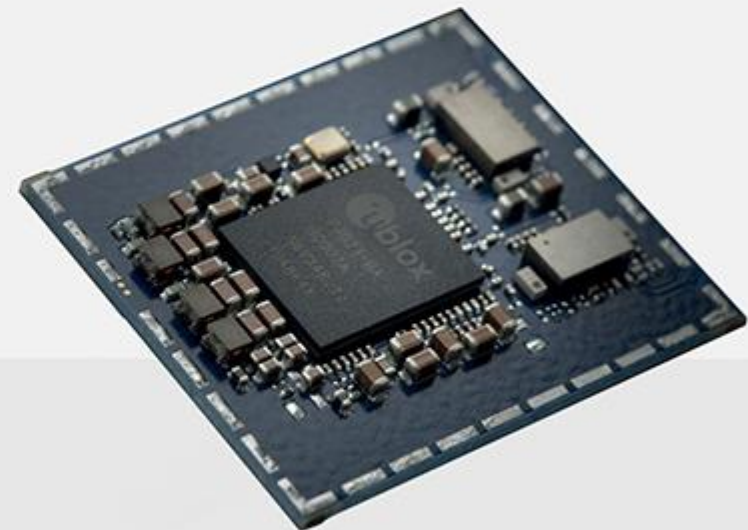# Unleash the potential of 5G Industrial IoT for Industry 4.0

29 Feb 2024

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Leading the world to reliably locate and connect every thing
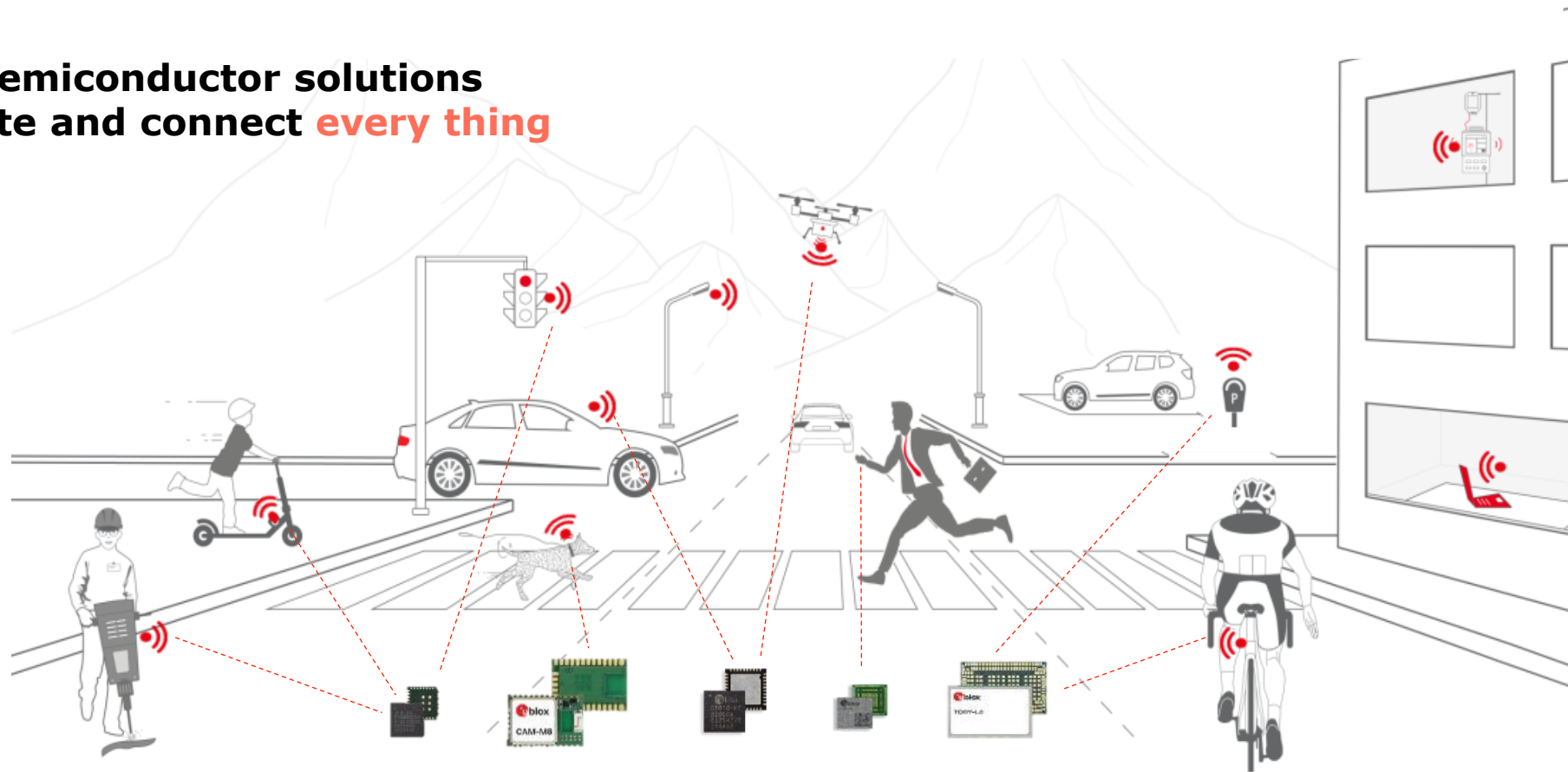
2007
SIX:UBXN

1,300+
employees

10K+
customers

**Offer semiconductor solutions
to locate and connect every thing**

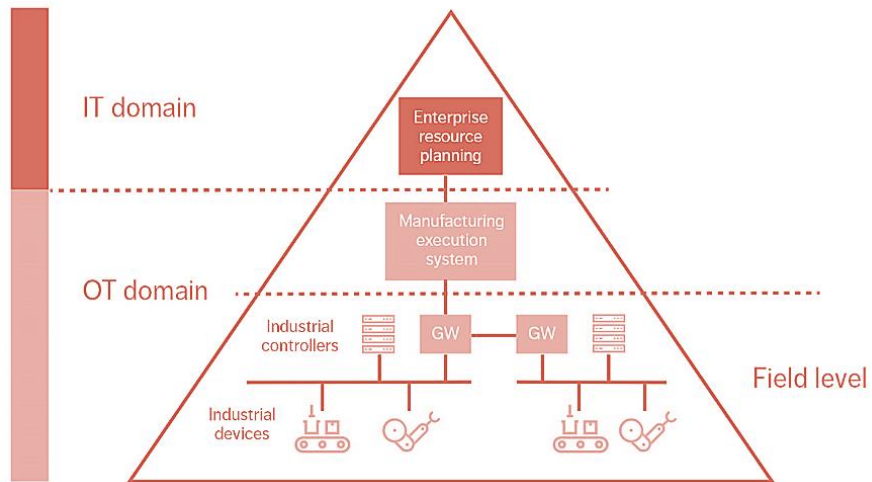Source: Geeny.io

P
Positioning

C
Cellular

S
Short Range

U
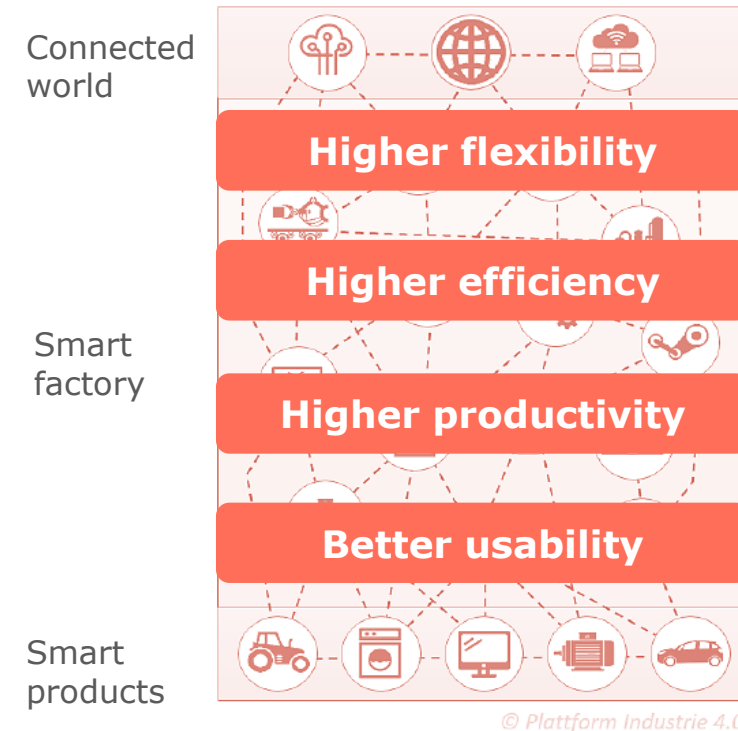Services

Enabling Industry 4.0 – the crucial shift from hierarchical to fully connected systems through enhanced connectivity

Factory of Today: hierarchical design
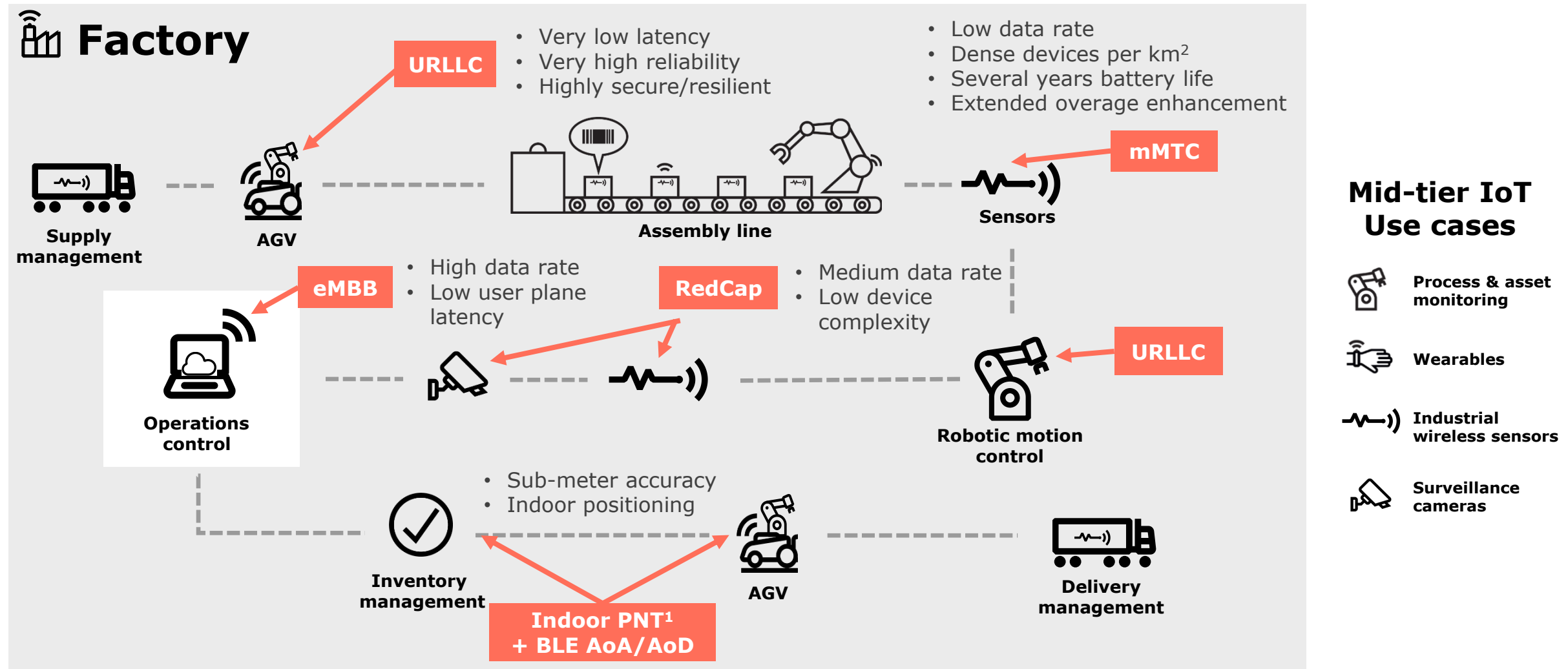
Factory of the Future: fully connected

Factory of Today

- OT* network domain dominated by wired technology (>90%)
- Heavily fragmented market with wired technologies (Profibus, Peofinet, EtherCAT...)
- Connectivity islands separated by gateways in the field level

Addressing diverse industrial IoT use cases – beyond a single 5G solution

No single 5G technology can address all industrial IoT use cases

Factory

- Very low latency
- Very high reliability
- Highly secure/resilient

URLLC

- Low data rate
- Dense devices per km^2
- Several years battery life
- Extended overage enhancement

mMTC

Supply management

AGV

Assembly line

Sensors

Mid-tier IoT Use cases

eMBB
- High data rate
- Low user plane latency

RedCap
- Medium data rate
- Low device complexity

URLLC

Operations control

Robotic motion control

- Process & asset monitoring
- Wearables
- Industrial wireless sensors
- Surveillance cameras

- Sub-meter accuracy
- Indoor positioning

Inventory management

AGV

Delivery management

Indoor PNT[1] + BLE AoA/AoD

5G NR RedCap expands industrial IoT possibilities

By bridging a critical gap in 5G for medium data rate IoT applications
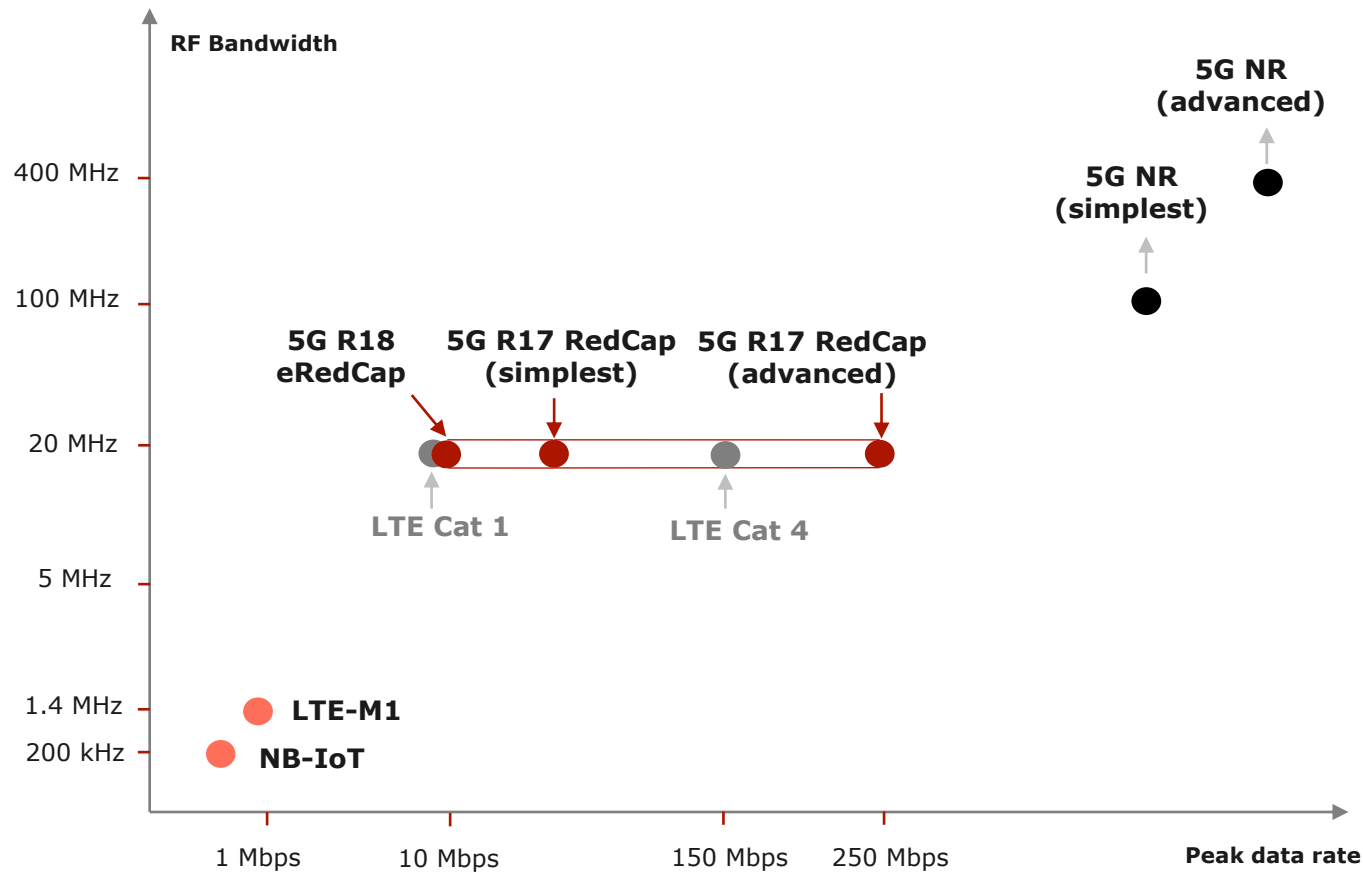
1. RedCap bridges a **critical gap** in 5G for medium data rate IoT applications
2. Provides a **strategic pathway** for **migration** to advanced 5G technologies, by facilitating the transition from LTE Cat 4 and Cat 1 to 5G NR
3. Nevertheless, LTE will **remain** operational on operator networks well into **2030s**[1]
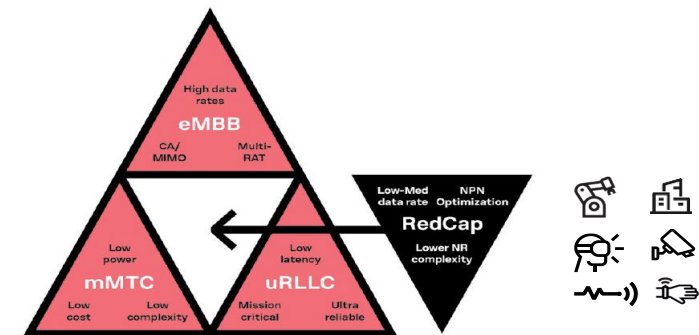
Indoor PNT[1] – Indoor positioning for Industrial IoT

Indoor positioning takes asset tracking beyond the reach of GNSS signals

Manufacturing
To dominate the indoor location Real-time location service (RTLS) markets by 2030:
5.9 billion USD by 2030 (hardware)
5.3 billion USD by 2030 (service)[1]

Use case examples
Tracking of equipment and tools, asset tracking

Needs
Sub-meter level accuracy, ultra-low power consumption, cost-effectiveness, simple and quick deployment

Adoption barriers so far
High initial CAPAX and OPEX costs due to infrastructure requirements, fragmentation in technology and solutions, unclear ROI

Adoption momentum of 5G positioning anticipated as the device ecosystem matures

5G positioning - a key value proposition of 5G in the manufacturing sector, by leveraging existing 5G infrastructure.

However, the wider adoption of 5G positioning is anticipated as the 5G device ecosystem matures, aligning with the timeline for wider RedCap adoption.

Meanwhile, **BLE** based indoor positioning solution is expected to remain the primary choice for global indoor RTLS tag shipments to 2030[1]. Due to its cost-effectiveness, power efficient and ease of deployment, alongside providing real-time, meter-level accuracy for indoor positioning.

Indoor PNT [1] - the role of cellular time sync for IIoT

## Time sync is crucial in industrial applications

Use case examples
- Data logging and analysis
- Control systems and automation (operation coordination)
- Network system integration
- Event sequencing and timestamping

Requirement[2] (for device synchronization and/or UTC time distribution): less than 1 us, deployed deep indoors

Complementary role of cellular timing

- **Indoor time sync**: Cellular time sync fills the indoor coverage gap of the GNSS receivers whenever GNSS signal reception is very weak and sporadic; cellular time and frequency distribution is based on the existing cellular infrastructure with good indoor signal penetration

- **Precision with 5G**: 5G offers precise time information (SIB-9), aligning with UTC, enhancing sync accuracy

- **Signal of opportunity approach**: Leverage cellular LTE/5G signals for frequency and phase synchronization of modems arrays within the same base station's coverage

Case study: time sync for digital twins
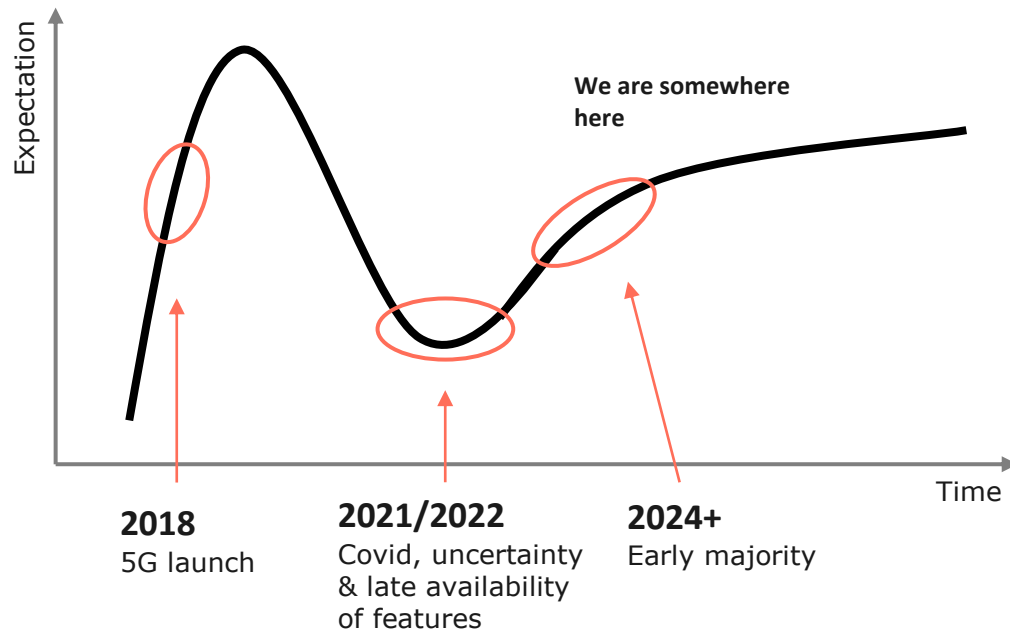

5G-SMART project
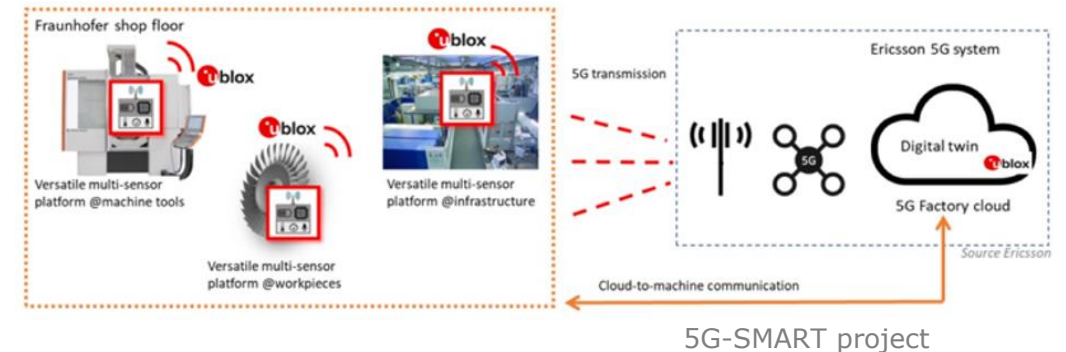
Multi-sensor platform is developed and integrated into multiple machines and attached to multiple pieces. Cellular LPWA modems were used to provide both connectivity and timing capabilities.

Time sync
- Cellular modems are frequency synchronized with the serving base station, utilizing the 4G/5G frame to establish a local time reference
- Integration with GNSS receiver: GNSS acts as the primary timing source when combined with the cellular modem, it allows to align the modem clock to UTC
- Time accuracy achieved < 1 us

Industrial 5G – Where are we heading?

The industrial 5G hype cycle

Expectation

We are somewhere here

Time

2018
5G launch

2021/2022
Covid, uncertainty & late availability of features

2024+
Early majority

Industrial 5G in numbers

Private networks[1]

1,148+
by Jul **2023**

→

13,500+
in **2026**

IoT Connections[2]

15.7 Bn
in **2023**

→

38.9 Bn
in **2029**

Increasing adoption of private 5G in challenging environments (e.g., mining, ports, plants), rising availability of IIoT capabilities (e.g. NR RedCap), indicating a growing industrial 5G ecosystem

Key enablers for long-term industrial success

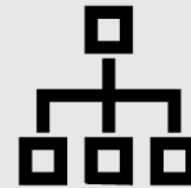## Given the long lifespan of industrial equipment & infrastructures (>20 years)[1]

Strengthening Non-Public Networks

Sophisticated self-management

Flexible & modular solutions

Open interfaces, scalable architecture

High-precision positioning & time sync

Summary

- **Diverse** industrial use cases – no single 5G technology fits all, **RedCap** bridges a critical gap in 5G for **medium data rate IoT** applications, provides a strategic pathway for migration to advanced 5G technologies, by facilitating the transition from LTE Cat 4 and Cat 1 to 5G NR

- **Indoor PNT** takes e.g., asset tracking beyond the reach of GNSS signals, however, wider adoption momentum of 5G positioning is anticipated as the device ecosystem matures, aligning with the timeline for RedCap adoption

- **Key for long-term success:** considering the long lifespan of industrial equipment and infrastructure, flexible, modular solutions featuring open interface and scalable architecture are the key. Such an approach positions 5G as the pivotal technology driving Industry 4.0