



Considerations on 6G Use Cases & Requirements

SWS-240006

3GPP Stage 1 Workshop on IMT2030 Use Cases

Rotterdam, NL
08 - 10 May 2024



3GPP Workshop on IMT-2030 Use Cases | 08 – 10 May 2024

5G-ACIA Considerations on 6G Use Cases & Requirements

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Thank You

Special thanks go to

Michael Bahr (Siemens), WG 1 Chair
Xueli An (Huawei), WG 1 Vice-Chair

for coordinating & driving the preparation
of this presentation so well!



5G-ACIA | Member Overview (Status: May 2024)

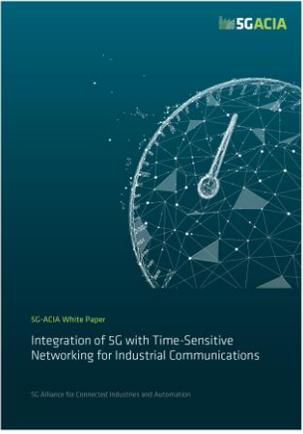


97 member organizations today

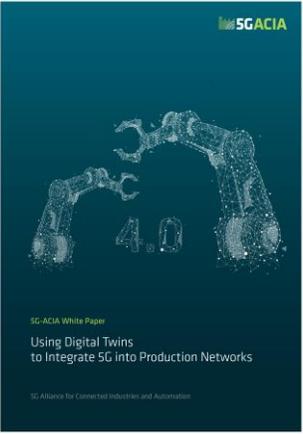
5G-ACIA | Global Collaboration Partners (Selection)



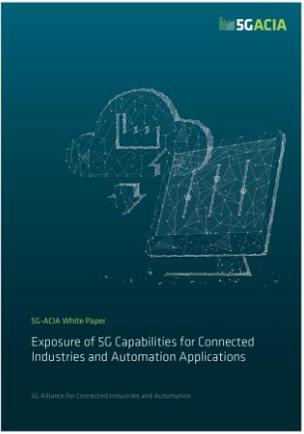
5G-ACIA | Overview of Selected White Papers



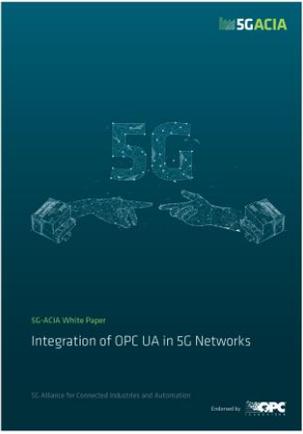
TSN-over-5G



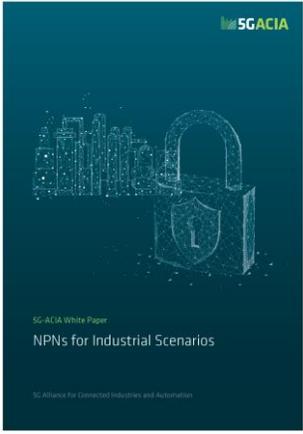
5G Digital Twins



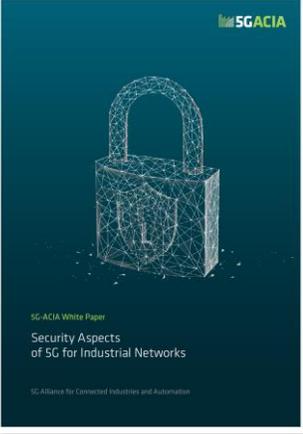
5G Exposure Interface



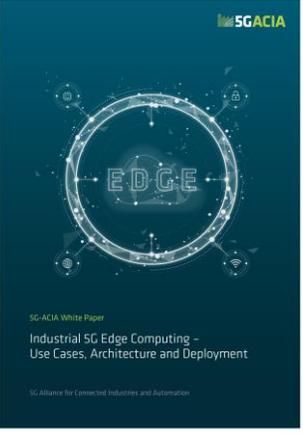
5G & OPC UA Integration



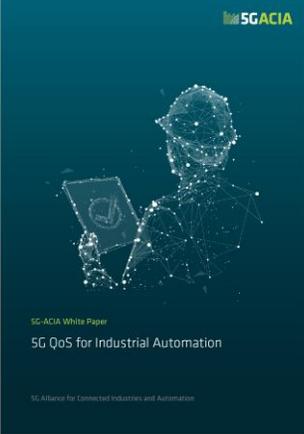
NPNs for Industrial Scenarios



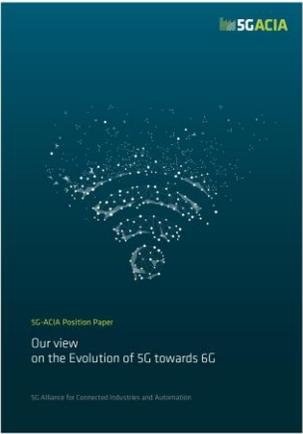
Security



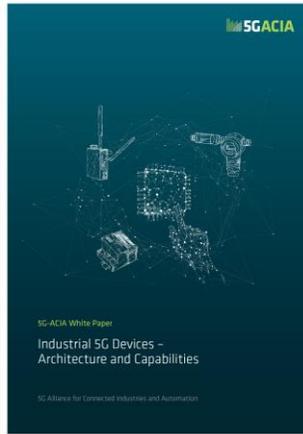
5G Edge Computing



5G QoS



6G Position Paper



5G Industrial Devices

5G-ACIA | Use Case & Requirements Contributions to 3GPP

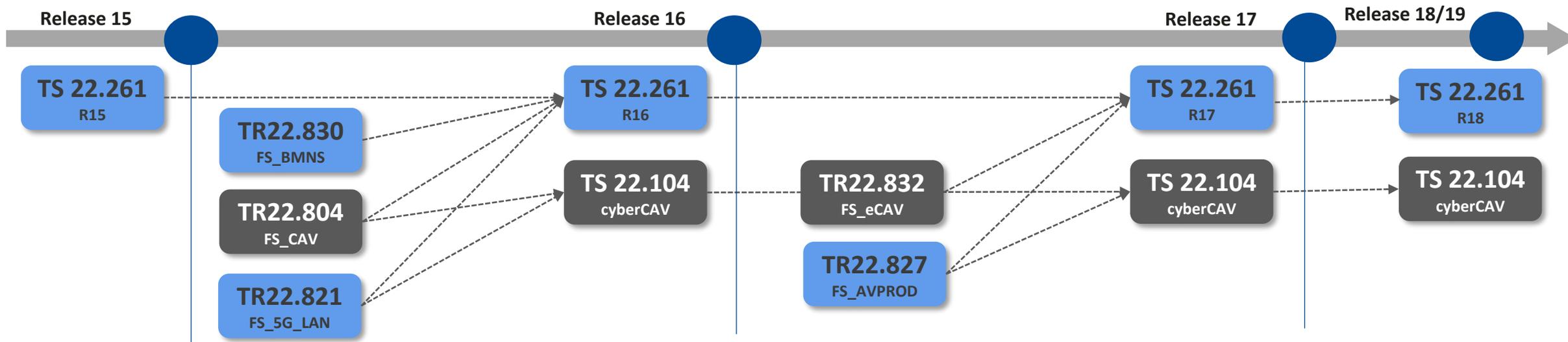


Analysis of Use Cases & Requirements

- Giving the OT industry a voice in 3GPP
→ triggered strong ICT interest in Industrial 5G
- Development of a common understanding what Industrial 5G may do (and what not)



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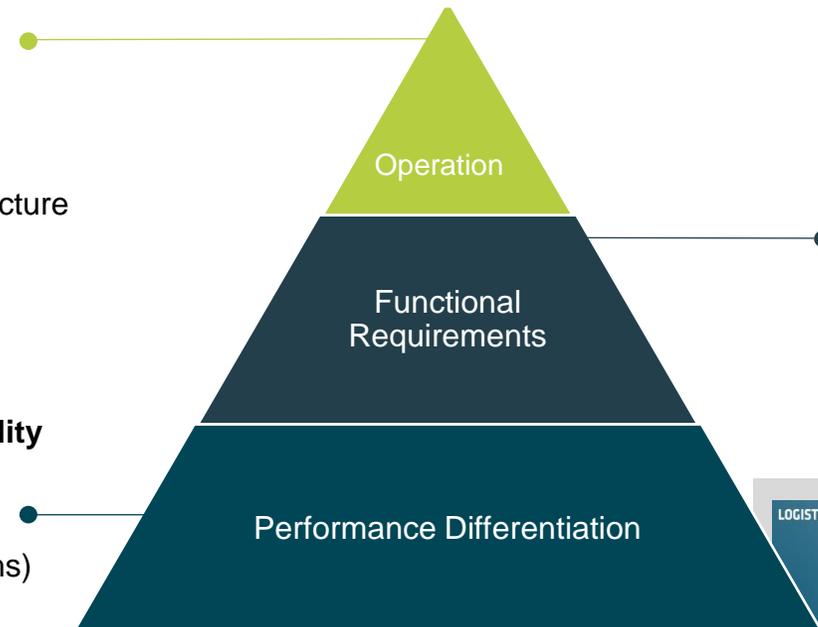
Multi-Dimensional Industrial 5G Requirements

Requirements / Challenges

- **High flexibility & versatility**
- Increasing number of mobile assets
- Service guarantees and 24/7 operation
- **Ease of use**
- Integration of installed network infrastructure

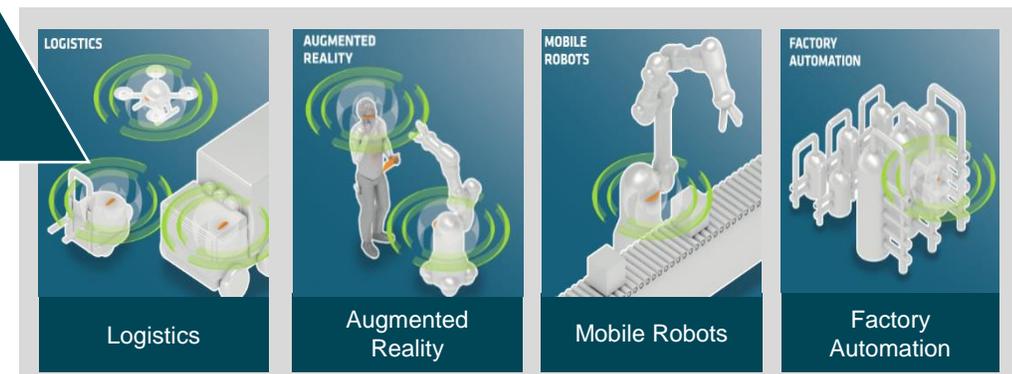
Key Performance Indicators

- **High communication service availability** (up to 99.9999%)
- **Ultra-low latency** (< 1..10 ms)
- **Cyclic traffic** (transfer interval 1..250 ms)
- **Transmission rate**
- **Typical service area** (~1..1000 m²)



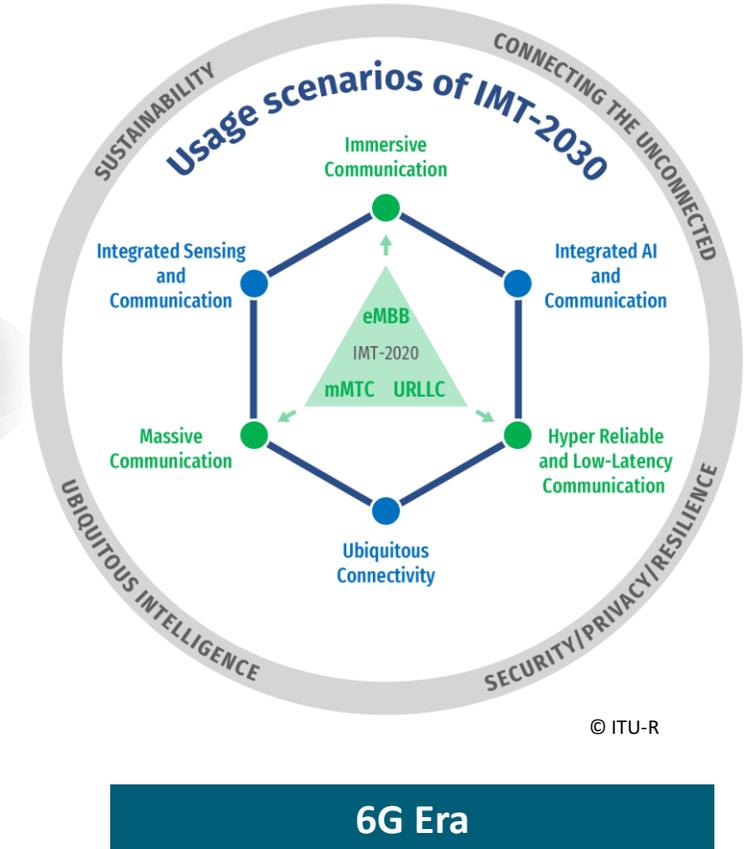
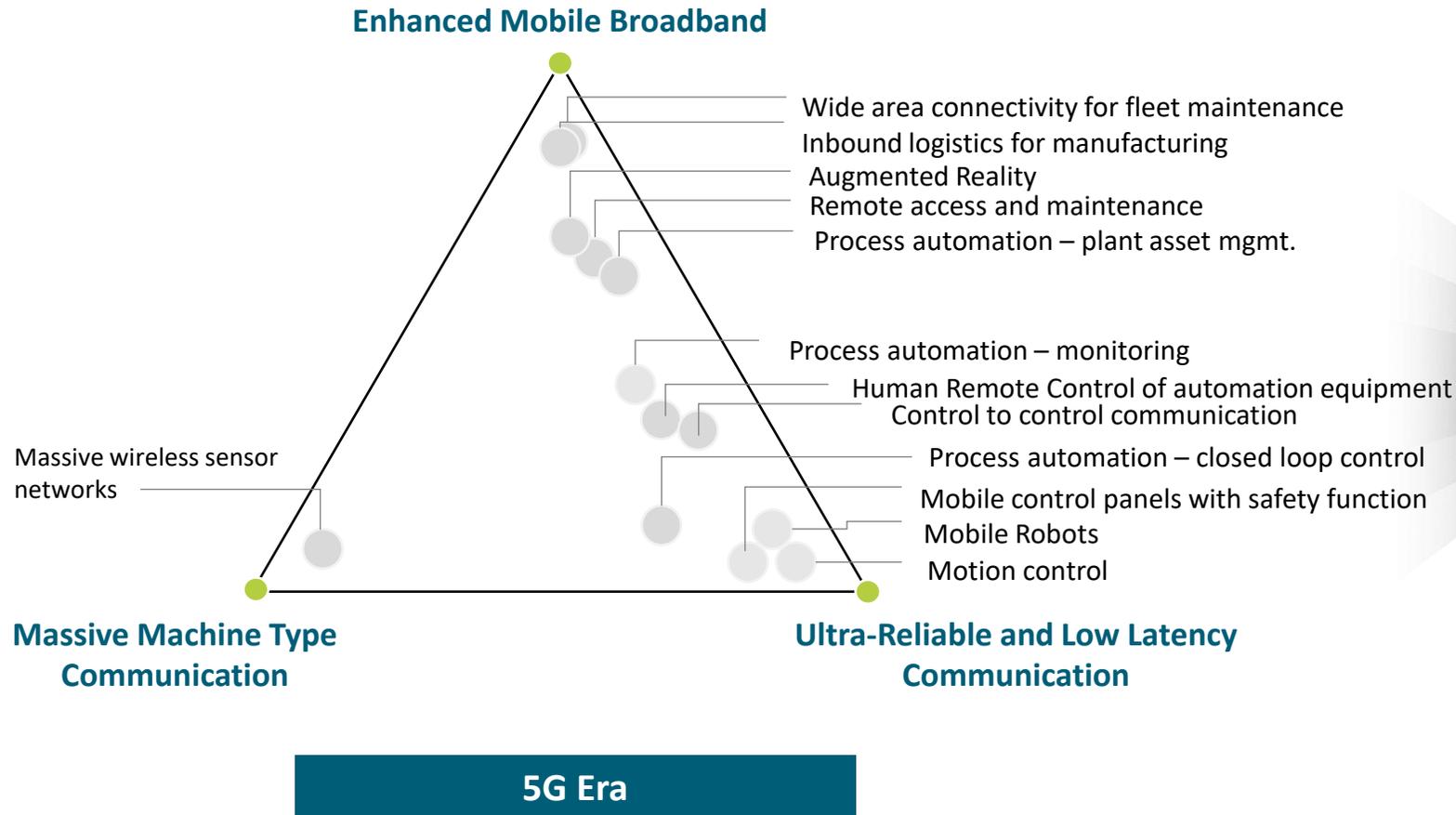
Functional Requirements

- **Non-public networks / operation (NPN)**
- **Security** (e.g. non-3GPP credentials)
- **Time synchronization** ($\pm 1 \mu\text{s}$)
- 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

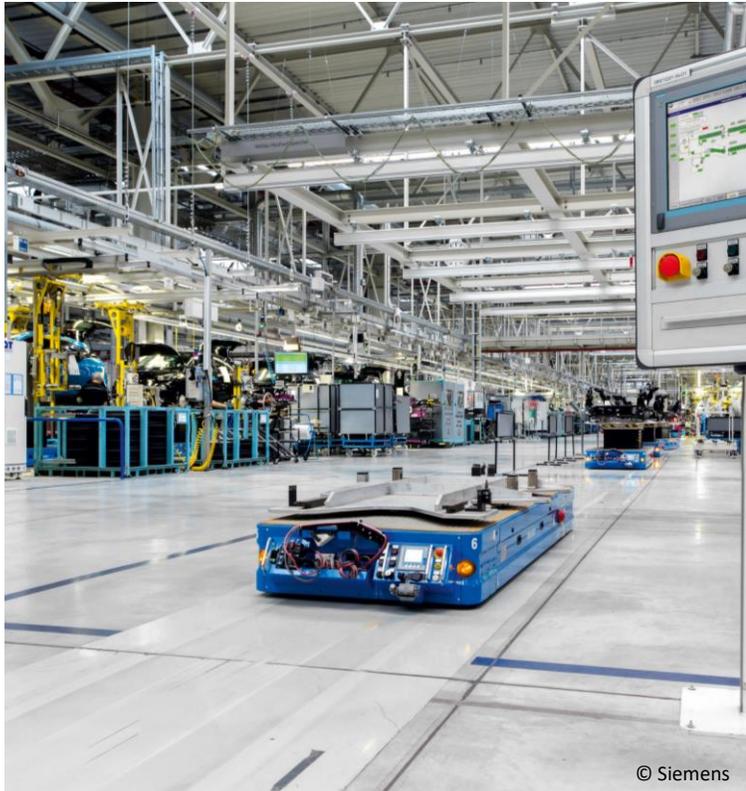
Industrial Use Cases – What’s Next?



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Industrial 5G / 6G Use Cases

Industrial 5G use cases are also applicable for 6G



Flexible Modular Assembly Area

Communication of mobile assets (AGVs, mobile robots, ...)



Industrial Automation

Wireless communication between PLCs and devices



Industry 4.0: Flexible Manufacturing

Dynamically configured production processes, mobility

5G-ACIA 6G Considerations

Recommendation from Business Aspects

6G as Evolution to Leverage Ongoing / Upcoming Investments

- 6G has to be an evolution of 5G, **allowing 5G-based deployments to be upgraded** with components of the next generation technology.
- It is of utmost importance to **protect ongoing and upcoming investments and deployments** of industrial users in 5G applications, devices, infrastructure & spectrum (where applicable).
- Manufacturing and process industries require **backwards compatible solutions**, which is in line with the often long lifetimes of industrial equipment.

Life Cycle Matching Between OT & ICT

- Mobile communication system is roughly progressing from one generation to the next every ten years, and its entire ecosystem (including research, standardization, commercialization of all technology components, etc.) are collaborating and self-adapting to reach this goal.
- In OT domain, the product life cycle is much longer than 10 years. **Life cycle mismatch** may result in different development speed, expectations, etc.

Ensuring an adequate evolution of 5G is very important – An evolution that meets the evolving challenging requirements of industrial automation, leverages OT investments in 5G technology, recognizes longer life cycles in the OT domain, and supports further sustainable development.

Dependability & Resilience

Performance Aspects

Background:

For mobile equipment data acquisition and control scenarios, such as **collaborating AGVs**, **synchronized control of multiple robots**, and **integration of mobile networks in industrial time-sensitive networks**, it's necessary that the wireless network supports advanced features beyond the capabilities of 5G.

Ultra-Accurate & Stable Synchronization

- Demanding production data acquisition, e.g., motion control with further **improved and stable clock synchronization** beyond 5G target and **latency of ~1 ms**.
- **Better scalability** – URLLC/IIoT communication with demanding QoS for many concurrent communications



Simplicity & Maintainability

Operational Aspects

Reduced Complexity

- **Simplified network management**
- **Tailor-made functionality** for industrial use cases

Modularity & Extensibility

- **New operating models** based on technology enablers, e.g., virtualization and softwareization.

Advanced Exposure Capability

- Evolve secure exposure of communication services at network level for **monitoring, diagnosis, and standardized data and information exchange** with industrial applications, e.g. data or knowledge exchange for external processing by AI.



Sustainability

Energy efficiency and facilitating factors for sustainability

Energy Efficiency

- **Massive asset management and tracking demand with (very) low power consumption** (e.g., passive or ambient powered).
- Achieve **better energy efficiency for NPN** (e.g. radio and relevant networking aspects).
- **Energy efficient end devices** (i.e. UEs).

Evolution from 5G to 6G

- **New functionality via software updates**, maintaining compatibility to 5G

„Enablement“-Effect

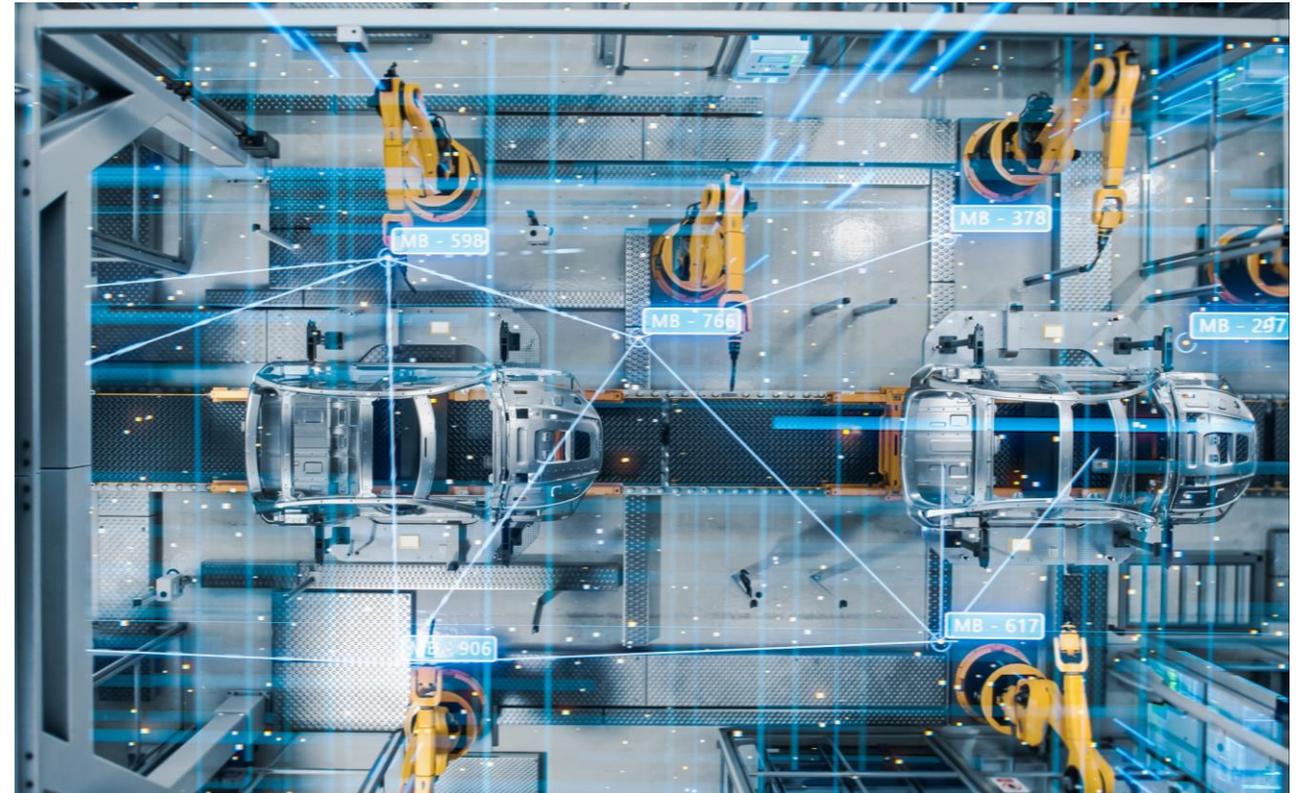
- **More efficient processes** and more utilization of resources in different industrial domains to support a **circular economy**.



Non-Public Networks (NPNs)

5G features transition towards 6G

- NPN concept, both Standalone NPN and Public-Network Integrated NPN, will be brought from 5G to 6G.
- Standards must allow **on-premises NPN deployments**: NPN deployed on-premises of the industrial enterprise is needed to support typical industrial use cases
- **Simplification** to deploy, configure and manage determinism & quality in NPN.
- **Flexibility** needed in O&M to support all NPN deployment types and operation models. (e.g. industrial enterprise has access to relevant networks management capabilities, NPN as-a-service data model).
- **Privacy and Security** need to be ensured in all NPN deployment types and operation models (network domains, external connections, third parties etc.)



Seamless Integration and Native Support of Industrial Communication Domains in NPN



5G features transition towards 6G

- Ability to build NPN that can further support several **logically independent communication domains**
- Support for **deterministic communication** with standardized means
- **Industrial applications of various suppliers in different compute environments** should be able to communicate with each other as they were in the same cloud
- Feature complexity kept to level justified by the use cases (= **economical feasibility**)
- **Integration of 6G wireless communication in non-3GPP industrial automation networks**
- **Advanced exposure capability** and well-defined interfaces.
- Further **distributed autonomous network** may bring new integration aspects.



VicenSanh/Adobe Stock (generated with AI)

Integrated Sensing and Communication (ISAC)

New capabilities triggering new use cases and requirements

Use the communication infrastructure as a sensor

Potential advantages:

- Sensing capability to enrich **digital twin**.
- Enabler of **industrial metaverse**.
- **Monitoring and maintenance**.
- **Calibration / improvement of machine sensors**

5G-ACIA will explore potential new use cases and requirements on ISAC.



Native Intelligence

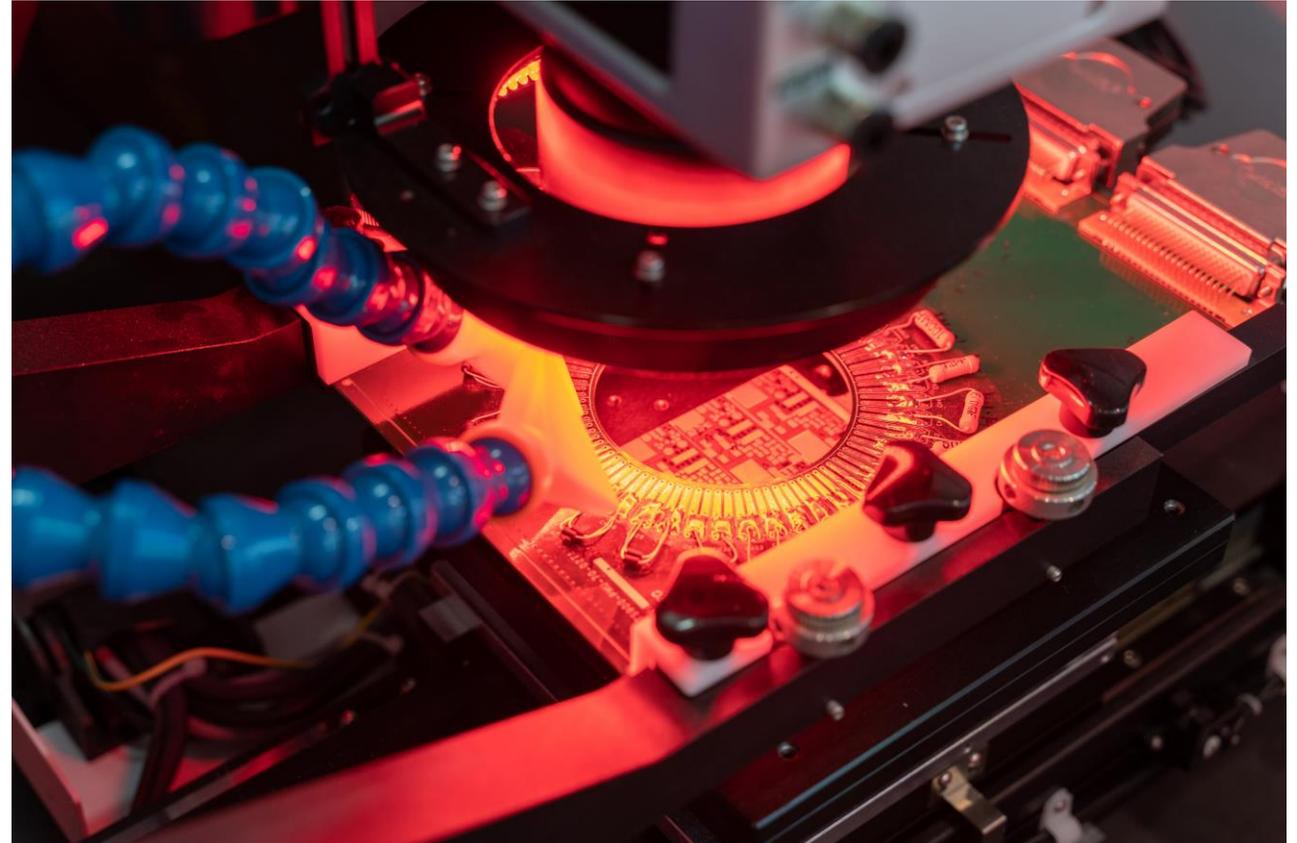
New capabilities triggering new use cases and requirements

Utilization of AI and decentralized intelligence

Potential advantages:

- **Native support of AI by 6G** (e.g., data management, model distribution) as potential enabler for better adaptability to industrial scenarios.
- **Handling of industrial data on-premises** with support of efficient local training, data aggregation, etc.

5G-ACIA will explore potential new use cases and requirements on native intelligence.



Real-Time Digital Twin

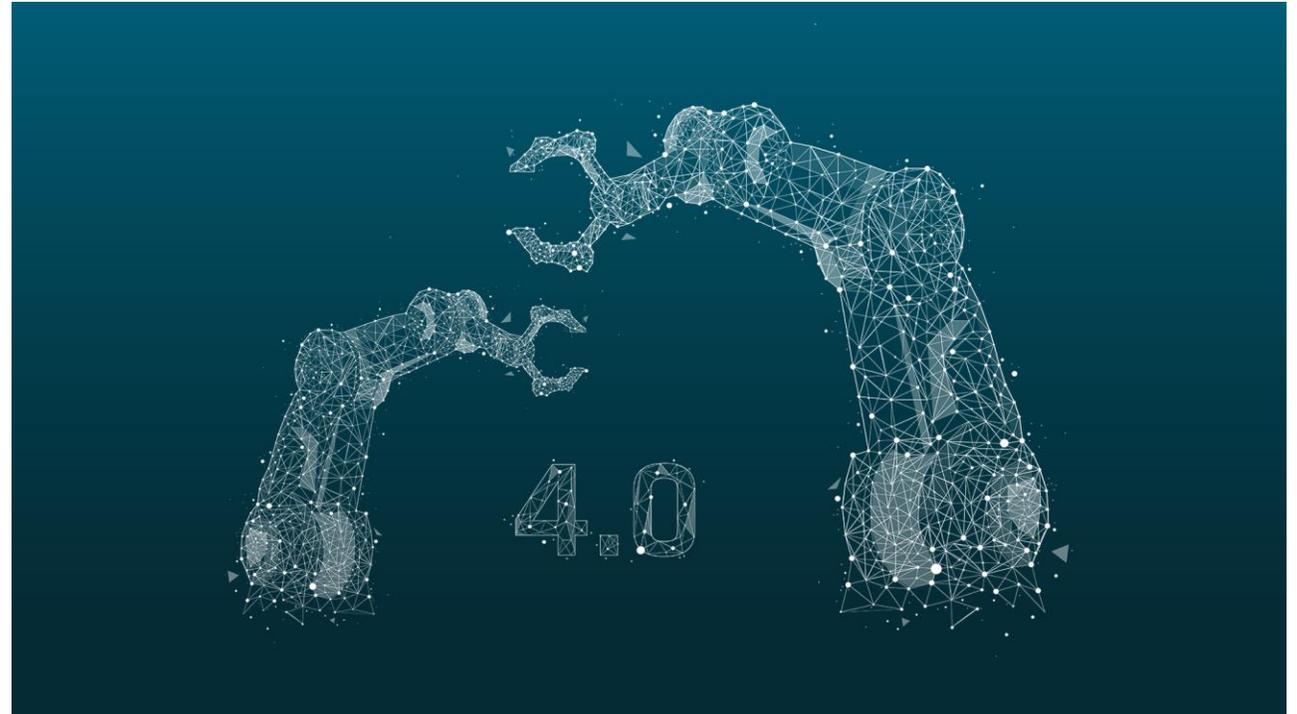
New capabilities triggering new use cases and requirements

Support of Real-Time Digital Twin

- Powerful communication system **enables real-time digital twins** allowing reduction of hardwiring / logic inside industrial systems to an environment outside of the system.

Potential advantages:

- Real-time data will support digital twins
- Real-time digital twin for **efficient integration and operation**
- Network Public Network **digital twin enhanced O&M**
- **More harmonized environment** to innovate faster
- **More efficient interoperability and upgradability** of industrial system over a long (+10 years) lifecycle



Key Messages

Fundamental considerations:

- **Industrial 5G use cases are still applicable for 6G**
- **Protect ongoing investments** by enabling a smooth evolution from 5G to 6G while meeting future demands
- 6G Vision on its evolution through all 6G releases needed to **accommodate verticals with longer life-cycles**
- **Industrial 6G has to be considered from the very beginning**
- **Most relevant 5G IIoT features shall set the benchmark for 6G** and maybe further discussed/enhanced in 6G, e.g. seamless integration of industrial domains, NPN, etc.

New thoughts brought by 6G:

- Overall, OT players value the following technical features: **Sustainability, dependability and resilience**, and **simplicity and maintainability**.
- 6G new features like **ISAC, AI exposure** and **native intelligence** (based on ITU-R IMT2030 vision) will trigger **new use cases and requirements** for industrial IoT, e.g., digital twin, industrial metaverse, etc.

5G-ACIA is also open for further use case & requirements discussions enabled by 6G features

Thank you!

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5G-ACIA General Chair

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