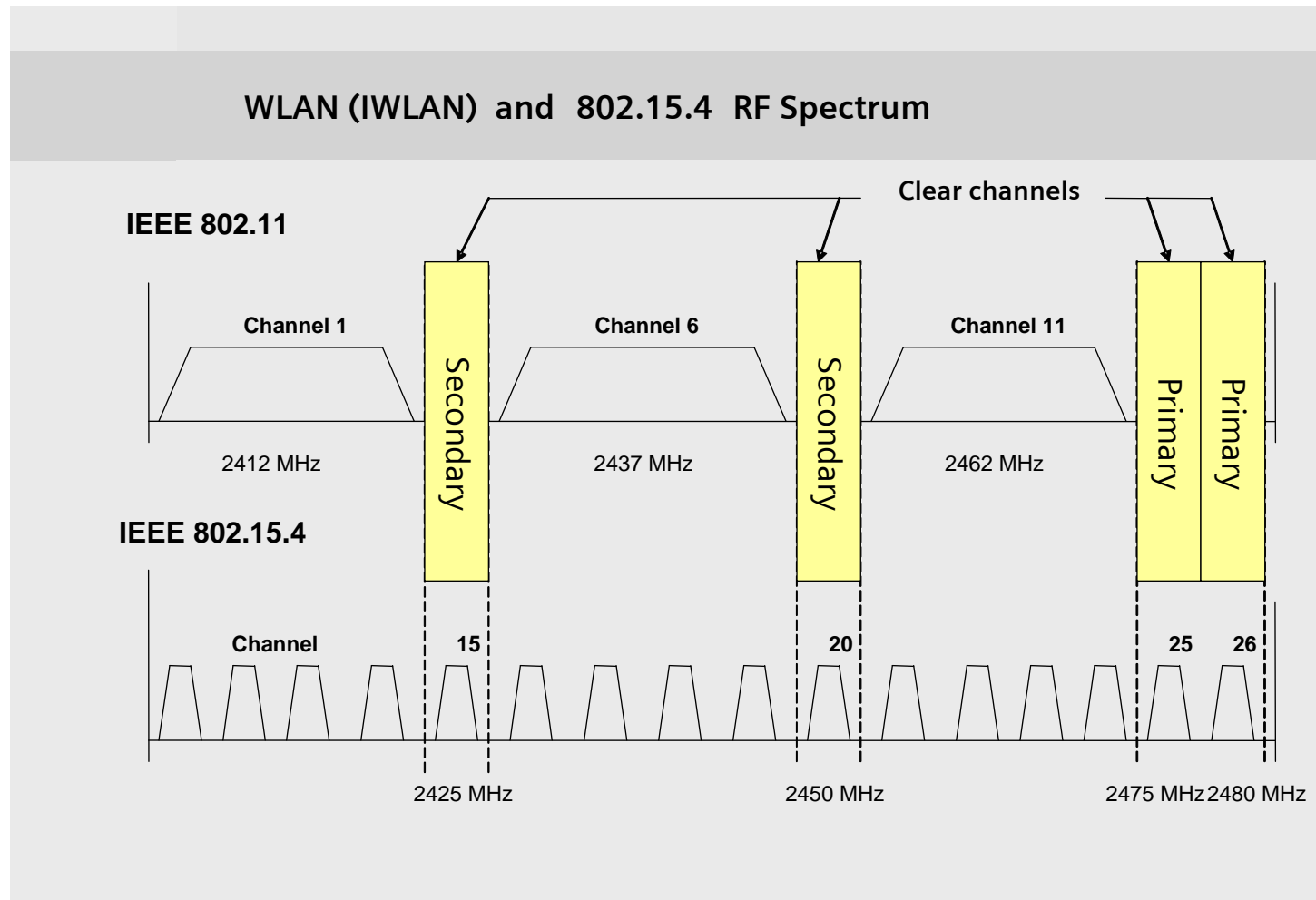
- Standard Technology, specified by IEEE
  - Cheap
  - Multi vendor
  - Low power
  - Scalable
- 2.4 GHz Band
  - High performance
  - Worldwide usability enabled

## Requirements are

- Interoperability from an end-user's and supplier's perspective
- Lifetime >5 years



# Coexistence with IEEE 802.11



Standard should allow to enable only selected channels (e.g. in the gaps of running WLAN)

# Security

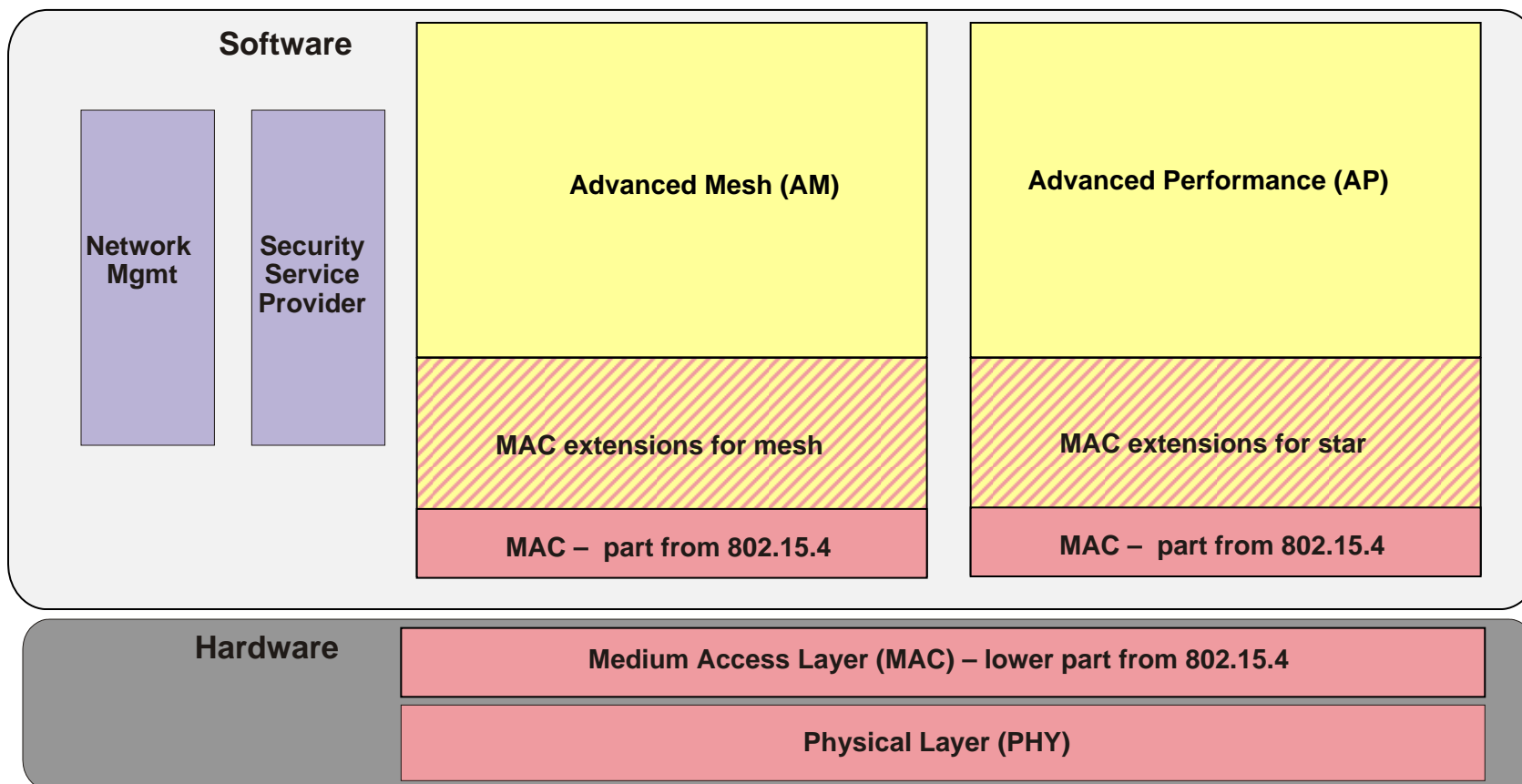
- AES encryption (Advanced Encryption Standard)
  - Open and accepted encryption technology
- Authentication and key update approach suitable for mesh networks as well
  - Scalable technology, applicable for simple devices (primitive sensors) as well
- Security on Wireless should be based on available standard technologies

# Overall Approach

## Dual Mode approach

- Unique hardware platform
- Minor difference in FW stack
  - Optimization for advanced mesh (AM) functionality
  - Optimization for advanced performance (AP) functionality

# Overall Approach



# Your Questions and Comments

Thank you  
for your  
attention



Questions  
Comments



a1

das ist eine wiederholung von oben, dann besser weglassen

adbire0; 06.09.2006