



Industrial 5G. For the industry of tomorrow

Siemens: David Gibson

More reliability, more efficiency, more flexibility



” 5G is going to change industry – with its speed, with the multitude of devices you can connect, and with its reliability. We at Siemens have entered the next phase: In our own private stand-alone 5G test network, we’re testing Industrial 5G communication and applications with the aim to develop a whole 5G ecosystem suited for the industry. With Industrial 5G, we’re making the future happen.

Eckard Eberle, CEO Process Automation

The evolution of cellular networks in Industry – from the first commercial network to the network of the future

1G

Released: 1979
Standards: NMT, AMPS & TACS
Capabilities: Analog voice

2G

Released: 1991
Standards: GSM & CDMA
Capabilities:

- Digital voice
- Encrypted communication
- Limited roaming
- SMS & MMS

Extensions:

- GPRS (2.5G)
- CDMA2000 (2.5G)
- EDGE (2.75G)

3G

Released: 2002
Standards: UMTS & EV-DO
Capabilities:

- Mobile broadband
- Locating services
- Multimedia streaming
- Seamless global roaming

Extensions: HSPA+ (3.5G)

4G

Released: 2009
Standards: LTE
Capabilities:

- High Speed mobile Internet
- IP-based packet switching
- HD multimedia streaming
- Seamless global roaming

Extensions: Feature extension through new category/releases

5G

Released: 2019
Standards: 5G
Capabilities:

- Private networks (local use frequency)
- (I)IoT Ready
- Massive Machine-Type communication
- Ultra-low-latency
- Ultra-high reliability
- Millimeter wave support

Extensions: Feature extension through new categories/releases



No impact on industrial applications



- Remote control/Telecontrol
- Text messages from and to remote machines



- Video monitoring
- Remote Access to machines (e.g. for teleservice)
- Remote Condition Monitoring



- Mobile service Technicians
- Service via smart phone
- Wireless Backhaul



- Autonomous Logistics
- Autonomous Machines
- Assisted Work
- Wireless Backhaul
- Edge Computing
- Mobile Equipment

Potential industrial applications with Industrial 5G



Mobile Equipment



Assisted Work



Backhaul



Autonomous Machines

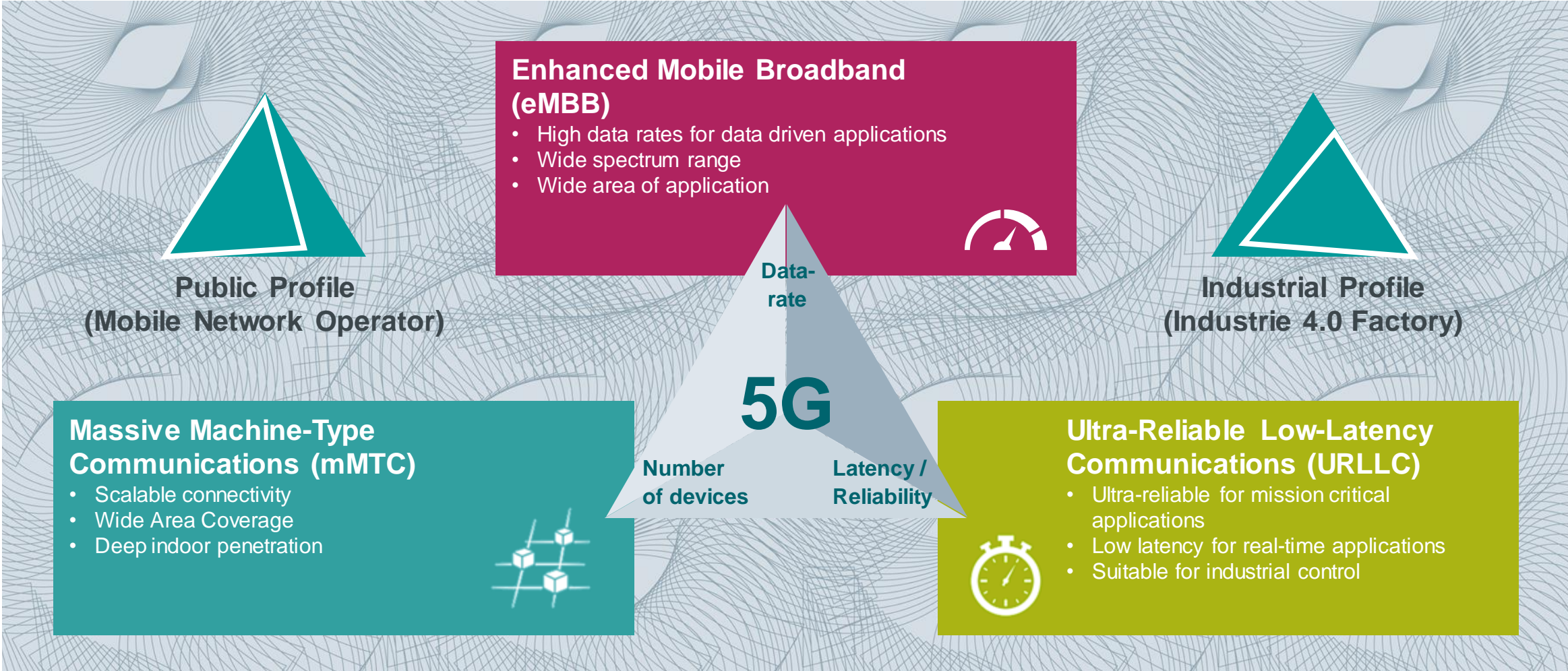


Autonomous Logistic

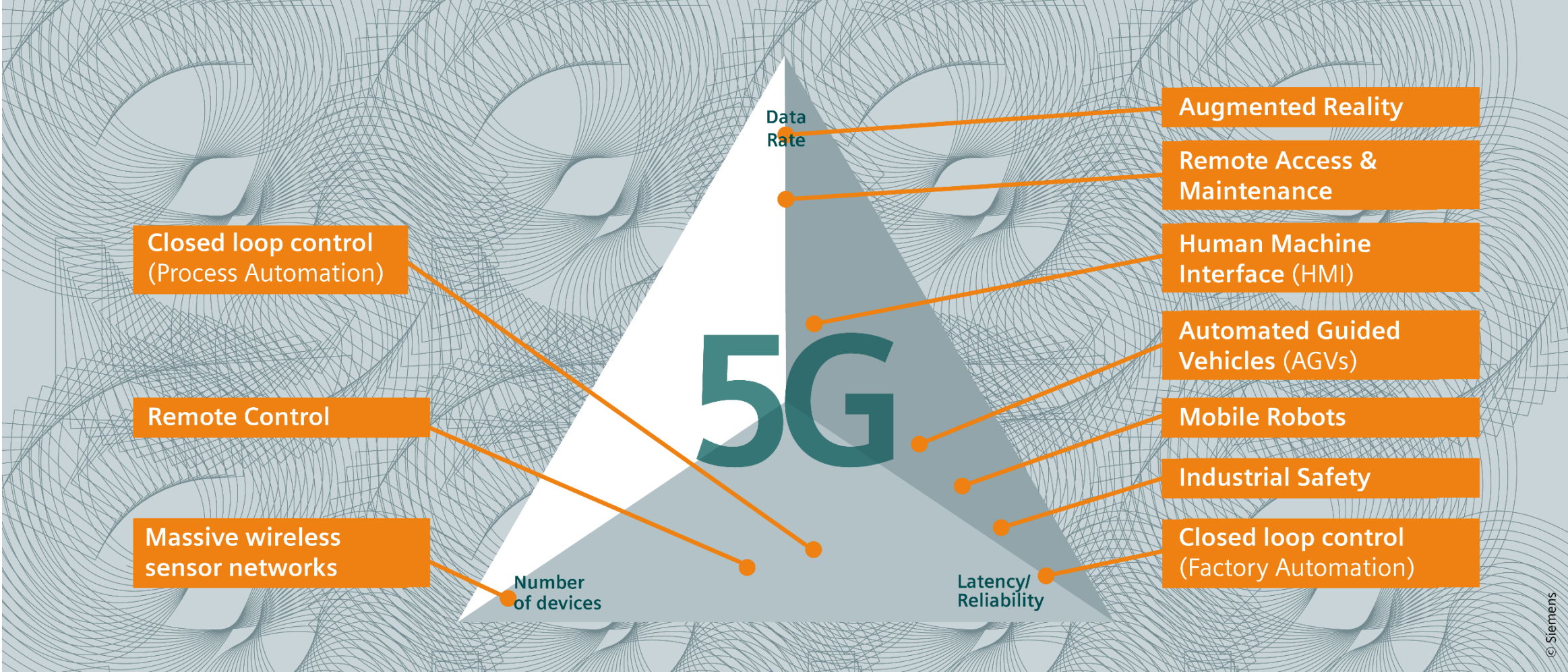


Edge

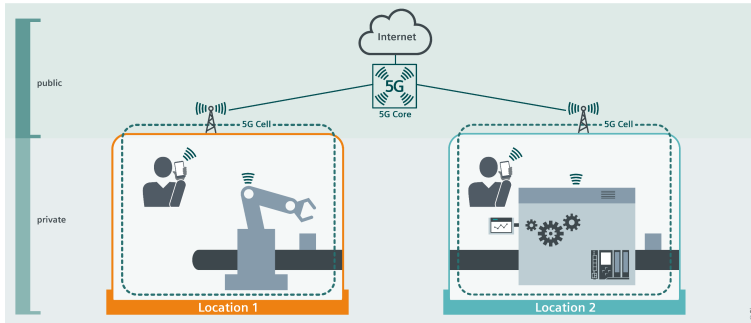
5G fulfills various network requirements



Classification of applications according to network requirements

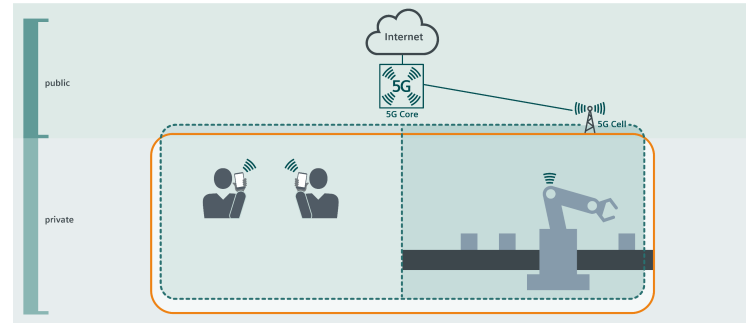


Industrial 5G can use different infrastructures. Which one is right for your application?



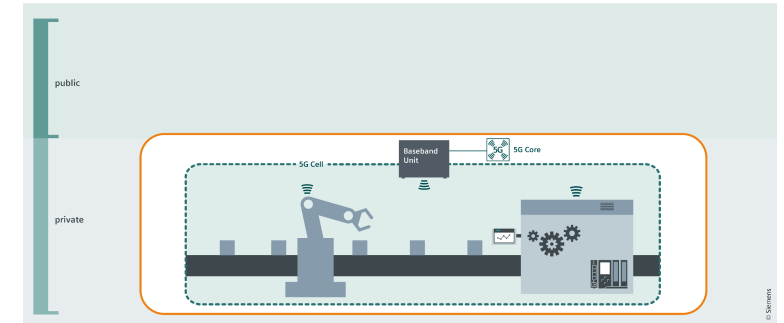
Public network

- Managed by Mobile Network Operator
- Production data leaves the premises
- Large coverage area
- Suitable for remote maintenance and monitoring



Semi-public network

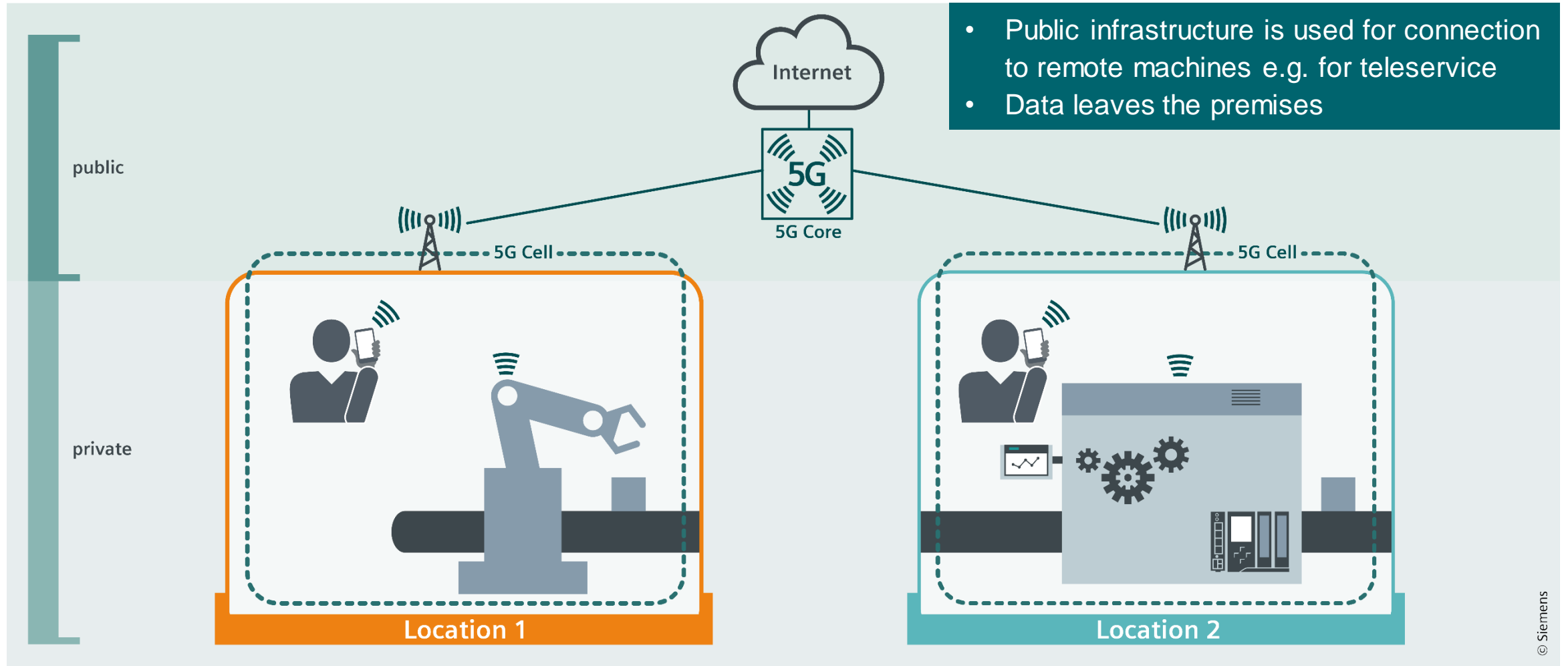
- Managed by Mobile Network Operator
- Production data partially leaves the premises
- Large coverage area
- High bandwidth
- Suitable for remote maintenance and monitoring



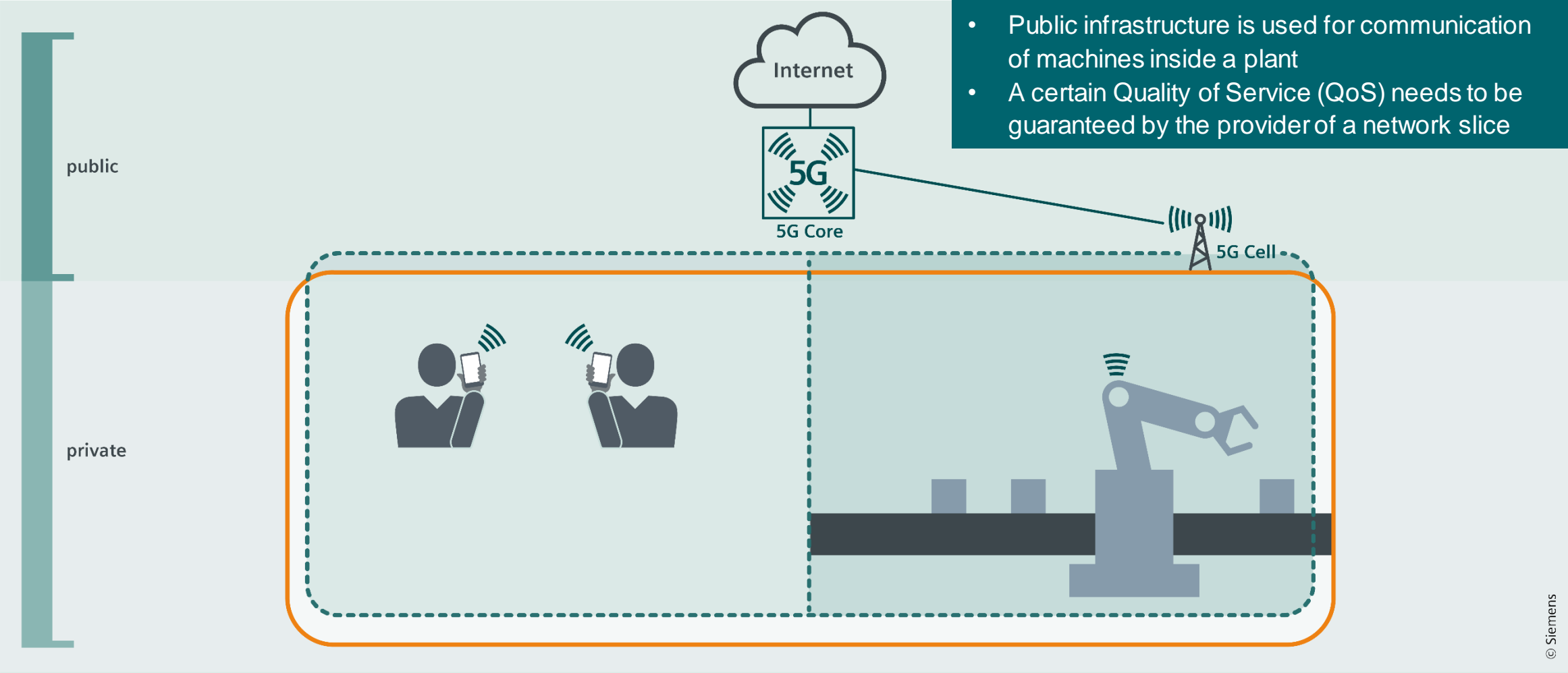
Private network

- Managed by the end-user (Production facility)
- Optimal data privacy, data stays on premises
- Highest reliability
- Highest real-time behavior
- No interference from other devices/networks

Public infrastructure: the network infrastructure is controlled by the provider. Data leaves the premises.



Semi-public infrastructure: the network infrastructure is controlled by the provider. Data partially leaves the premises.

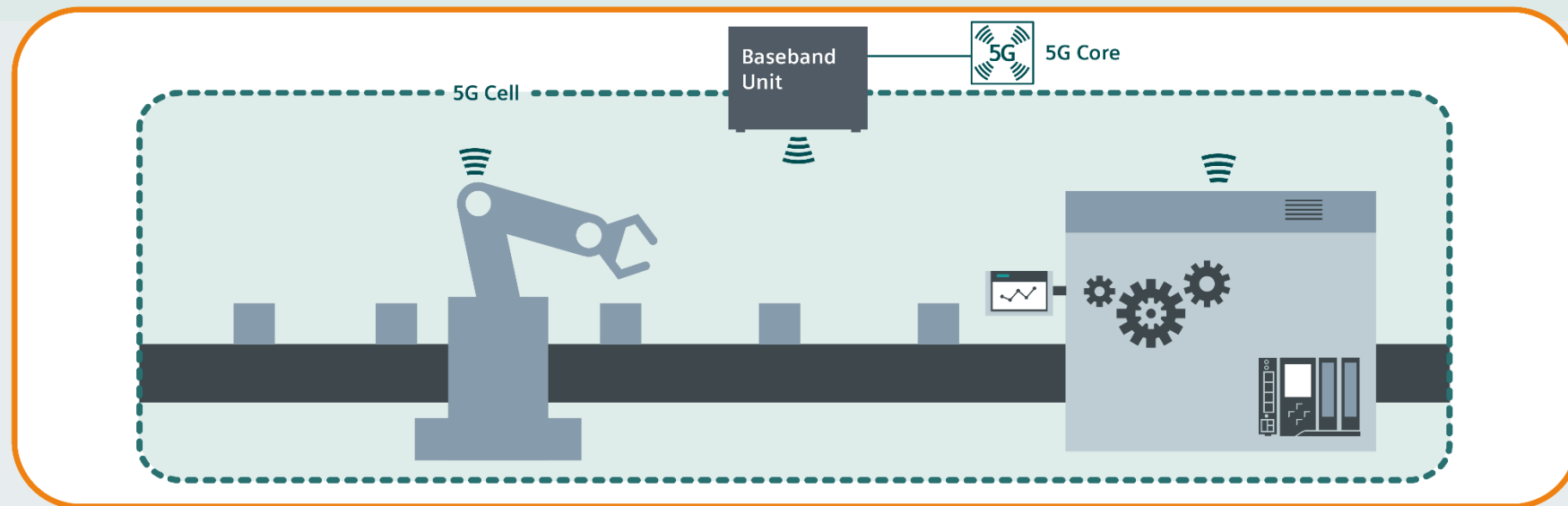


Non-public/ private infrastructure: the network infrastructure is controlled by the user. Data stays on premises. (1/2)

Radio Access Network (RAN) concept:

Non-public (private) with all-in-one baseband unit(s) based on a private 5G network preferably using an industry-specific frequency band.

- The customer hosts his own 5G network
- Network can be adapted to the requirements of the applications

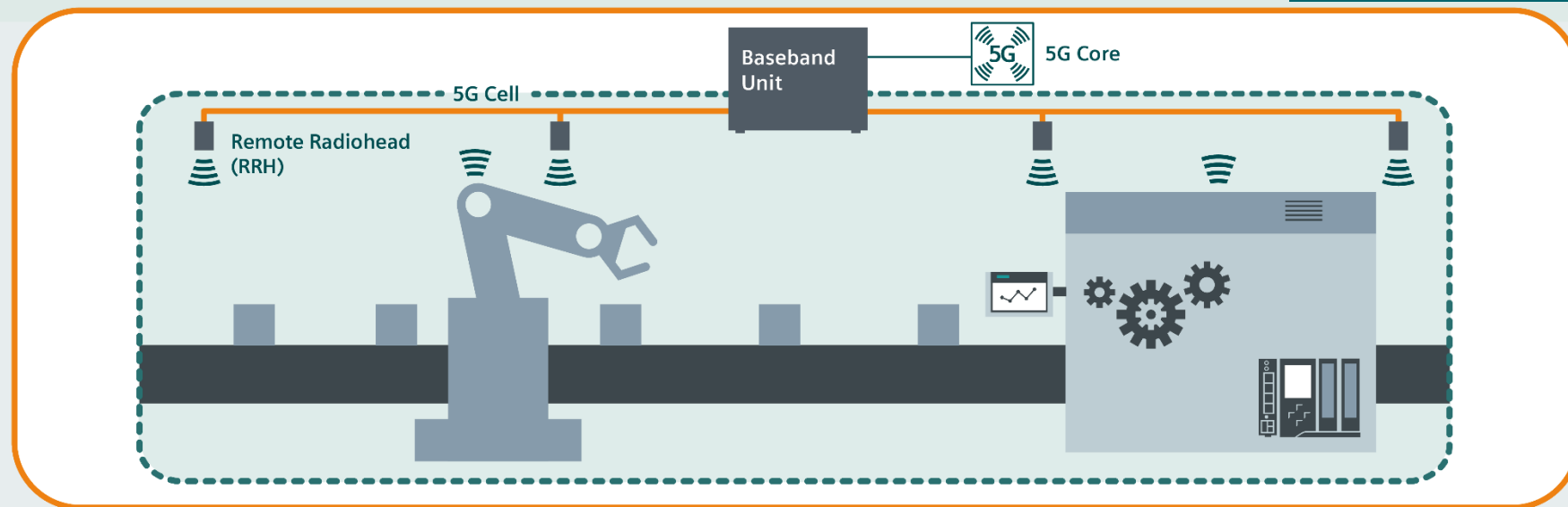


Non-public/ private infrastructure: the network infrastructure is controlled by the user. Data stays on premises. (2/2)

Radio Access Network (RAN) concept:

Non-public (private) with baseband unit(s) with remote radioheads based on a private 5G network preferably using an industry-specific frequency band

- The customer hosts his own 5G network
- Network can be adapted to the requirements of the applications

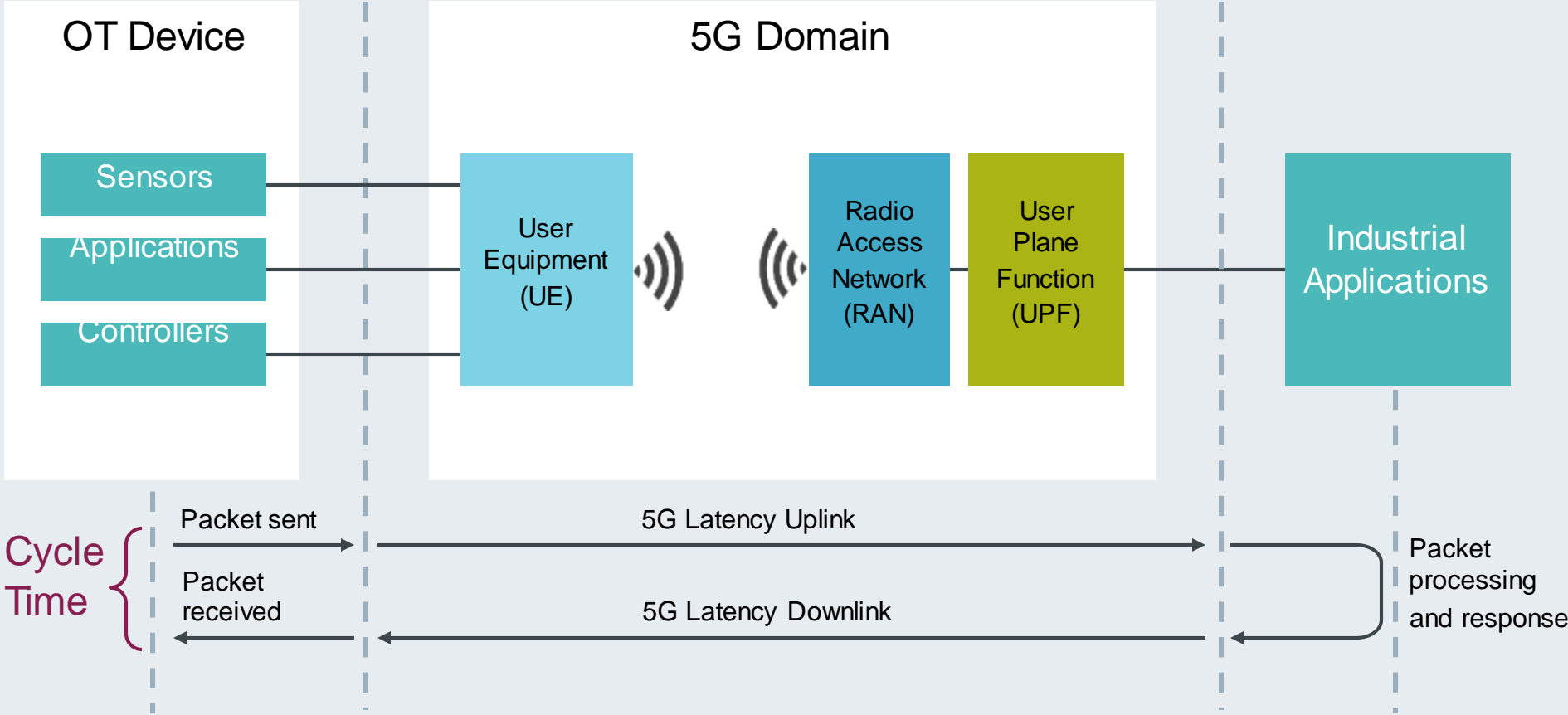


For Industrial 5G networks a private frequency band is recommended

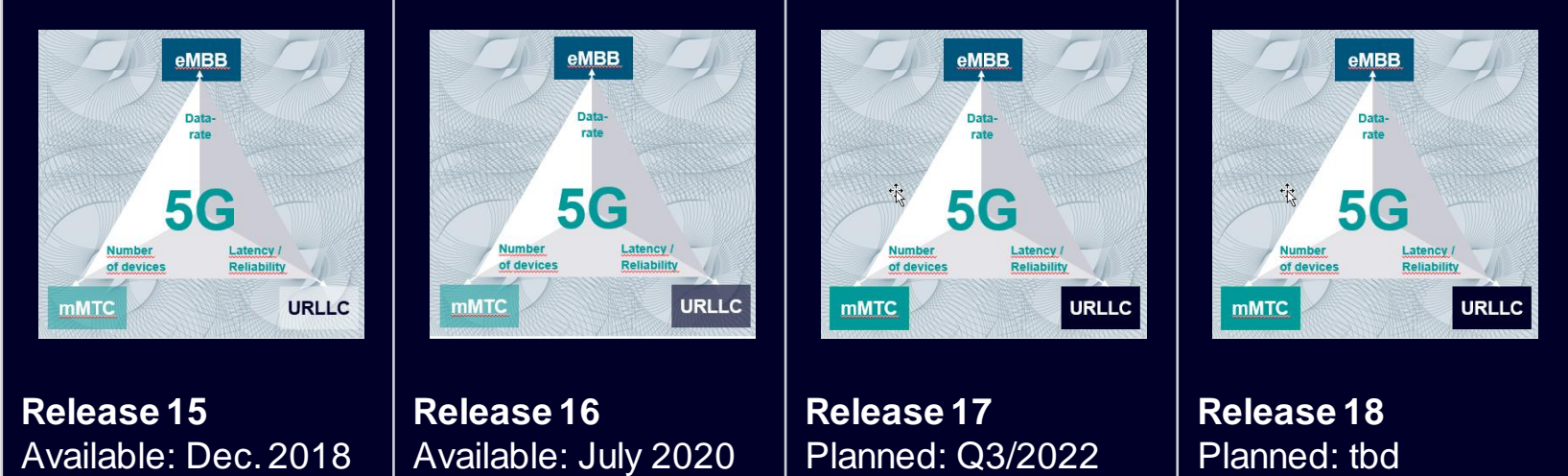
- Ownership and responsibility of the wireless network in the production facility:
 - Added flexibility by self management, important for the flexible factory of the future
 - Qualified staff with OT-knowledge on-site allowing for 24/7 support and maintenance of the network
- Maximum data-privacy:
 - Data stays on-premises
 - Protection of trade secrets, production data and patents
- Only possibility to support ultra-reliable and low-latency communication
- Dedicated network for industrial use
- Interference free wireless network



Determining the latency and cycle time of a 5G Network



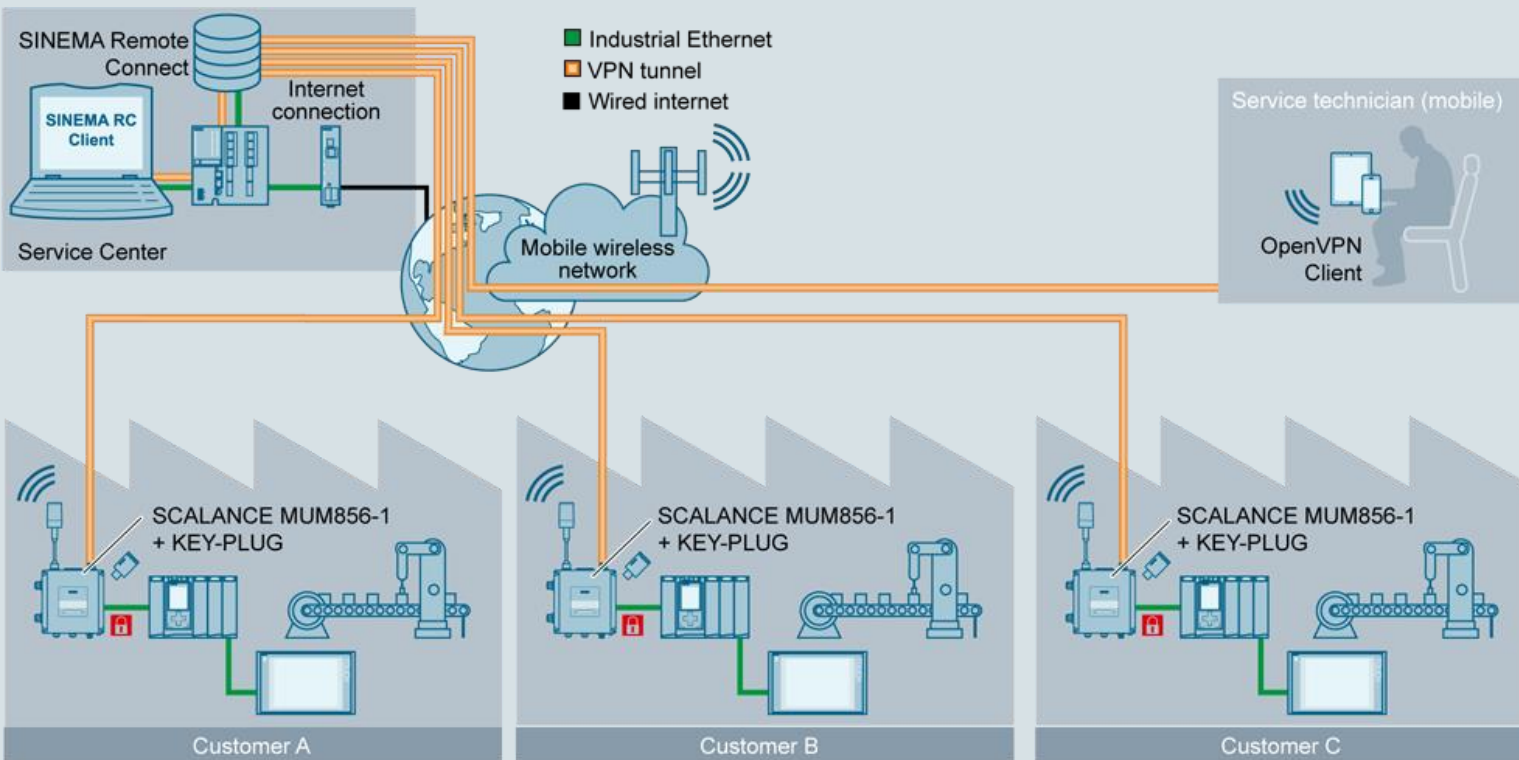
Why can we only start with Release 16 in Industry?



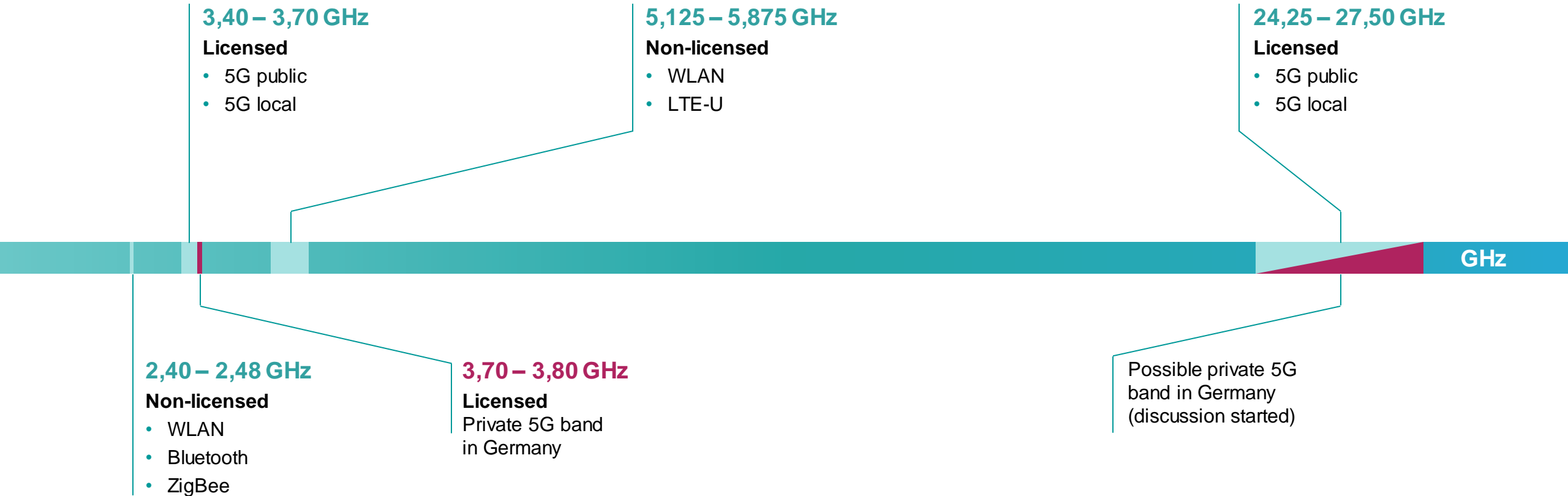
	Release 15 Available: Dec. 2018	Release 16 Available: July 2020	Release 17 Planned: Q3/2022	Release 18 Planned: tbd
Data rate / Area traffic capacity (20 Gbit/s)	Complete	Complete	Complete	Complete
Spectrum efficiency (3x 4G)	Complete	Complete	Complete	Complete
Network Energy efficiency (100x 4G)	Complete	Complete	Complete	Complete
Connection density (1.000.000 / km ²)	Partially	Partially	Complete	Complete
Latency (<10 ms)	None	Partially	Complete	Complete
Reliability (99.999% under 10 ms)	None	Partially	Complete	Complete
Mobility (roaming with 500 km/h)	Complete	Complete	Complete	Complete
Localization (Phase 1: 1 meter accuracy)	None	Partially	Partially	Complete
Non-public networks (Private Networks)	None	Partially	Complete	Complete
Industrial IoT (TSN Support)	None	Partially	Partially	Complete
Network slicing (Multiple networks on shared network)	Complete	Complete	Complete (+ more)	Complete (+ more)
SideLink (Direct Communication between end-devices)	None	Partially	Partially	Complete

Enabling secured remote access with public 5G networks

- Easy remote access for teleservice and remote maintenance
- Central management of up to 1000 devices and combined with simple user management
- Flexible deployments options depending on needs, SINEMA RC can be deployed on premise or in cloud environments.
- Combined with our new SCALANCE MUM856-1, an Industrial 5G Router, high bandwidths are possible by utilizing state-of-the-art public 5G networks



Industry-specific spectrum is necessary. Is Germany an example for other countries?



5G spectrum fees for local use in Germany

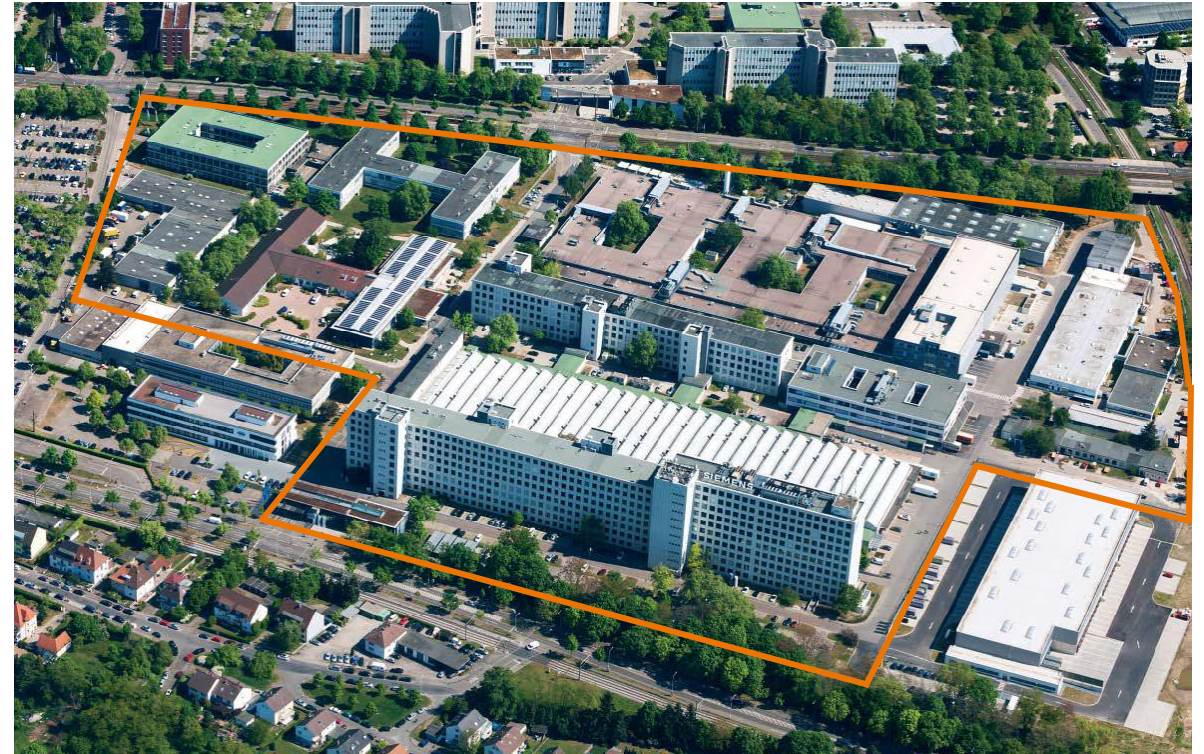
Example: Siemens Factory Karlsruhe (South)

Formula to calculate the fee:

$$1000 + B \cdot t \cdot 5 (6a_1 + a_2)$$

The fee comprises the following elements:

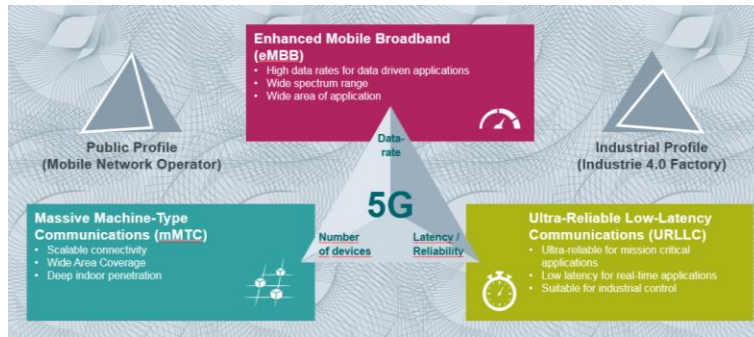
- A base amount of **1.000 €**
- Planned bandwidth (**B**): 100 MHz
- Planned term (**t**): 10 years
- Surface area covered in square kilometers
 - (**a1**): 0,141 km²
 - (**a2**): 0 km²



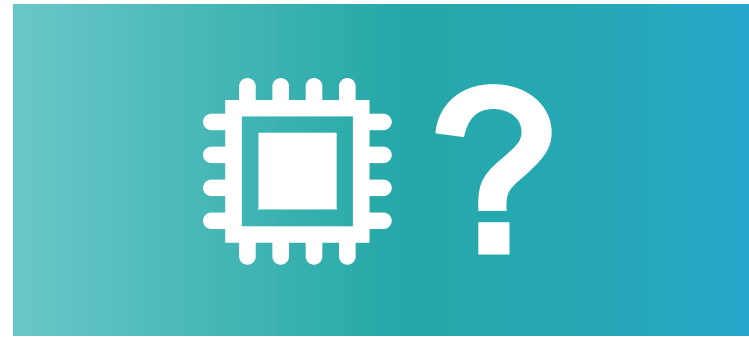
$$1.000 \text{ €} + 100 \text{ Mhz} \cdot 10 \text{ Year} \cdot 5 \text{ €} (6 \cdot 0,141 \text{ km}^2 + 0) = \underline{5.230 \text{ € for 10 years}}$$

What needs to be done until we can say 5G is fit for industry?

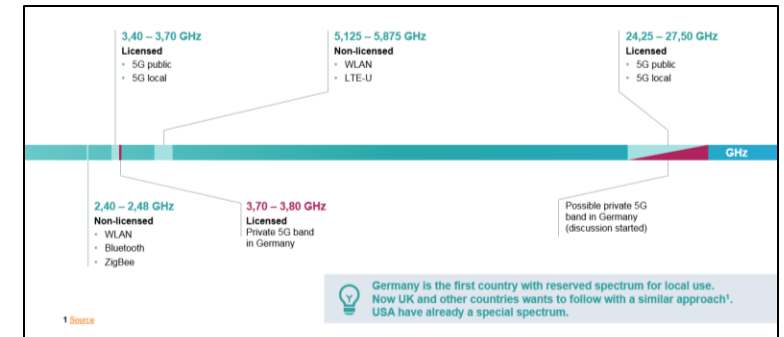
Release 16



Hardware-Availability



Local / Industrial Frequency



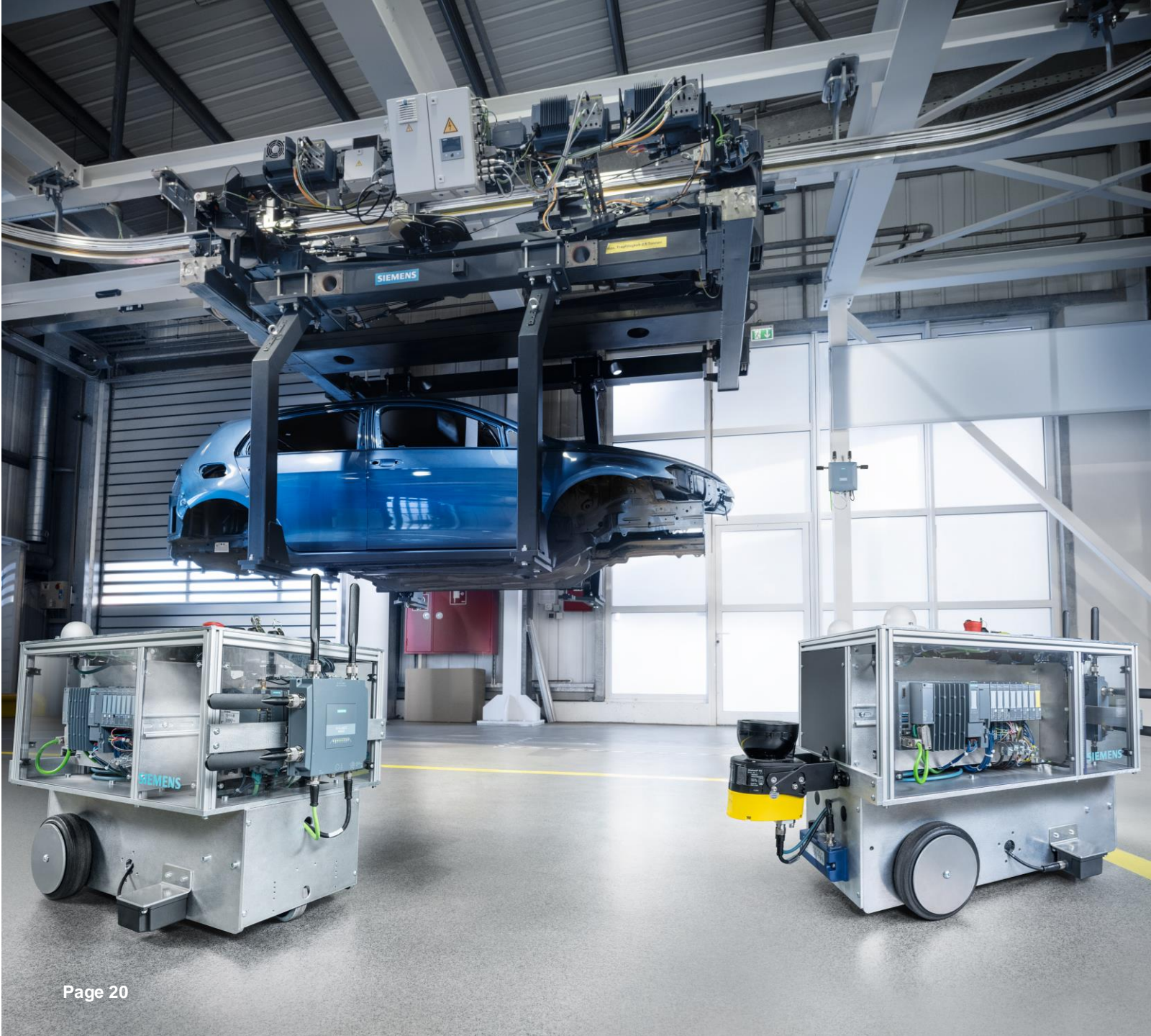
+ Support industrial protocols

- PROFINET
- OPC UA
- Engineering

Industrial 5G!

Use cases

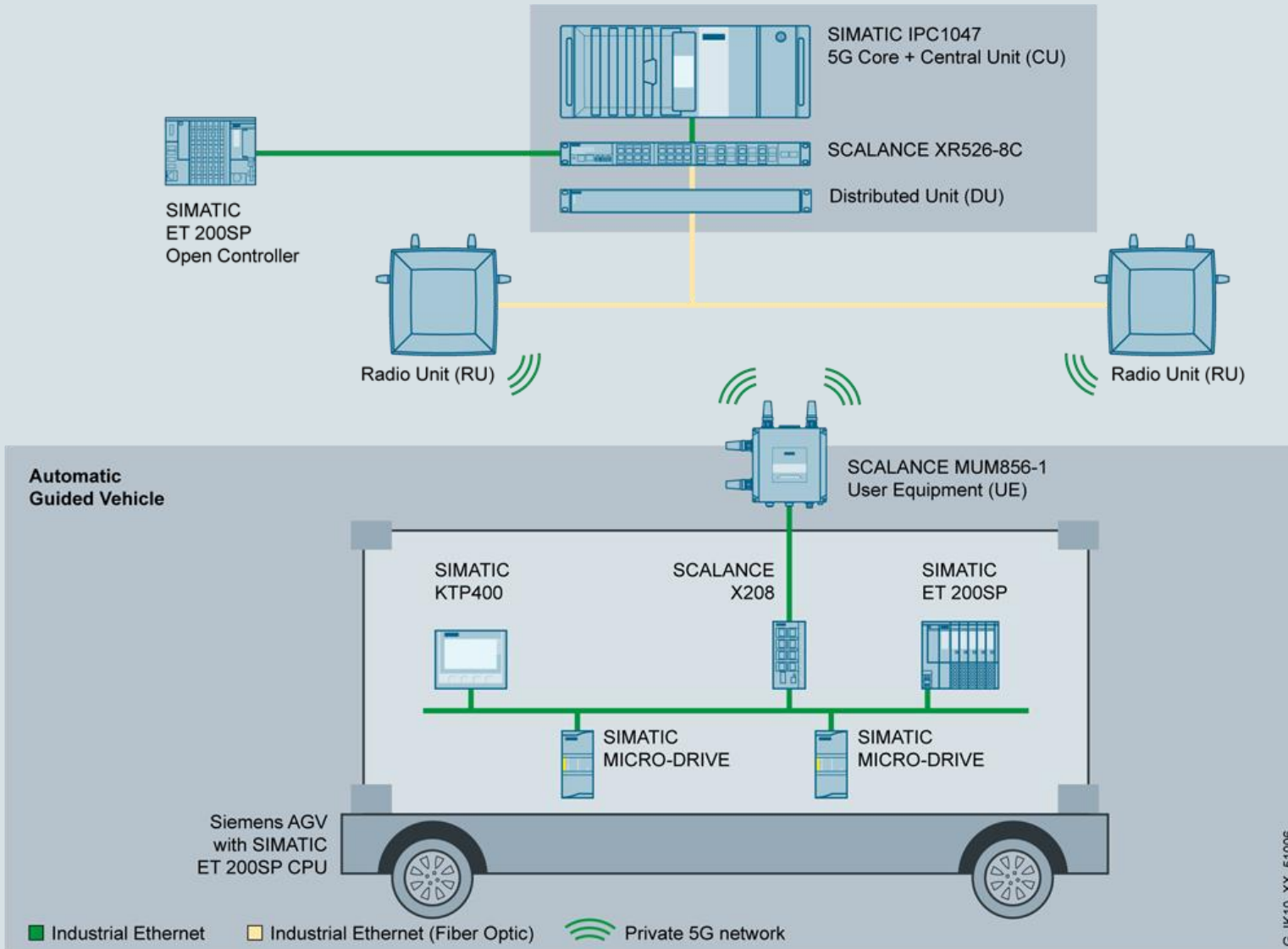
- Nationwide 5G Digitally Connected Smart Substation to Spearhead NetZero targets for customer.
 - Smart substations that speak to each other adapting the flow of electricity in real-time.



Industrial 5G - we are testing the future!

- Siemens is driving the future of industrial automation forward with a private standalone 5G test network
- Prototype of a full 5G ecosystem from infrastructure to user equipment completely developed by Siemens
- Testing 5G solutions in a realistic industrial environments
- Our first test results of Industrial 5G in industrial applications are very promising

Siemens Private Standalone 5G Network



- Private 5G Standalone network based on Split Option 7.2
- Benefiting from the local use spectrum for campus networks in Germany in the 3.7 – 3.8 GHz band
- Evaluating currently available industrial protocols such as Profinet and OPC UA over together with wireless communication via 5G

Siemens Private 5G Infrastructure based on Release 15

Test setup in the Siemens Automotive Center

Radio Unit

An active radio device connected to the distributed unit, responsible for converting the digital radio signal into an analog

Distributed Unit

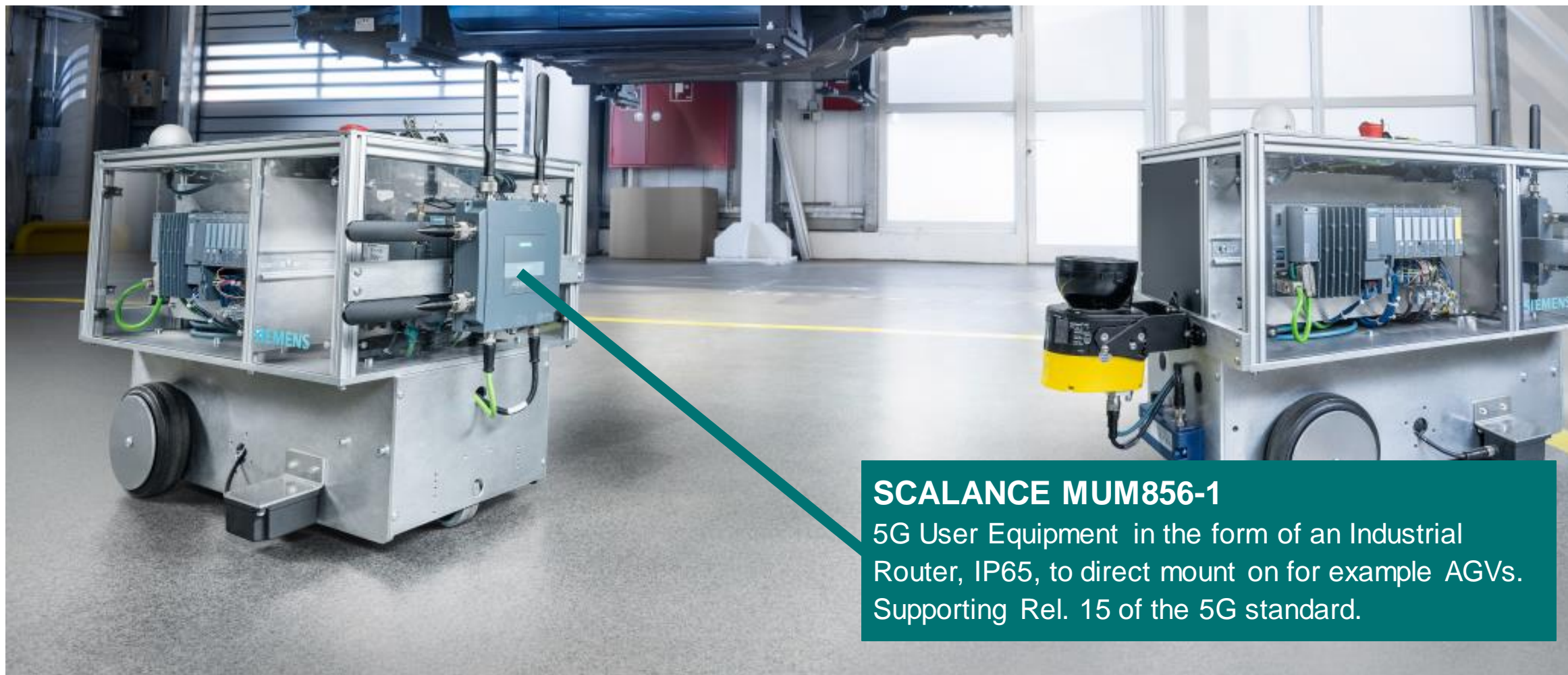
Dedicated hardware component responsible for translating the digital radio signal which is send and received to radio units.

5G Core & Central Unit (Software)

5G Core and the Central Unit as software. The Core manages the complete network, the CU controls the radio equipment.



Siemens Private 5G Infrastructure based on Release 15 SCALANCE MUM856-1 direct mounted on a SIMOVE AGV



SCALANCE MUM856-1

5G User Equipment in the form of an Industrial Router, IP65, to direct mount on for example AGVs. Supporting Rel. 15 of the 5G standard.



Come test your application with Industrial 5G now!

- Deutsche Messe and Siemens enable enterprises of all sizes to get early access to innovative Industrial 5G technology at the 5G Smart Venue in Hannover
- Test your applications with our private Industrial 5G Standalone test network based on Release 15
- Industrial 5G network utilizing the spectrum for campus networks available in Germany (3.7 – 3.8 GHz band)

SIEMENS

More information on Siemens & 5G

Cooperating for the future – 5G Alliance for Connected Industries and Automation – <https://5g-acia.org/>

Siemens 5G landing page: <https://new.siemens.com/global/en/products/automation/industrial-communication/industrial-5g.html>

| Contact

David Gibson

Head of Sales – Digital Industries Ireland

Digital Industries / Dublin Ireland

Innovation House

Old Finglas Rd

Dublin 11, D11 KXN4

Ireland

E-mail gibsondavid@siemens.com

Tel: +353 866081884