

How 5G can unlock the Potential of Industrial IoT

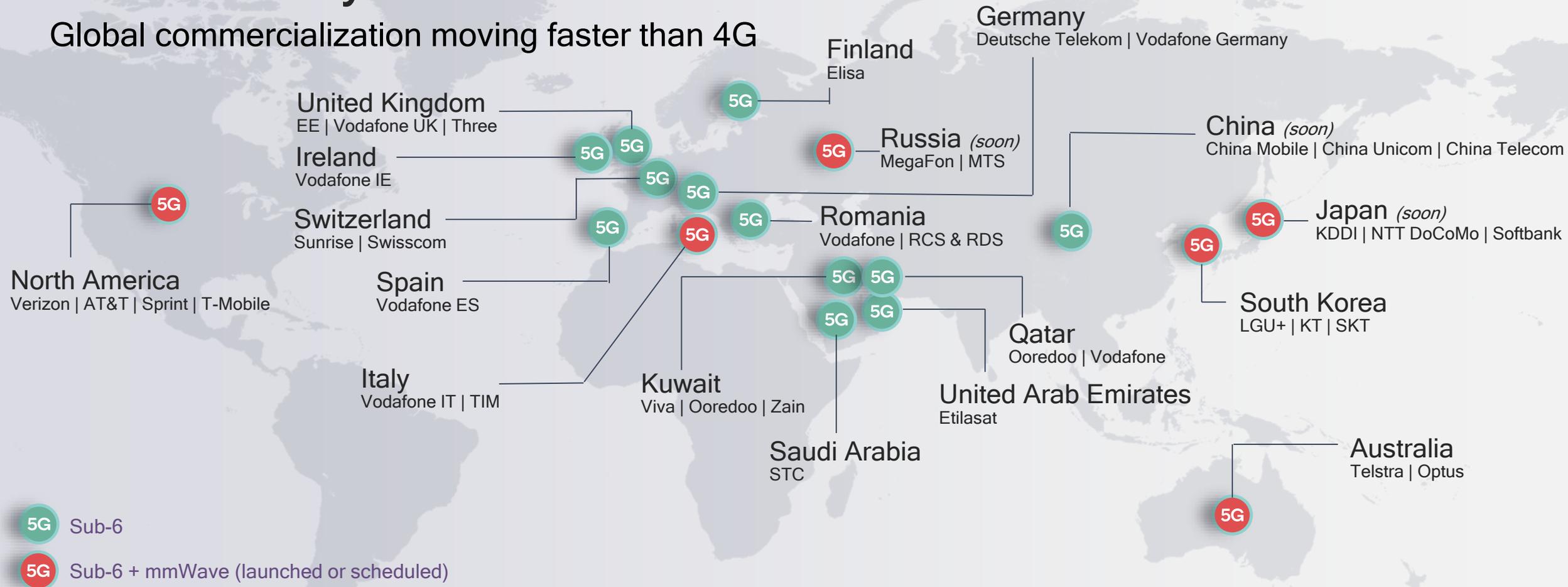
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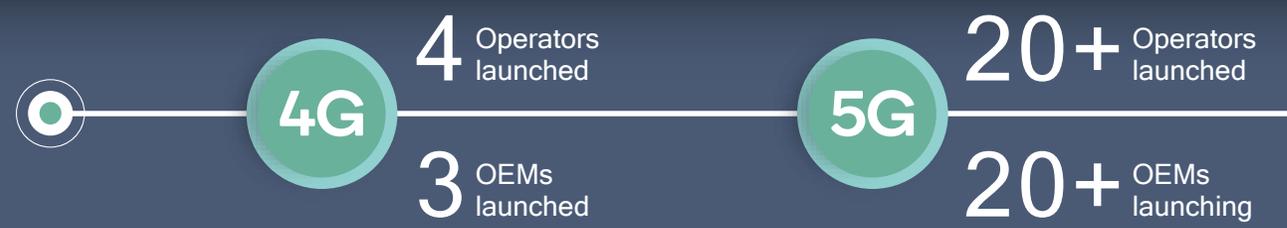
2019 is the year of 5G

Global commercialization moving faster than 4G



5G Sub-6
5G Sub-6 + mmWave (launched or scheduled)

Comparison of Year 1 announcements



Multiple operators and major OEMs already rolling out 5G this year



5G in Europe

Faster-than-anticipated
Launch of 5G devices,
Networks and services.



LG OnePlus
OPPO Xiaomi
ZTE Samsung



European Commission to harmonize radio spectrum in the 26 GHz band for 5G services¹

¹ <https://ec.europa.eu/digital-single-market/en/news/european-commission-harmonise-last-pioneer-frequency-band-needed-5g-deployment>

Qualcomm Snapdragon is a product of Qualcomm Technologies, Inc. and/or its subsidiaries.



Container ports



Oil refineries



Manufacturing



Construction



Mines



Warehouses



Wind farms



Oil rigs

>\$5 Trillion¹

Global economic output in 2035 enabled by 5G in the following five categories



Manufacturing
\$3,364B



Transport
\$659B



Construction
\$742B



Utilities
\$273B



Mining
\$249B

1. "The 5G economy: How 5G technology will contribute to the global economy" by IHS Economics / IHS Technology

Container ports



Local management for low latency and protection of sensitive data

Real-time inventory

- Manufacturing
- Earth/Soil
- Produce
- Retail
- Lumber
- Hardware
- Automotive
- Technology

Reliable robotic control

UHD surveillance

Reliable, autonomous AGVs

On-premise compute and storage

Updating

Real-time asset tracking

At port (Days): 3

Location: [Map]

Spools shipped: [Table]

Capacity: [Table]

Camera: [Image]

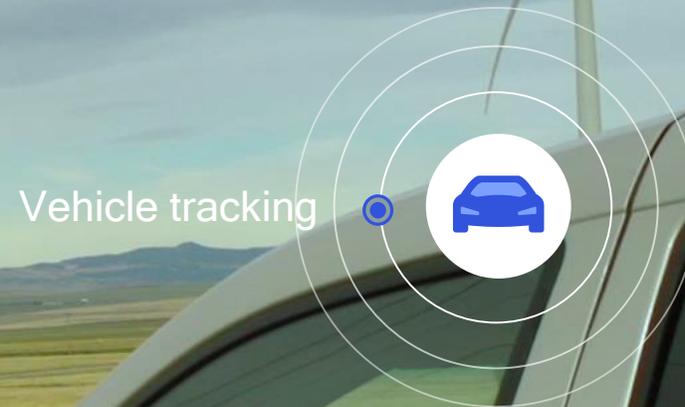
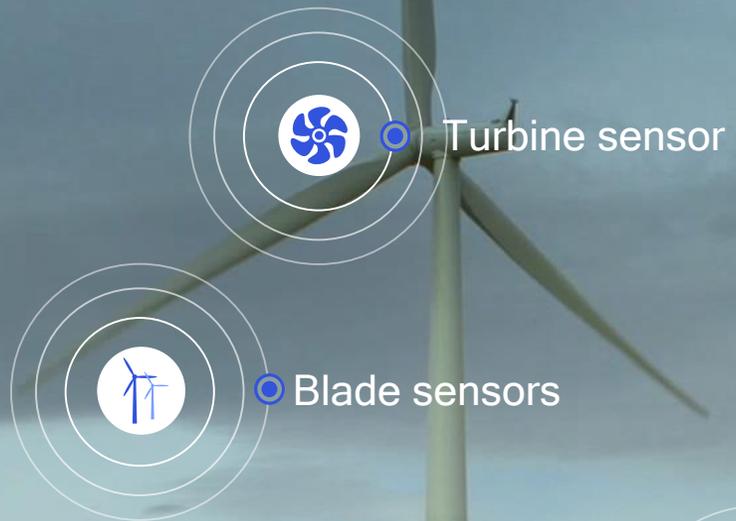
On-device intelligence

5G NR Private network

Seamless interworking with public network

AR-guided execution

Wind farms



Enhanced mobile broadband

Head mounted display

Augmented Reality

Latency: 10 ms
Availability: 99.9%
Rate: Gbps-Mbps

Handheld terminal

Safety functions

Latency: 10 ms
Availability: 99.9999%
Rate: Mbps-kbps

Security camera

Latency: 50ms
Availability: 99.9%
Rate: Mbps

Massive IoT

Sensors

Process Monitoring

Latency: 100 ms
Availability: 99.99%
Rate: kbps

Automated guided vehicle (AGV)

Latency: 20ms
Availability: 99.9999%
Rate: Mbps

Industrial robot

Motion control

Latency: 1 ms
Availability: 99.9999%
Rate: Mbps-kbps

Edge computing and analytics

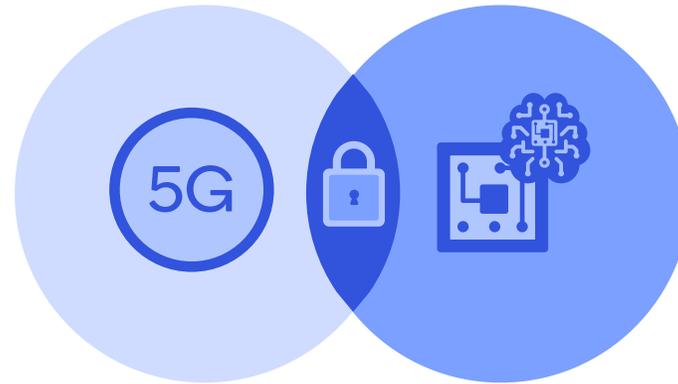
Ultra reliable low latency

5G takes Industry 4.0 to the next level

Single futureproof 5G network

Scalable capacity and reliability

Flexibility with wireless Ethernet



On-device processing and sensing

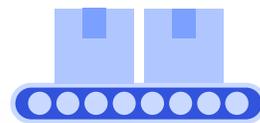
CV and AI for autonomous machines

Edge services and data privacy

Connectivity | Security | Compute



Industry 1.0
Mechanization



Industry 2.0
Electrification

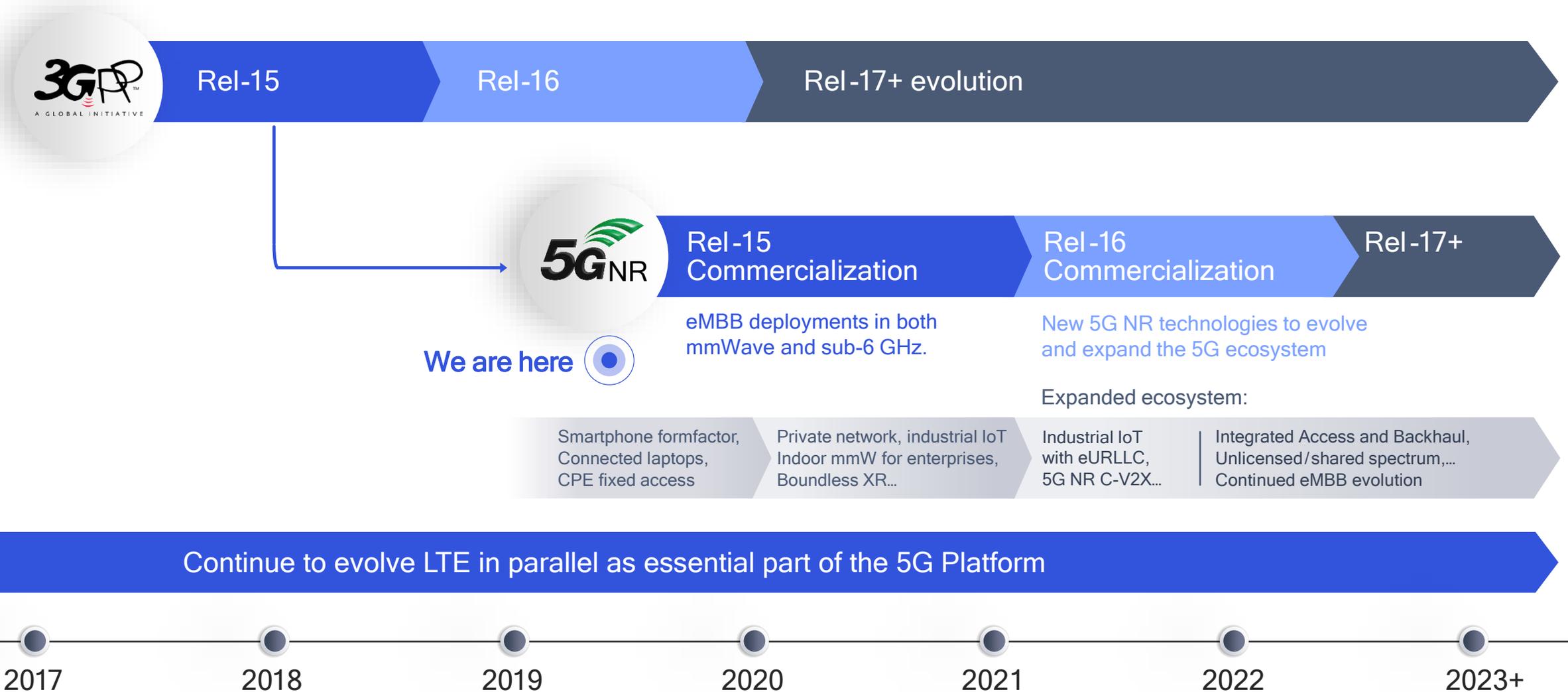


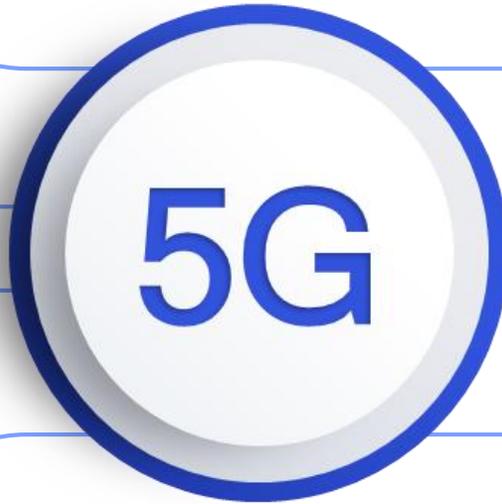
Industry 3.0
Digitalization



Industry 4.0
5G Connectivity

Driving the 5G roadmap and ecosystem expansion





Dedicated and reliable networks optimized for local services

Scalable wireless connectivity on a future proof platform

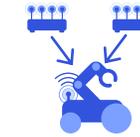
Capabilities for new use cases e.g. wireless Industrial Ethernet



Private 5G network



Licensed, shared and unlicensed Spectrum



Ultra Reliable Low Latency Communication (URLLC)

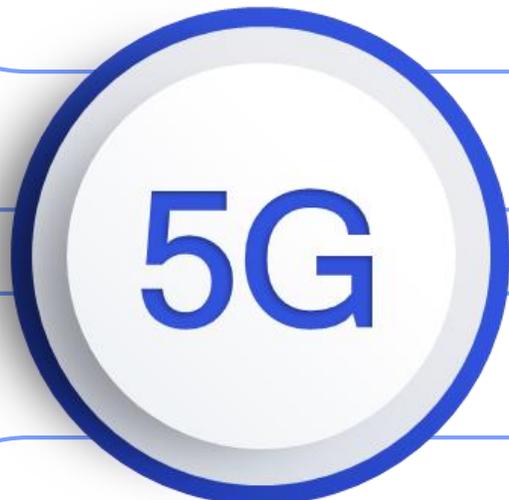


Time Sensitive Networking (TSN)



Positioning

Designing 5G to meet industrial IoT requirements



Private 5G network

- Unique network ID
- Integrated and independent architectures
- Seamless fallback to public networks



Spectrum

- With NR-U, 5G NR will support:
- Licensed spectrum
 - Shared spectrum
 - Unlicensed spectrum



URLLC

- Low latency
- Ultra-reliability
- CoMP multi-TRP
- Service multiplexing
- Enhanced mobility



TSN

- Ethernet over 5G
- Deterministic networking
- Device time synch.



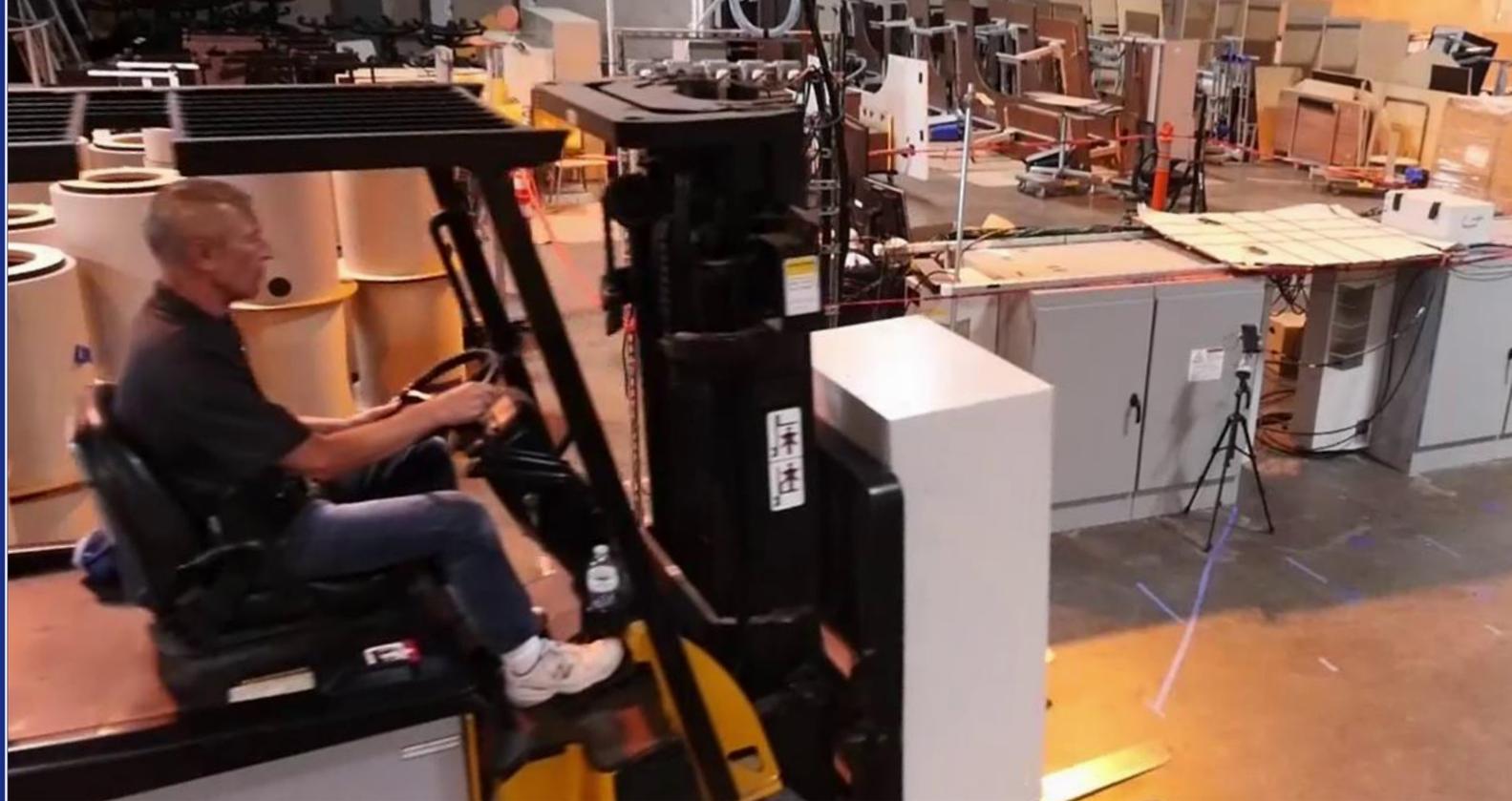
Positioning

- Network & device based
- Industrial IoT requirements

5G NR supports many industrial IoT use cases today;
3GPP Rel-16 brings additional capabilities

5G Industrial IoT testbed to drive and track progress in standards

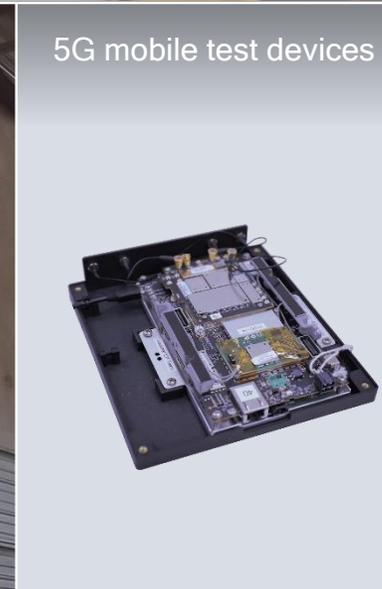
Over-the-air testbed to demonstrate new IIoT functionality such as CoMP, eURLLC, and TSN



5G small-cells



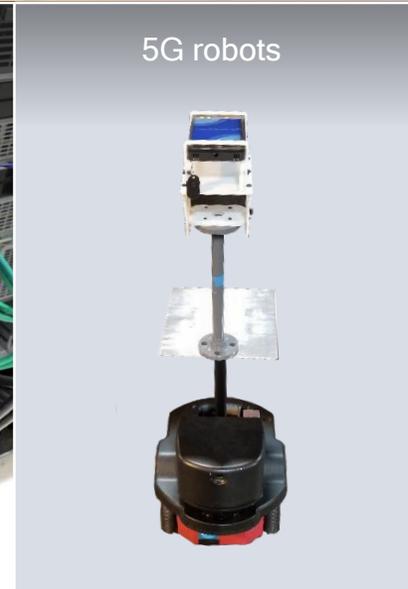
5G mobile test devices



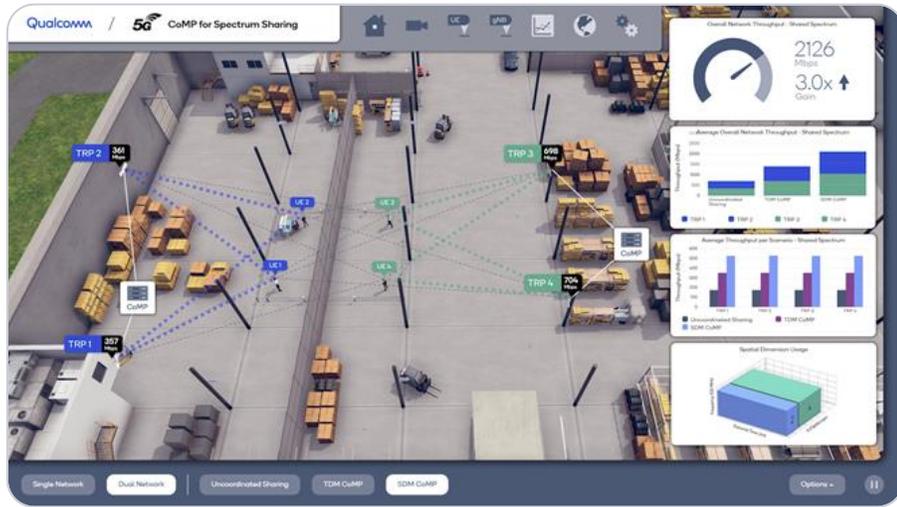
5G CoMP server



5G robots



Demonstrations of 5G CoMP at MWC Barcelona 2019



5G CoMP for capacity

Synchronized sharing with 5G CoMP in shared/unlicensed spectrum provides higher network capacity and perceived data speeds.

With synchronized sharing, adjacent deployments to simultaneous use of the same spectrum.



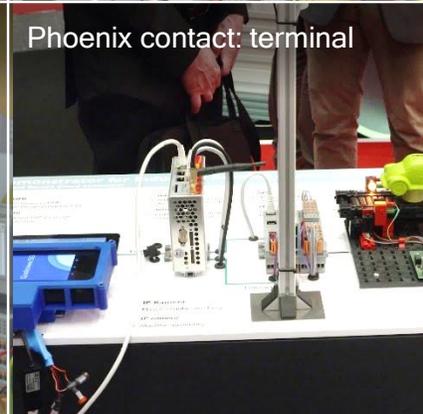
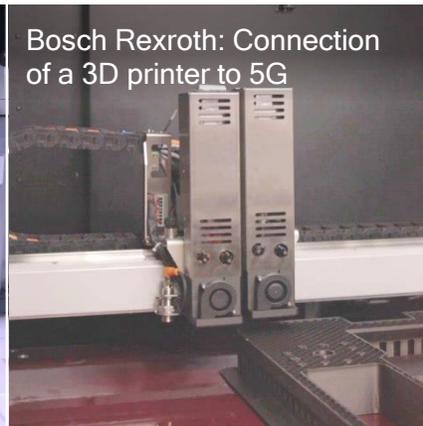
5G CoMP for ultra-reliability

Industry-first demo of 99.9999%¹ ultra-reliability in a 5G NR over-the-air testbed using CoMP

5G CoMP provides spatial diversity that can overcome blocking in challenging radio environments

1) One of the performance requirements in 3GPP TS 22.104

Strong industry collaboration around 5G Industrial IoT



Kickstarted 5G for Industrial IoT with 10+ live ecosystem demonstrations at Hannover Messe 2019 based on Rel-15

Research collaboration with Bosch announced Feb. 2019

5G Alliance for Connected Industries and Automation (5G-ACIA)—advancing 5G for the industrial domain

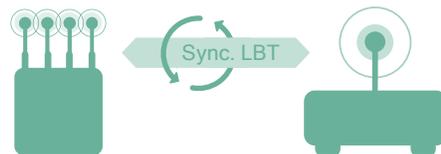


Summary



Extending 5G to industrial IoT

5G can serve many industrial IoT applications today and 3GPP Rel-16 bringing additional functionality such as eURLLC for wireless industrial Ethernet



Synchronized sharing

Synchronized sharing support industrial IoT in unlicensed spectrum (e.g. 5GHz & 6GHz) and sharing dedicated spectrum (e.g. 3.7GHz Germany)



Multiple spectrum options

There are multiple deployment and spectrum options for private 5G industrial IoT networks with NR-U being part of 3GPP Rel-16.



5G testbeds to drive standard

Utilizing over-the-air testbeds with our 5G NR mobile test devices to research new functionality, e.g. 5G CoMP, and to drive and track progress in standard

SPS Nuremberg

We will be speaking & attending, please get in touch if you wish to find out more!



Thank you

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