
# 5G for Industry 4.0

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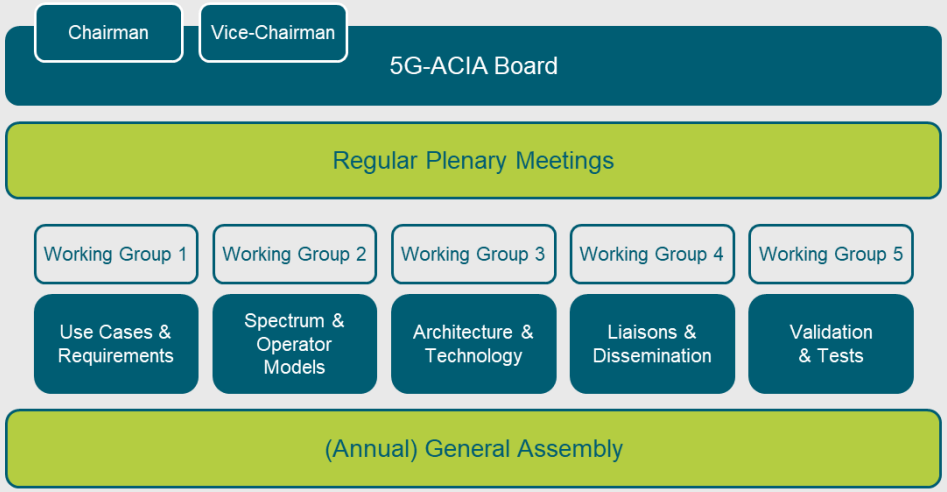
**5G-ACIA WG “Use Cases and Requirements” Vice-Chair**

# 5G-ACIA Introduction

5G ACIA
5G Alliance for Connected Industries and Automation

## Mission

Ensure the best possible applicability of 5G technology and 5G networks for the manufacturing and process industry by addressing, discussing and evaluating relevant technical, regulatory and business aspects.


**79 members**

**9 MoU**

**3GPP MRP**

(Status till Jan 28, 2021)

# 5G Use Cases in Manufacturing

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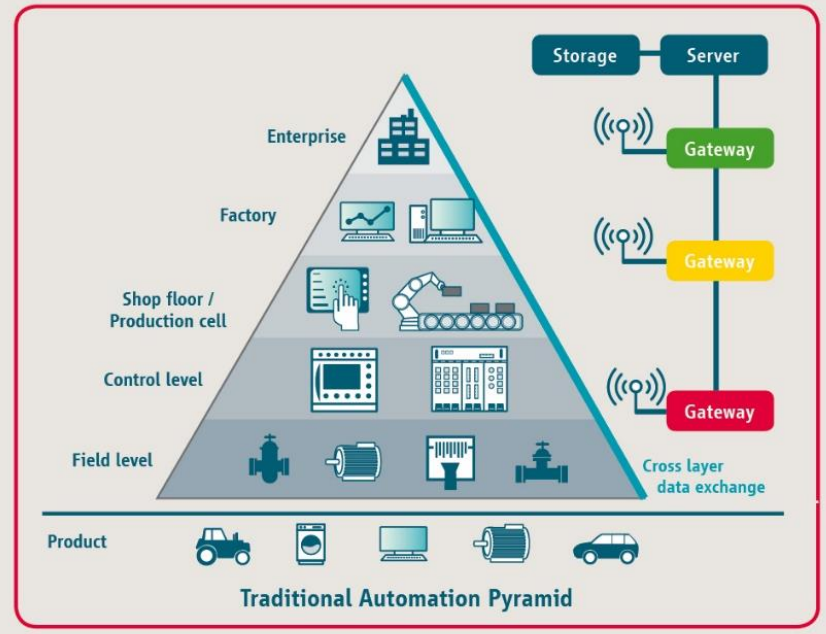
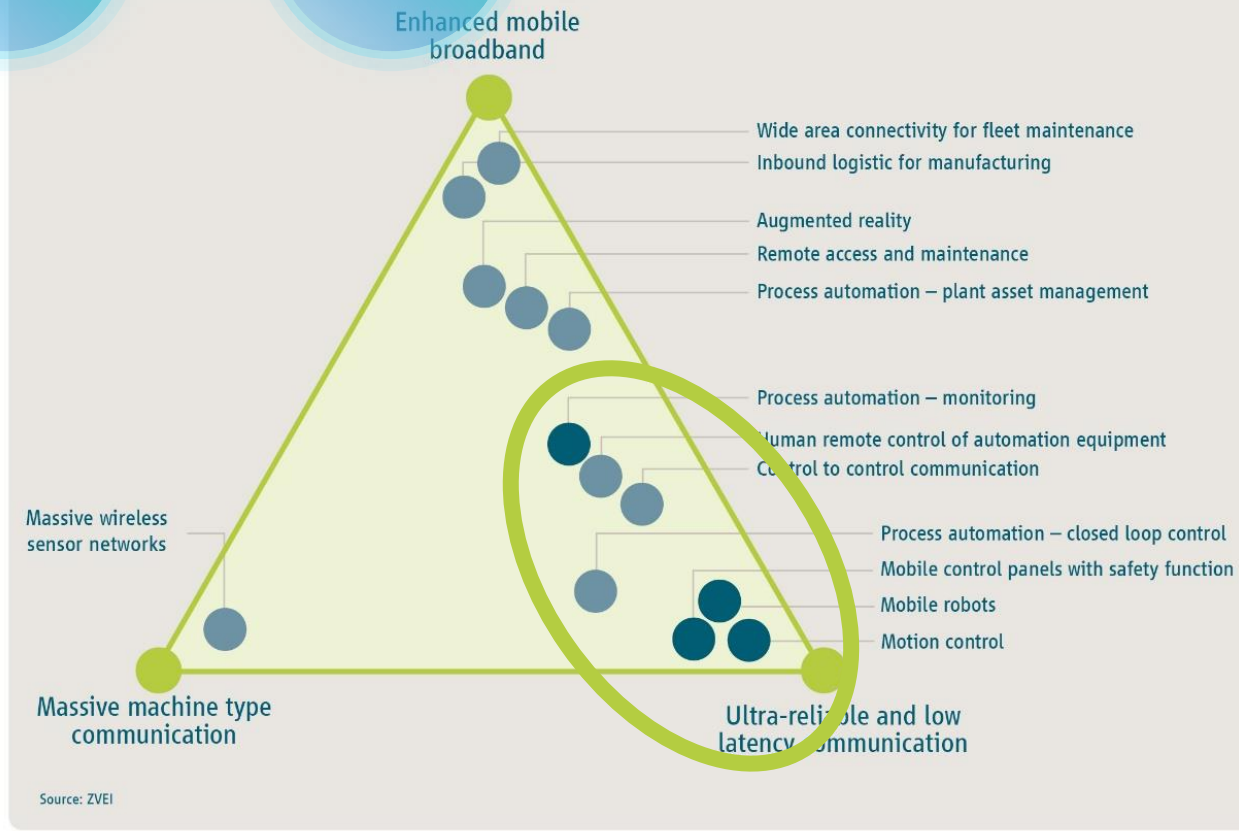
Real Life → Current → Future





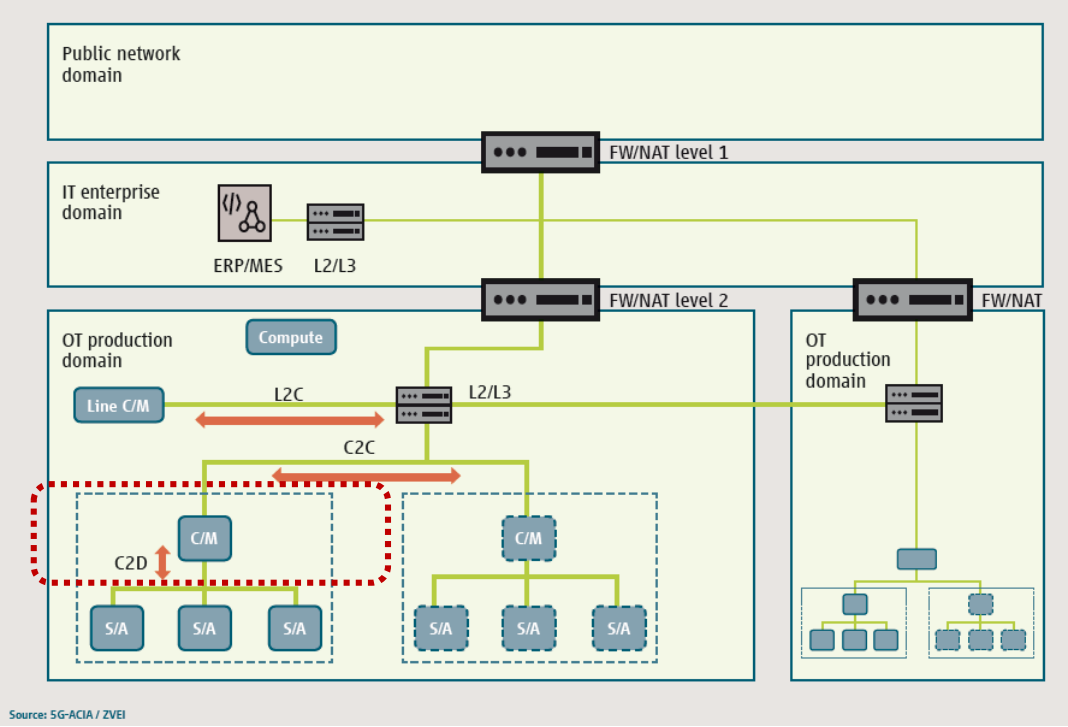
Source: ZVEI

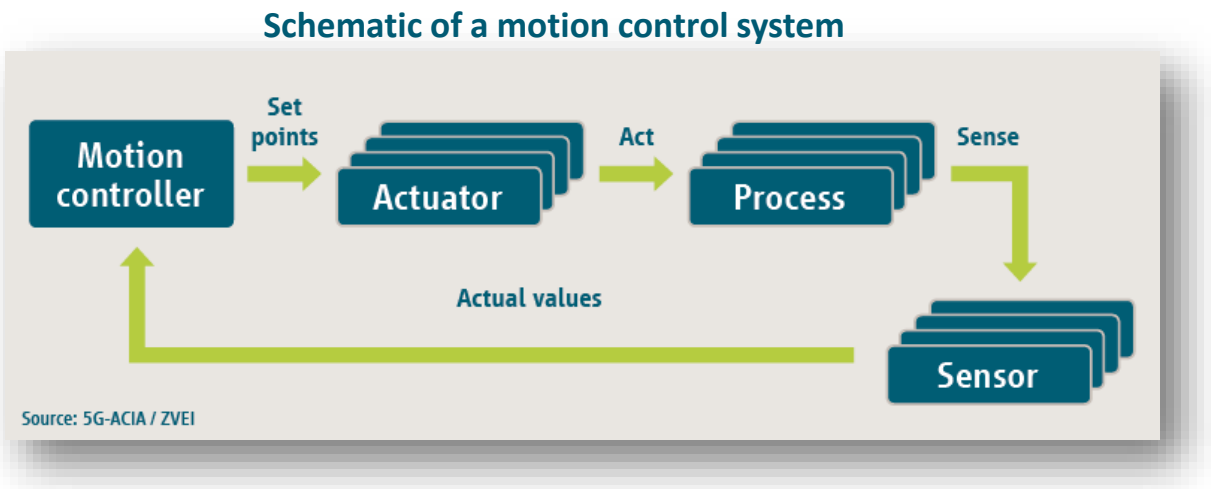



*Ref: 5G-ACIA White Paper „5G for Automation in Industry“*

*Ref: 5G-ACIA White Paper „5G for Connected Industries and Automation“ 2nd edition*

# Example 1: Motion Control



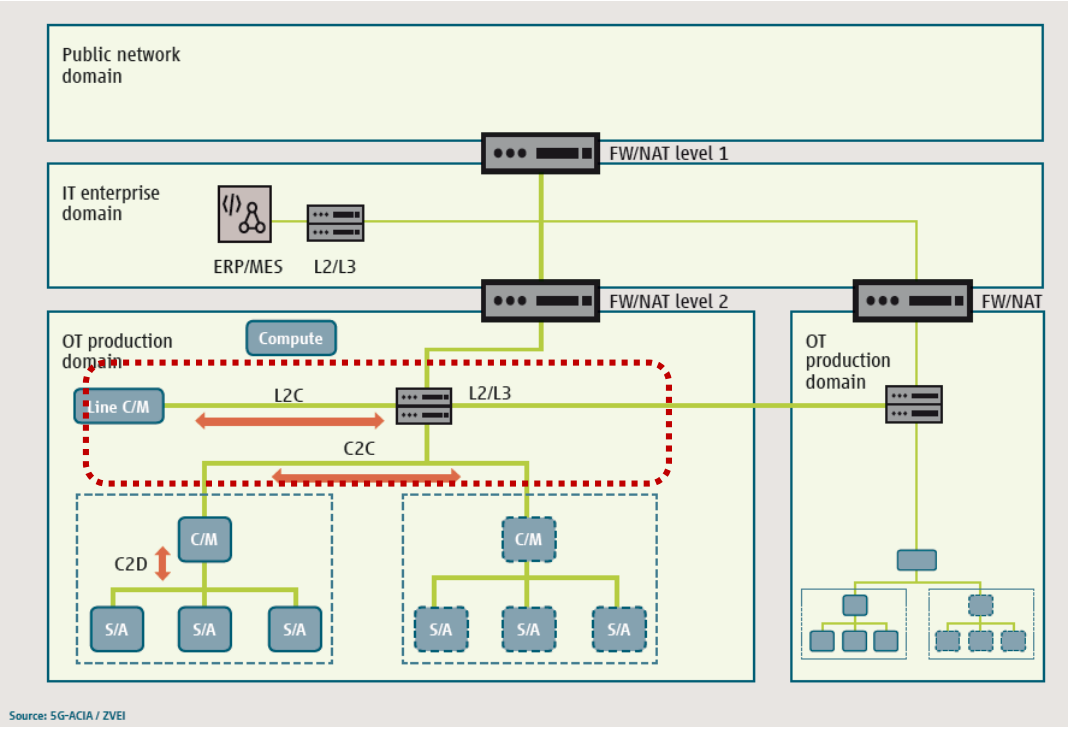




- Line controller-to-controller (L2C) and controller-to-controller (C2C) communication
- Controller-to-device (C2D) communication

CSA: Communication service availability
CSR: Communication service reliability
MTBF: Mean time between failures

| Use case (high level) | | CSA (%) | CSR (MTBF) | Transfer interval | Survival time | Message size (byte) | # of devices | Typical service area |
|---|---|---|---|---|---|---|---|---|
| Motion Control | Printing machine | >=99.9999 | ~ 10 years | < 2 ms | 2 ms | 20 bytes | >100 | 50 m x 10 m x 10 m |
| | Machine tool | >=99.9999 | ~ 10 years | < 0.5 ms | 0.5 ms | 50 bytes | ~20 | 50 m x 10 m x 10 m |
| | Packaging machine | >=99.9999 | ~ 10 years | < 1 ms | 1 ms | 40 bytes | ~50 | 50 m x 10 m x 10 m |

# Example 2: Control to Control



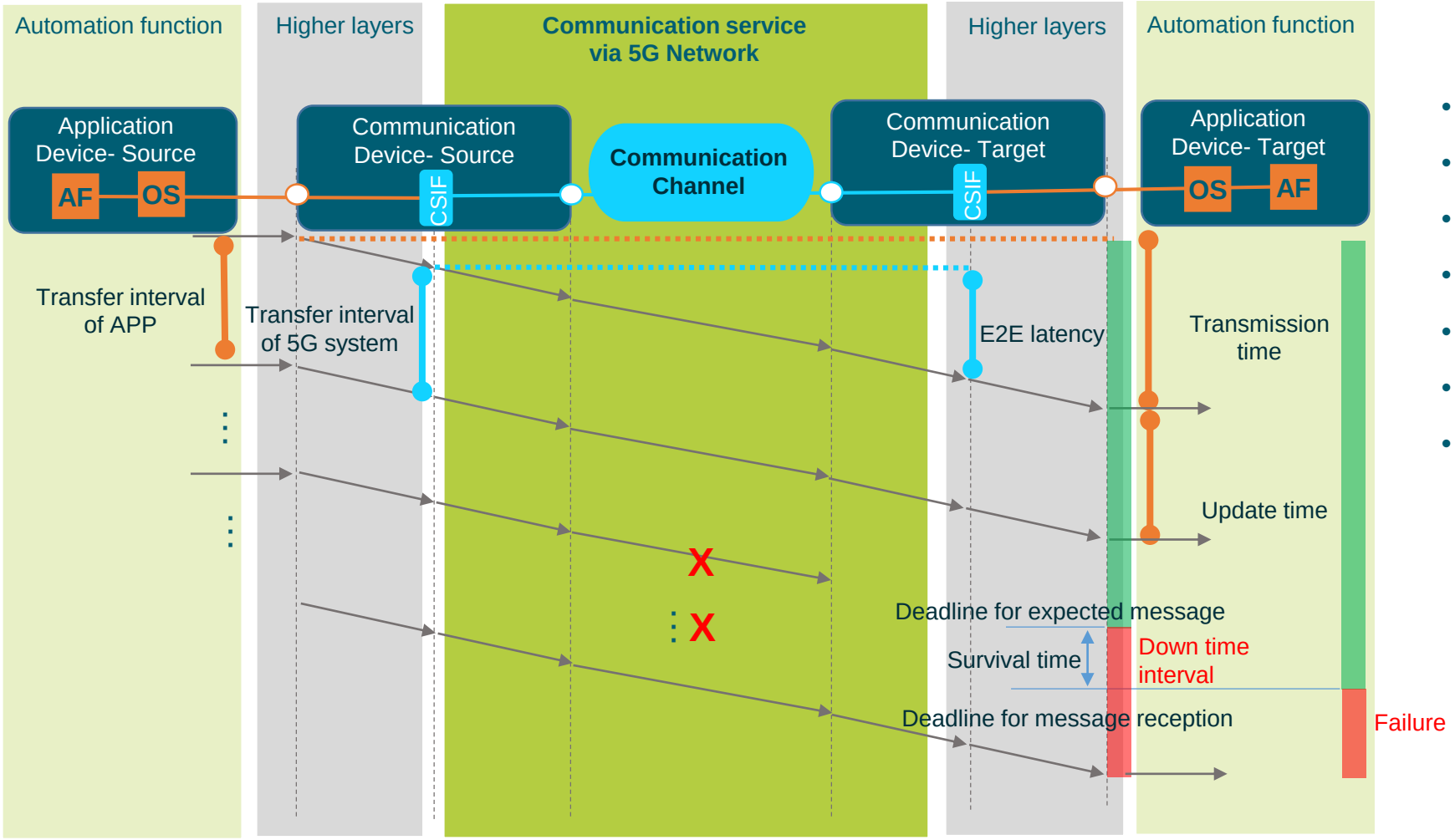

Source: Siemens AG

- Line controller-to-controller (L2C) and controller-to-controller (C2C) communication
- Controller-to-device (C2D) communication

CSA: Communication service availability
CSR: Communication service reliability
MTBF: Mean time between failures

| Use case (high level) | | CSA (%) | CSR (MTBF) | Transfer interval | Survival time | Message size (byte) | # of devices | Typical service area |
|---|---|---|---|---|---|---|---|---|
| Control to Control | Large Printing machine | ≥ 99.9999 | ~ 10 years | ≤ 10 ms | 10 ms | 1 k | 5 to 10 | 100 m x 30 m x 10 m |
| | Machines in an assembly line | ≥ 99.9999 | ~ 10 years | ≤ 50 ms | 50 ms | 1 k | 5 to 10 | 1000 m x 30 m x 10 m |

# Requirements Deep Dive




- **End to end latency**
- **Transfer interval**
- **Transmission time**
- **Survival time**
- **Communication Service Availability**
- **Communication service reliability**
- **etc.**

AF: Application function
OS: Operating system
HCL: Higher communication layer
LCL: Lower communication layer
CSIF: Communication service interface

Up time interval
Down time interval

# Overview Industrial 5G Requirements

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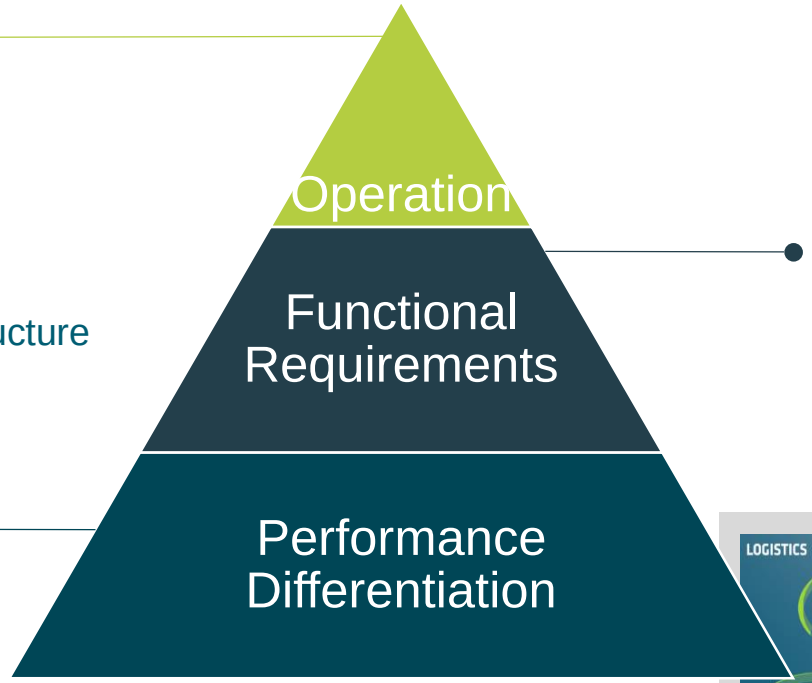
**Requirements / Challenges**

- high flexibility and versatility
- increasing number of mobile assets
- service guarantees and 24/7 operation
- ease of use
- integration of installed network infrastructure

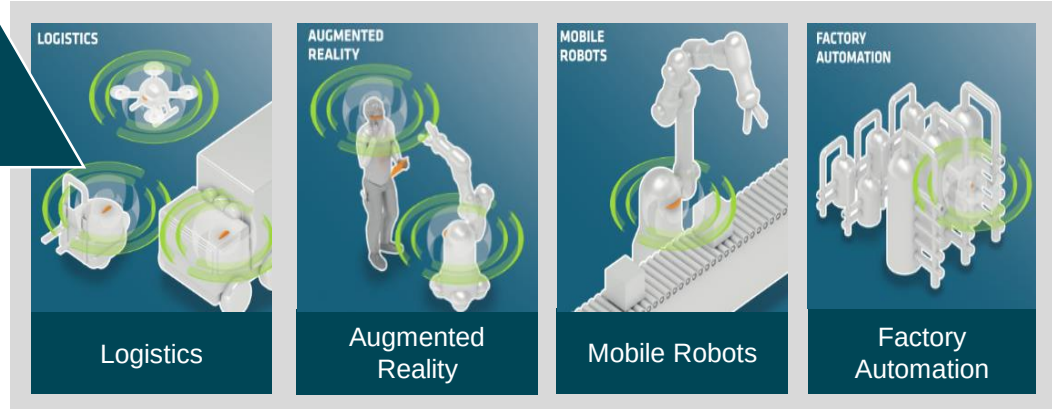



**Key Performance Indicators**

- high communication service availability (99.9999%)
- ultra-low latency (< 1..10 ms)
- cyclic traffic (transfer interval 1..250 ms)
- transmission rate
- typical service area (~1..1000 m²)

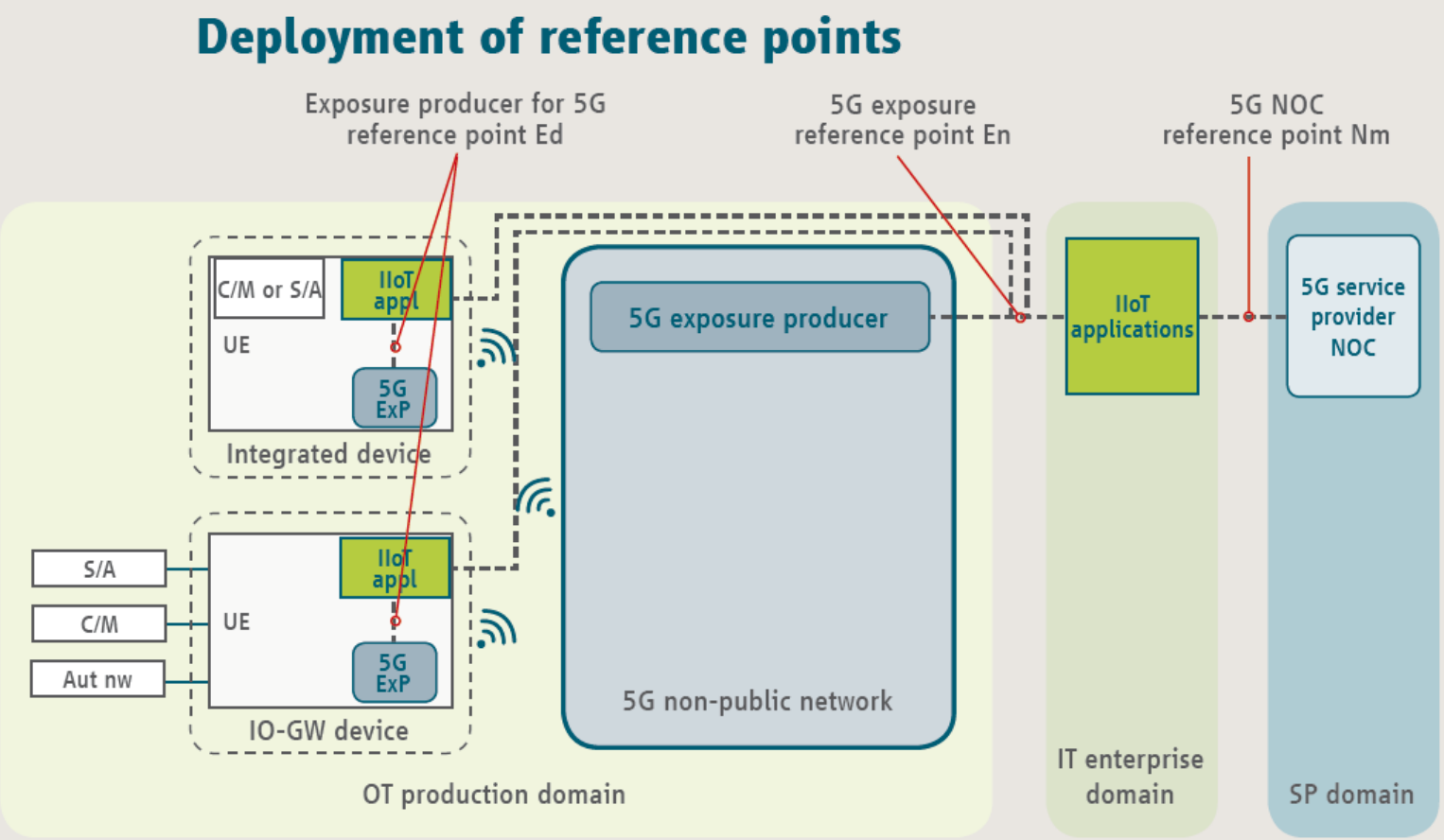
**Functional Requirements**

- Non-public operation (NPN)
- Security (e.g. non-3GPP credentials)
- Time synchronization (±1 µs)
- Integration with existing industrial communication networks
- Support of time-sensitive networking (TSN)
- Communication Service Interface / API for operations and management by vertical
- QoS Monitoring
- Positioning




Source: 5G-ACIA/ZVEI

# 5G Capabilities Exposure Interface




A: actuator; C: controller; M: manager; S: sensor

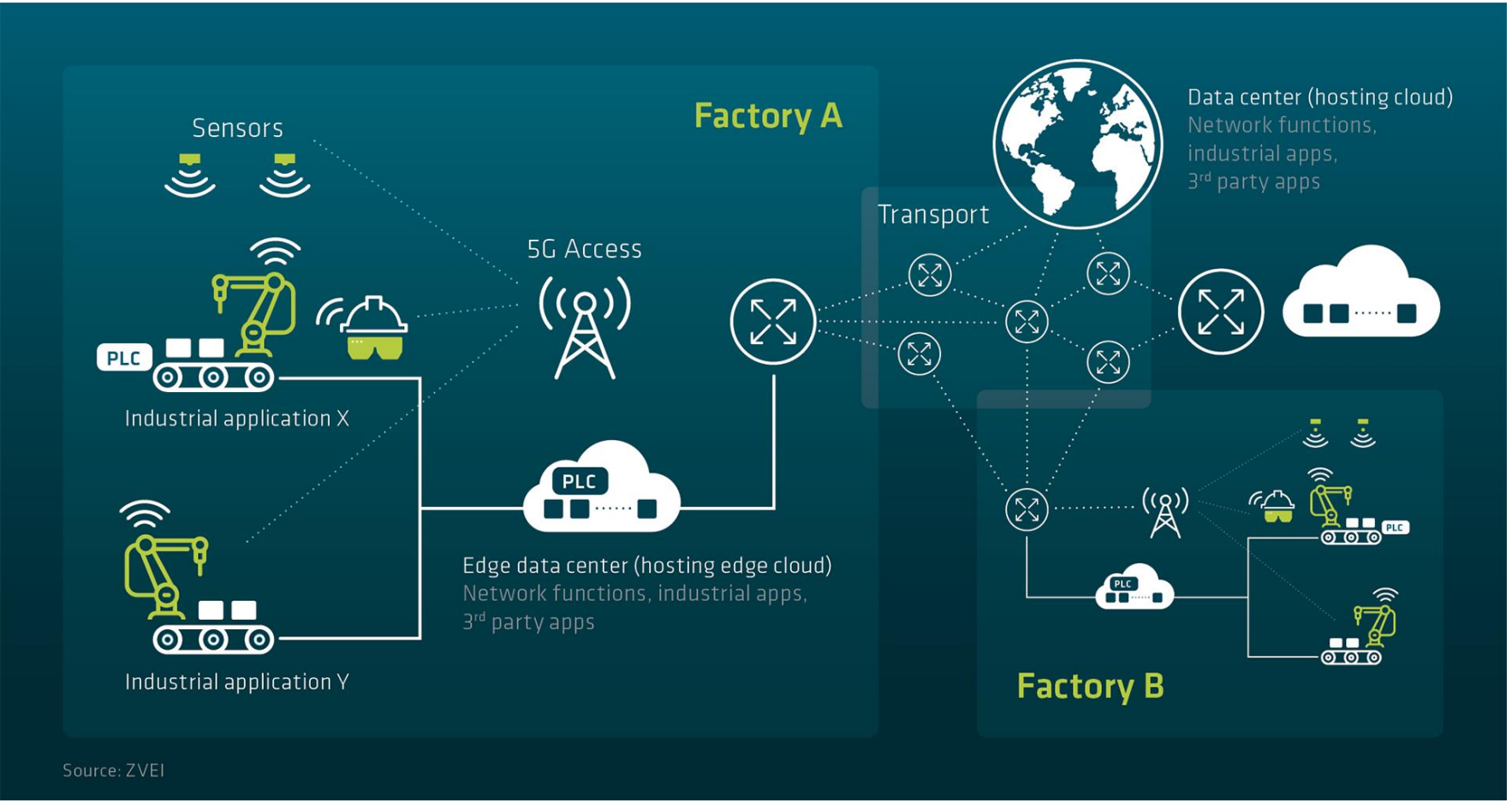
Source: 5G-ACIA

NOC: Network operation center
SP: Service provider

- **Device management**
  - Device identity management
  - Device provisioning and onboarding
  - Device connectivity management
  - Device connectivity monitoring
  - Device group management
  - Device location information
- **Network management**
  - Network monitoring
  - Network configuration and maintenance

*Ref: 5G-ACIA White Paper „Exposure of 5G Capabilities for Connected Industries and Automation Applications“; enhanced version 2 currently under preparation.*

# Architecture & Technology




**Finalized Work**

- Deployment scenarios for 3GPP-defined 5G non-public networks
- User data traffic model based on industrial use cases employing a 3GPP-compliant RAN
- Functional principles of Industrial Ethernet Networks with integrated 5G technology
- Security Aspects of 5G for Industrial Networks

**Ongoing Work**

- 5G & TSN integration
- Alignment I4.0 and 3GPP architecture
- OPC UA & 5G integration
- …

# Summary

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1. Industrial 5G may lift Industry 4.0 / the Industrial IoT to the next level.
2. Establishing common understanding and terminology of networking topics between ICT/OT
3. Many demanding use cases & requirements -> 5G could lead to a convergence
4. Key architecture features (e.g. URLLC, TSN over 5G, industrial QoS) as major game changers
5. A close collaboration between the ICT & OT industries is essential for unlocking the full potential

# 5G ACIA

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