

Future Outlook for 5G and Anritsu

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5G



Anritsu
envision : ensure

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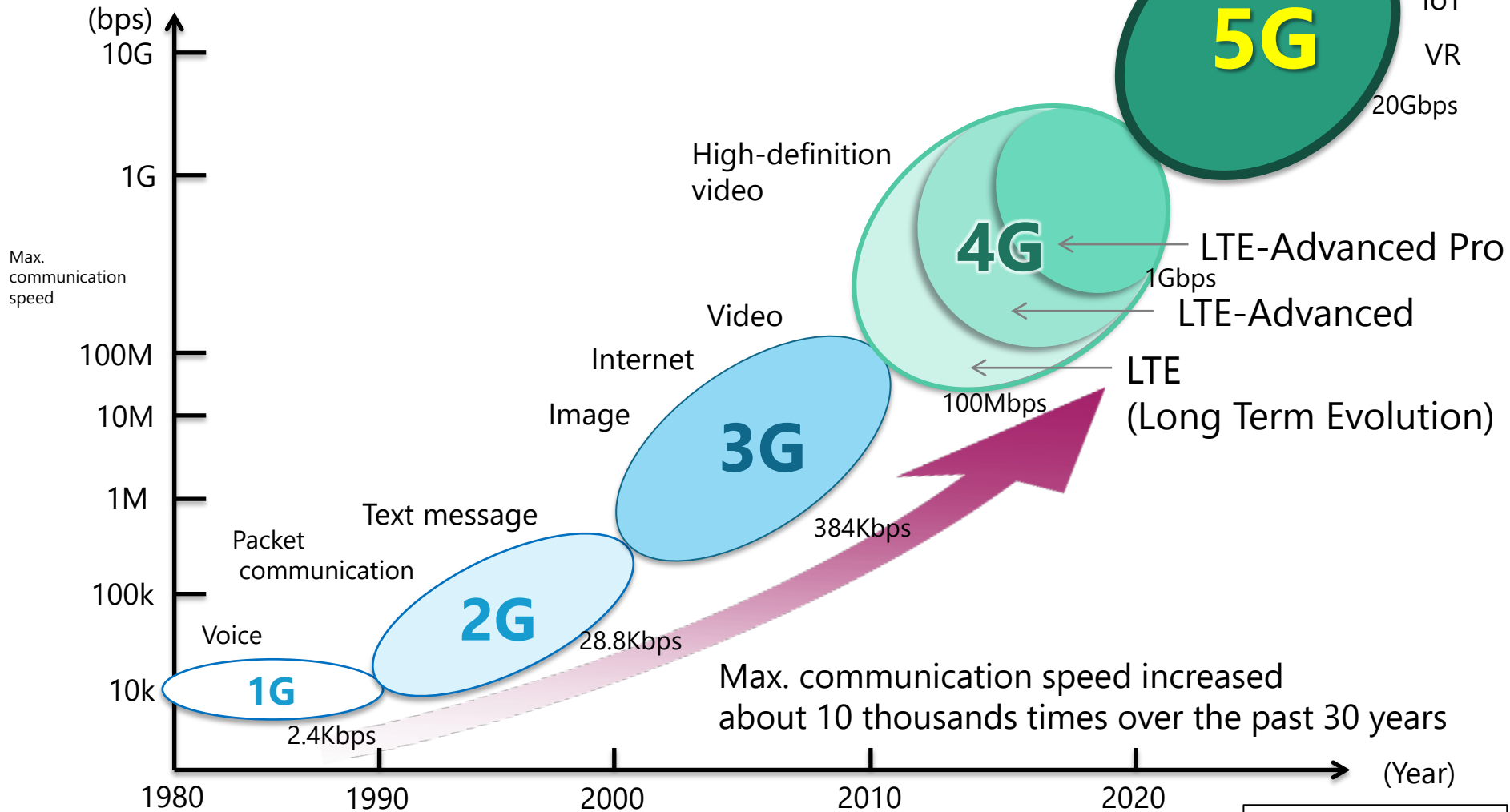
Agenda

- The Dawn of the First Year of 5G
- Another Scenario for 5G Adoption (Local 5G)
- Anritsu Efforts for 5G

The Dawn of the First Year of 5G

Evolution of mobile communication

Supporting evolution of mobile communication system



(From materials of the Ministry of Internal Affairs and Communications)

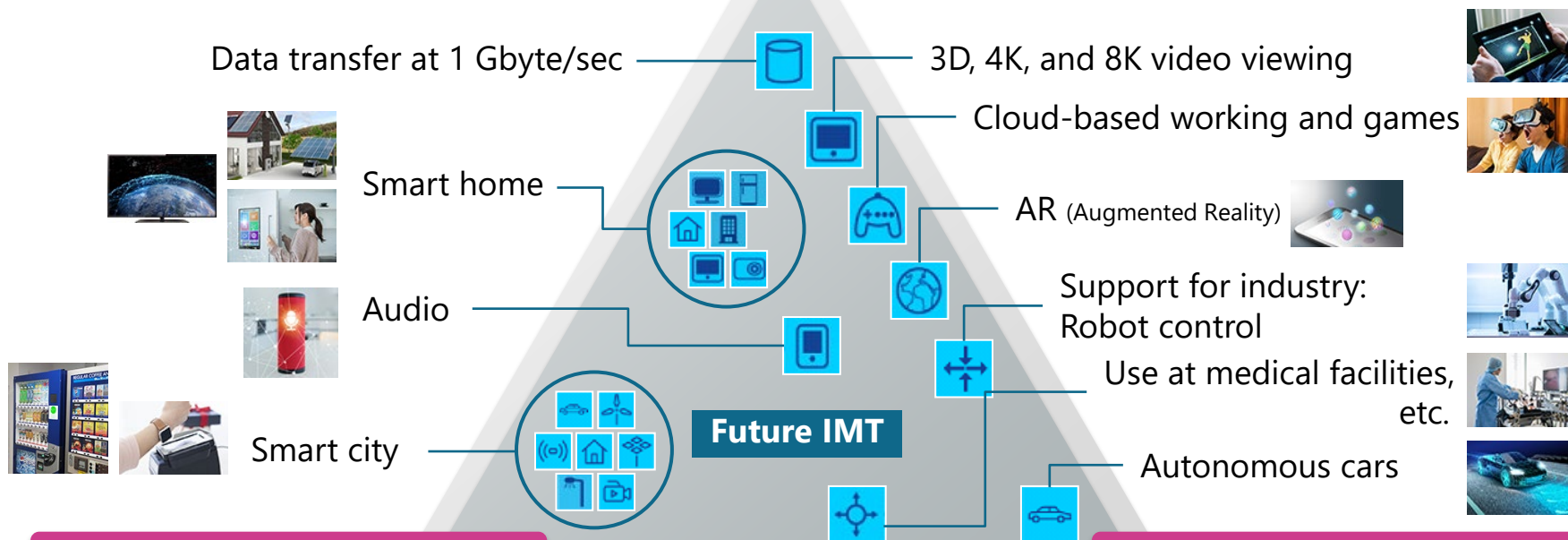
Evolution
every 10 years

Three Features of 5G

Source: Recommendation ITU-R M.2083
"Framework and overall objectives of the future development of IMT for 2020 and beyond"

High speed/Large capacity (eMBB)

	LTE	5G
Peak speed (downlink) (uplink)	1 Gbps 100 Mbps	20 Gbps 10 Gbps
User-experienced speed	10 Mbps	100 Mbps



Multiple connections (mMTC)

Number of
simultaneously
connected terminals
[Number of
terminals/km²]

	LTE	5G
	10 ⁵ /km ²	10 ⁶ /km ²

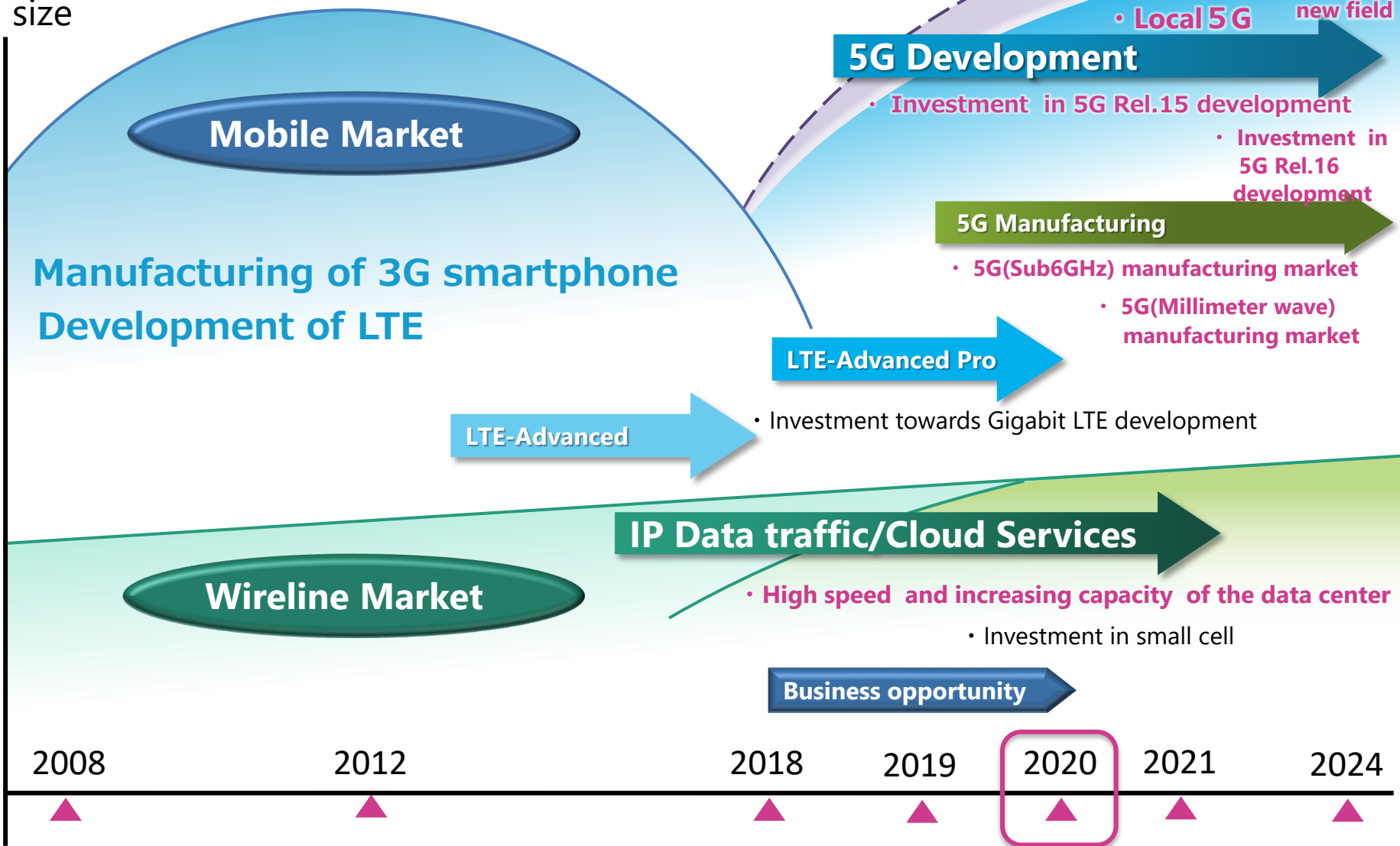
Ultra-reliable, low latency (URLLC)

Latency of
wireless
connections

	LTE	5G
	10ms	1ms

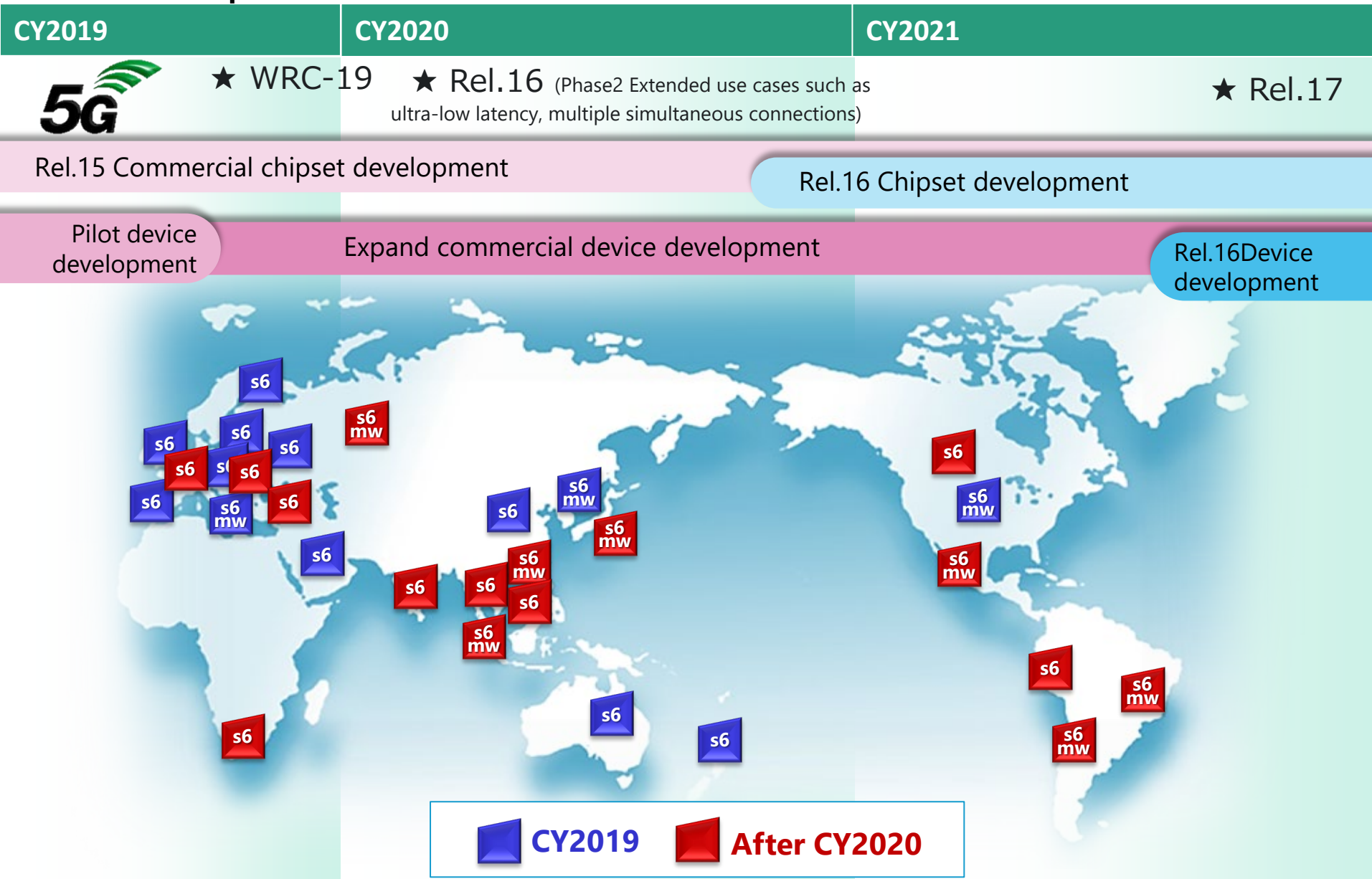
T&M : Mobile market trends and Business opportunity

Market size



Roadmap of 5G

* Created by Anritsu referring to publicly available information



Main Added Features of 5G

Features will be added for automated driving and Industrial IoT

Release 16

- Use of V2X, IIoT, and unlicensed bands
- System improvements

eMBB

Millimeter-wave CA

URLLC

Adoption of TSN to resolve jitter

mMTC

- More advanced indoor positioning
- Energy conservation

Release 17

- Addition of V2X and IIoT features
- Energy efficiency
- Expanded frequencies

Use of frequencies above 52.6 GHz

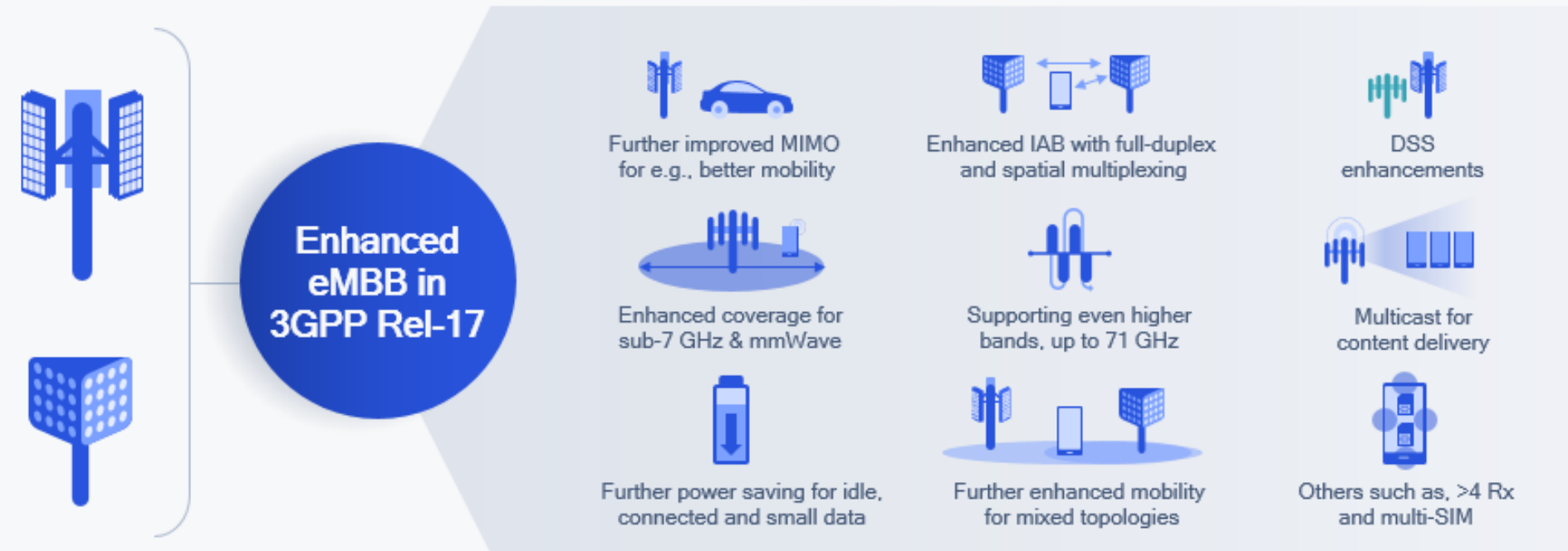
Enhancements to Sidelink (direct device-to-device communications)

- Optimization of small-scale data transmission
- 3D positioning

TSN : Time-Sensitive Networking, **CA** : Carrier Aggregation, **IIoT** : Industrial Internet of Things,
eMBB : enhanced Mobile Broadband, **mMTC** : Massive Machine-Type Communications ,
URLLC : Ultra-Reliable, Low-Latency Communications

Enhancement of High-Speed Mobile Broadband and Its Applications

Release 17 adds further enhancements to eMBB, URLLC, and mMTC, in addition to resolving such issues as lowering power consumption and enhancing coverage, toward implementation in society



Enhanced foundation

Coverage, capacity, latency, power saving, mobility

Expanded deployments

New spectrum, topologies, integrated backhaul,

New services

Latency, reliability, positioning, use cases like XR

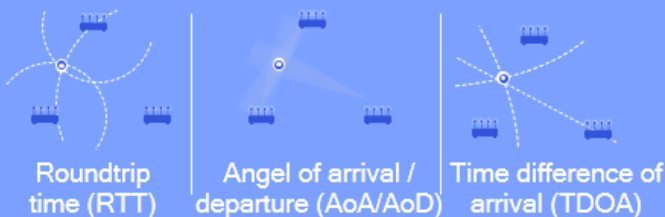
Source: Qualcomm (<https://www.qualcomm.com/news/onq/2019/12/13/3gpp-charts-next-chapter-5g-standards>)

High-Precision Positioning and Support for Industrial IoT

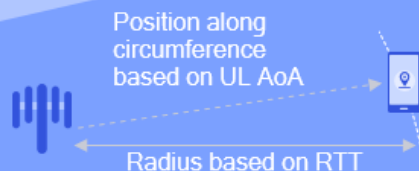
Will also support high-precision positioning available both outdoors and indoors

Release 16

Meeting initial accuracy requirements of ~3-10 meters



Single-cell positioning



Release 17

Enhancing capability and performance for a wide range of use cases

Centimeter level accuracy

Meeting accuracy of down to 0.3m



Lower positioning latency

Reducing latency to as low as 10 ms



New evaluation scenarios

Supporting IIoT channel models



Higher capacity

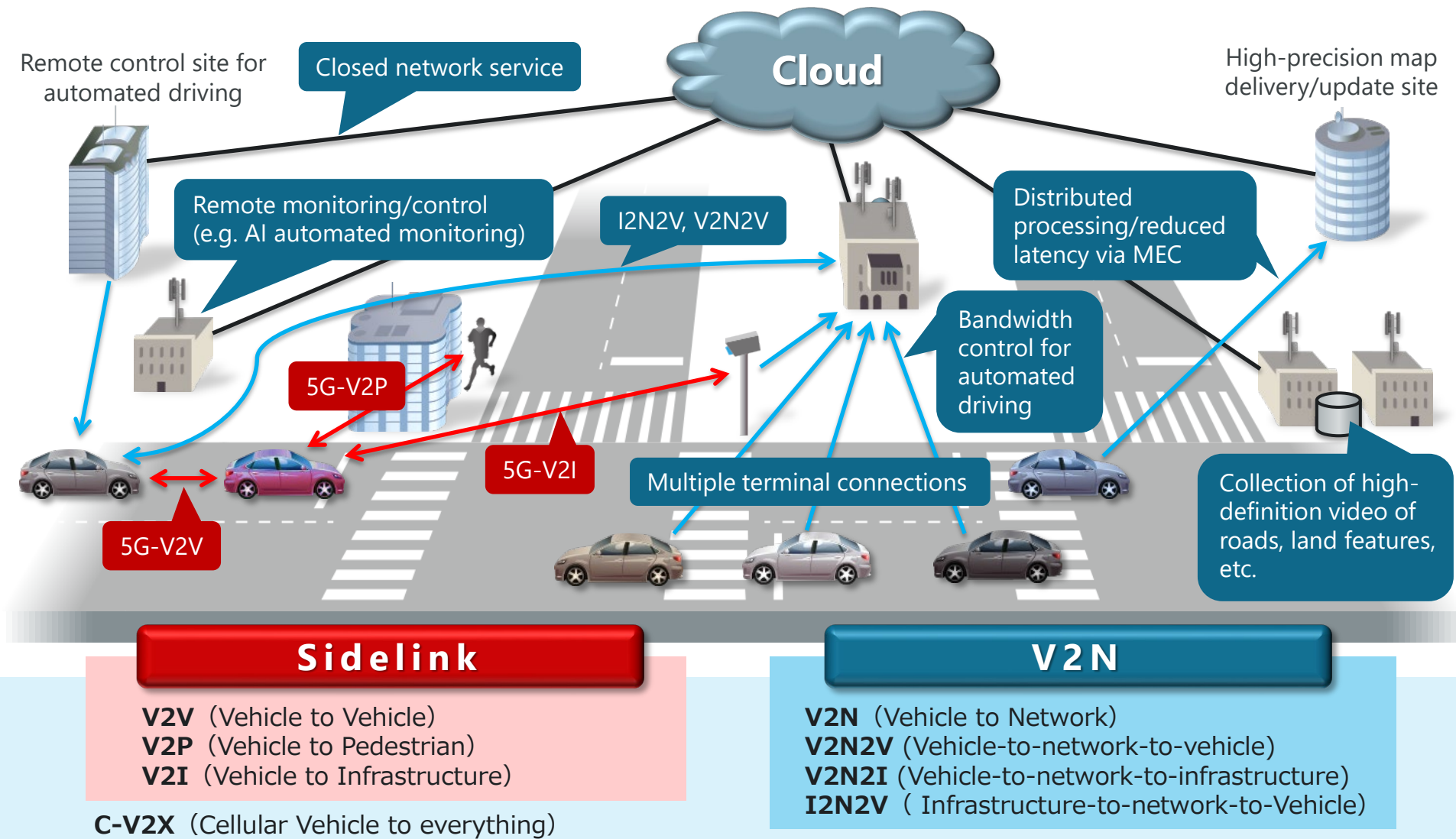
Scaling to millions of simultaneous devices



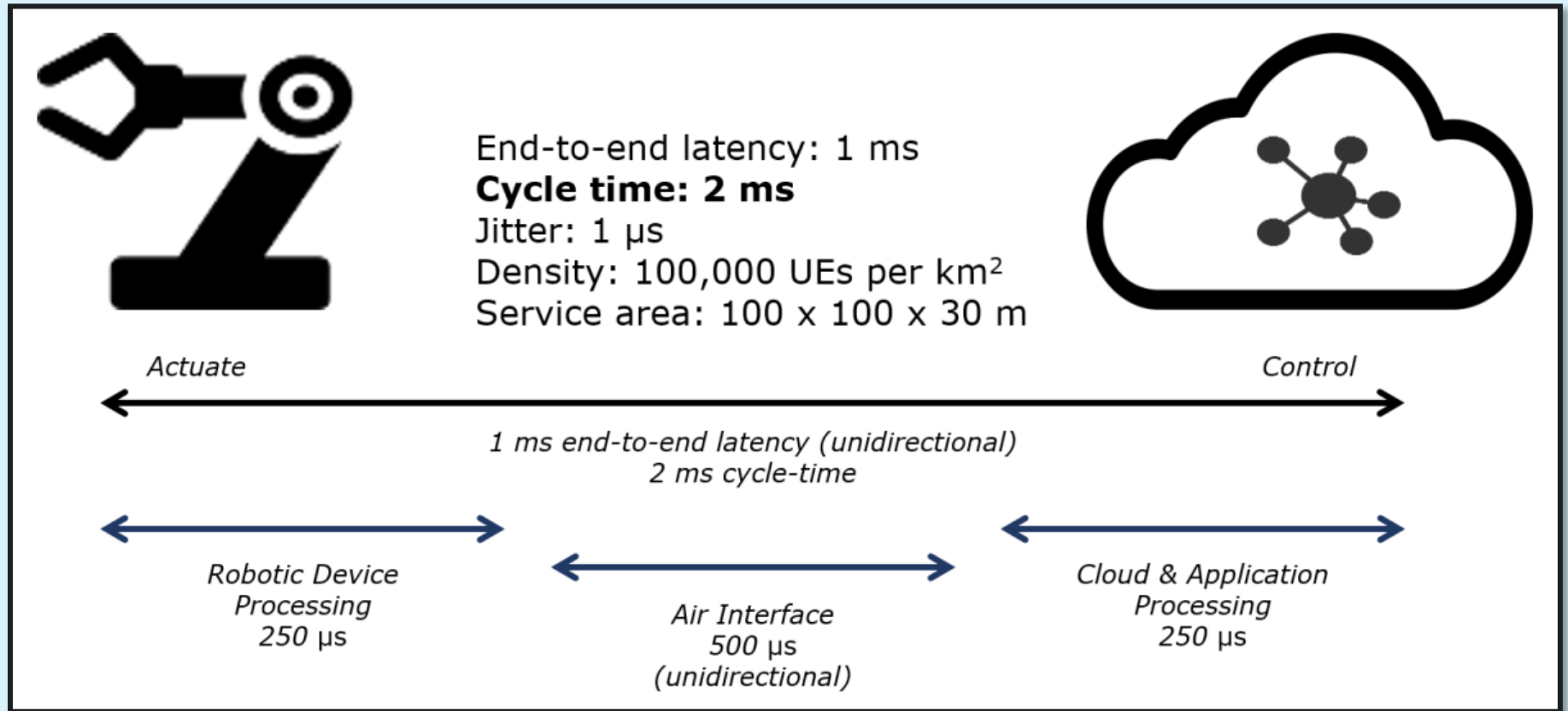
Source: Qualcomm (<https://www.qualcomm.com/news/onq/2019/12/13/3gpp-charts-next-chapter-5g-standards>)

Expanded V2X: An Added Automotive Feature

Getting one step closer to automated driving by realizing C-V2X via 5G



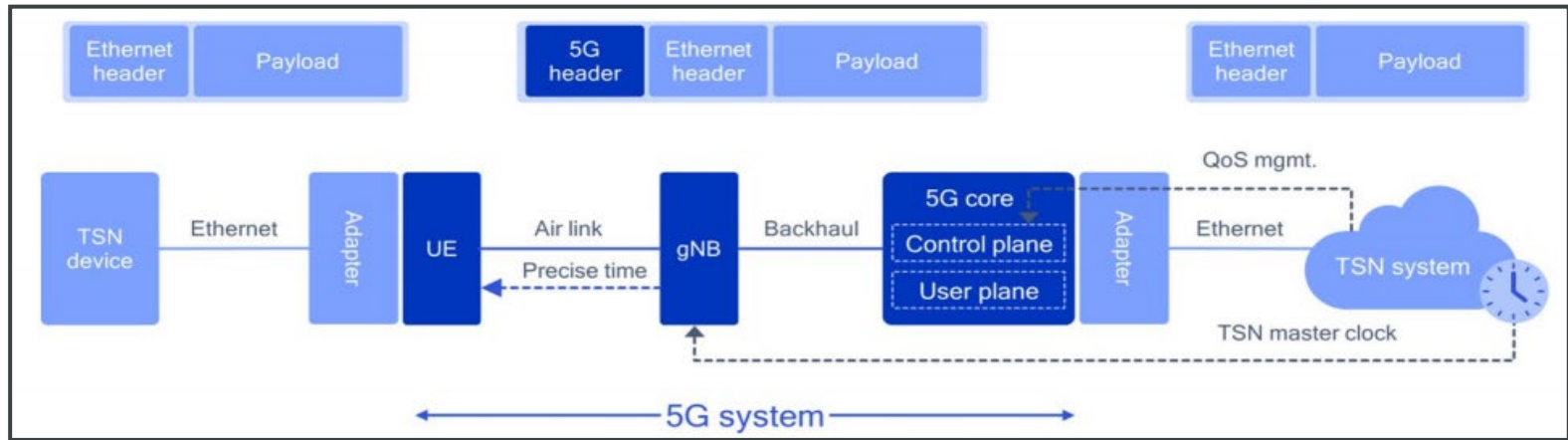
Cycle Time for Robotic Motion Control



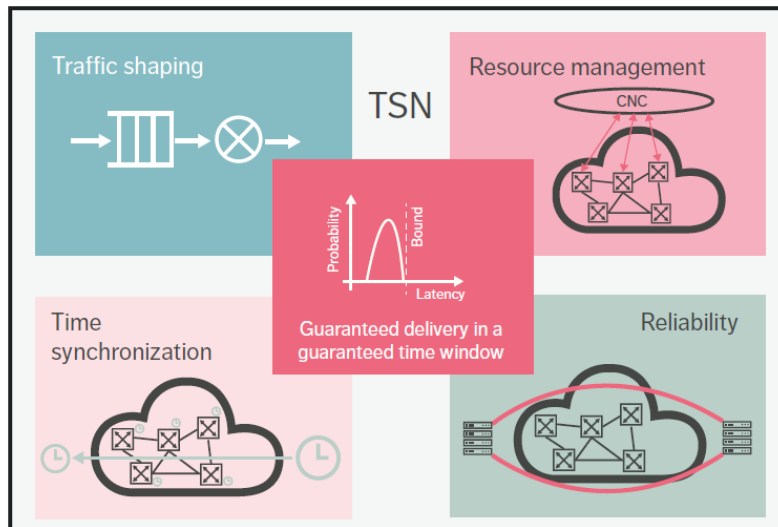
Source: Qualcomm, Ultra-Reliable Low-Latency 5G for Industrial Automation

Added Feature for Industrial IoT

TSN actualize latency reduction and jitter resolution



Source: Qualcomm (<https://www.qualcomm.com/media/documents/files/read-the-white-paper-by-heavy-reading.pdf>)

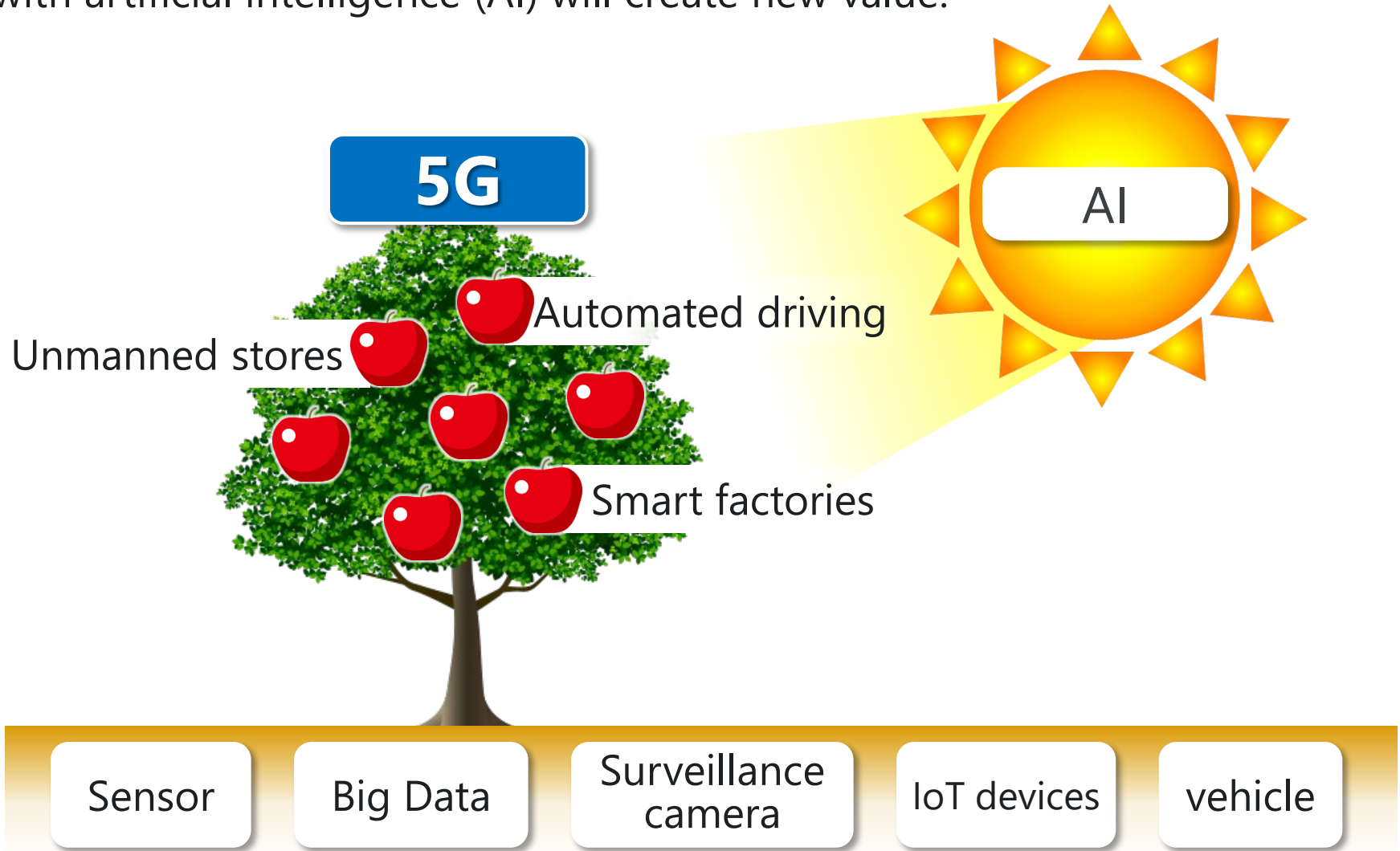


※ TSN: Time-Sensitive Networking

Source: Ericsson, 5G-TSN
INTEGRATION FOR INDUSTRIAL AUTOMATION

Artificial intelligence + Big Data = Evolution of 5G

5G will accelerate enterprise Digital Transformation(DX). Combining it with artificial intelligence (AI) will create new value.

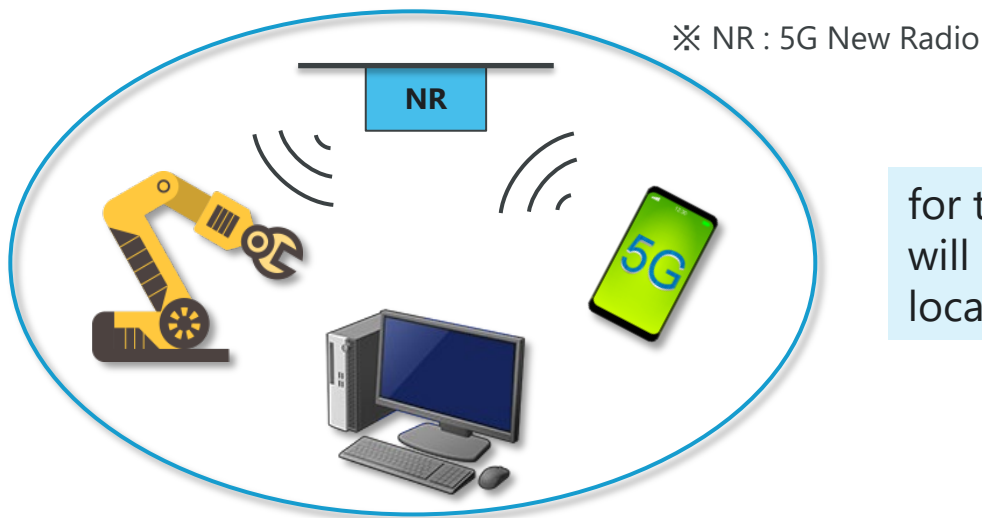


Another Scenario for 5G Adoption (Local 5G)

Local 5G

The concept of Local 5G (from materials of Japan's Ministry of Internal Affairs and Communications)

- Local 5G will use fifth-generation mobile communications systems (5G)
- Relatively small-scale communication environments will be created locally based on local needs by regions
- It will be possible to obtain radio station licenses or to use systems by other parties with licenses

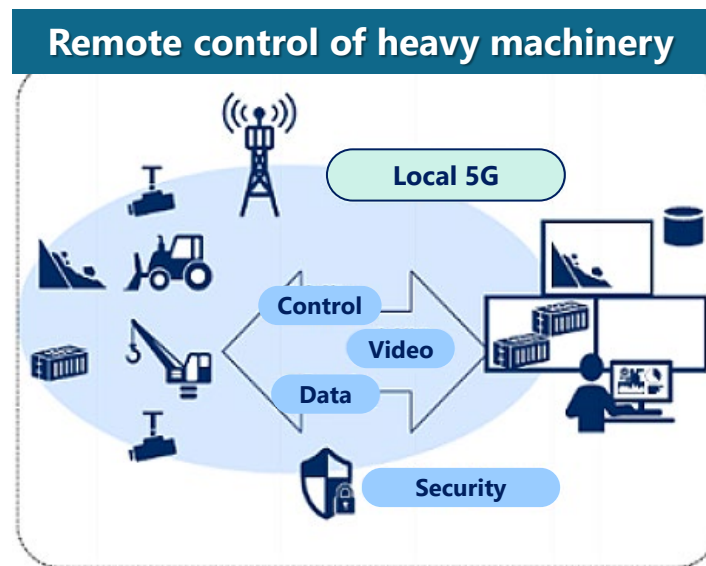
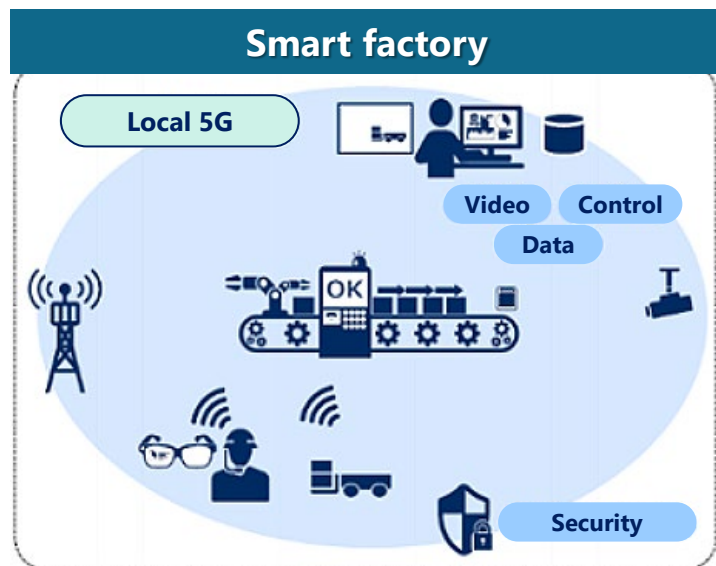


for the time being, national carriers will not be able to acquire licenses for local 5G bandwidth

Why is Local 5G drawing much attention?

Local 5G can leverage max benefit of 5G advantages

<Image cases using local 5G>



(From materials of the Ministry of Internal Affairs and Communications)

- **Dedicated bandwidth available → High stability**
- **Local communication → Security can be assured**
- **User businesses can determine the area and time of introduction**

What is local 5G ?

Local 5G will be newly introduced in Japan, while overseas its introduction is expected to be an extension of private LTE.

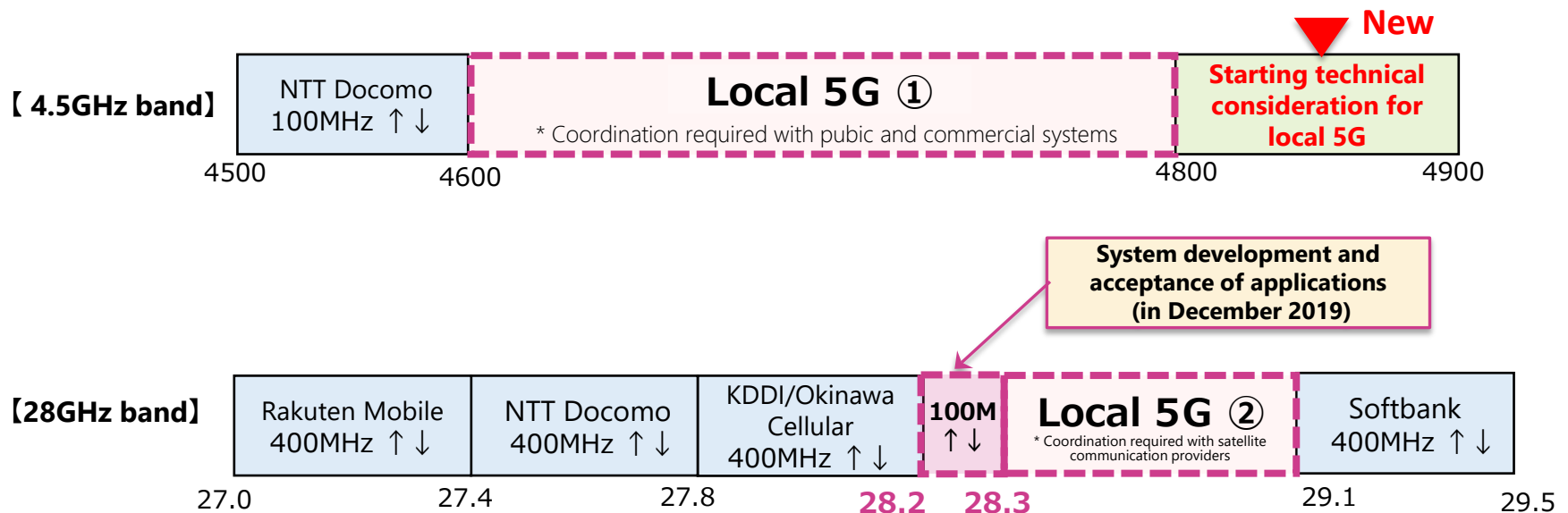


AGV: Automatic (Automated) guided Vehicle

Frequency Allocation in Japan

- 28.2-28.3 GHz (100 MHz band) prioritized (Dec. 24, 2019)
- 4.6-4.8 GHz and 28.3-29.1 GHz under technical consideration. Will be institutionalized in Nov. to Dec. 2020
- Use of 4.8-4.9 GHz also under consideration

Local 5G Frequency Allocation in Japan



Local 5G Places where Anritsu could play an active role

Delay measurement for remote operation

Measurement of **delays** for remote operated trucks



MT1000A Network Master Pro

Local 5G monitoring

Local network status monitoring



Radio wave interference measurement

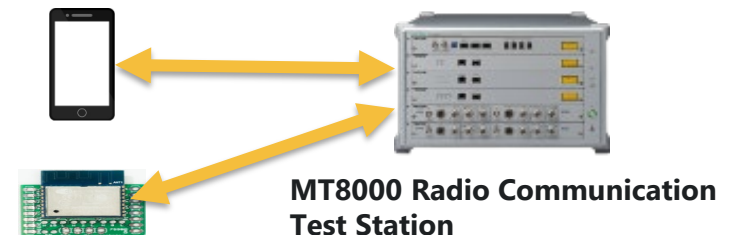
Measurement of radio wave interference caused by overlapping of local 5G areas



MS2090A Field Master Pro

Performance testing of handsets and communication modules

Testing radio transmission characteristics and Protocol of handset and communication module



MT8000 Radio Communication Test Station

Source: Local 5G Study Group - Report outline (draft) - Ministry of Internal Affairs and Communications, Telecommunications Bureau, Radio Department, Land Mobile Communications Division

Anritsu Efforts for 5G

5G terminal development/manufacturing process and test solutions

Sub6 / Millimeter wave

Sub6 / Millimeter wave

Sub6

Millimeter wave

Verification of Core Technologies at Chipset Vendors



Protocol



Baseband Chipset / RF Front End

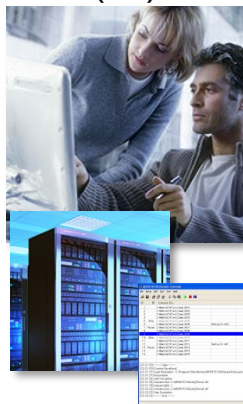
Evaluation of Functions & Performance at UE Vendors



Evaluation of Functions & Performance

Conformance Test at UE Vendors & Test Houses

Conformance Test (CT)



Carrier Acceptance Test

Carrier Acceptance Test (CAT)



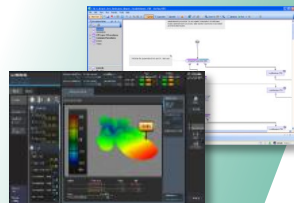
Mass Production Test



RF Calibration & Inspection



MT8000A
Radio Communication
Test Station

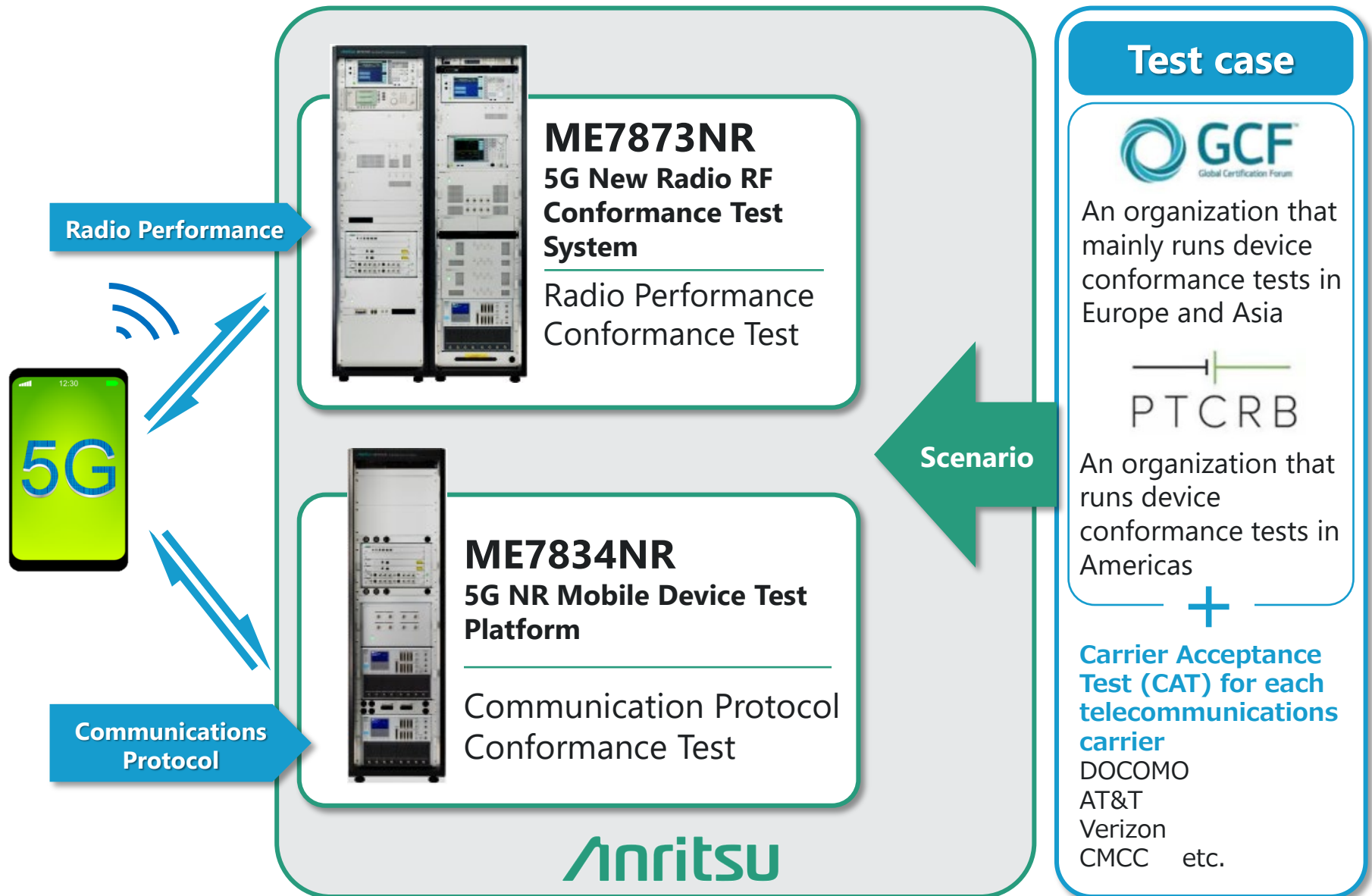


ME783NR/ME7834NR
5G NR Conformance Test and
Carrier Acceptance Test System



MT8870A
Universal Wireless Test
Set

5G Test Solutions Conformance Test



5G Test Solutions Base-Station Installation and Maintenance

5G NR Base-Station Field Performance Measurements and Coverage Mapping

Field Master Pro MS2090A

- Frequency Range: 9 kHz to 9/14/20/26.5/32/43.5/54 GHz
- Supports testing of GSM, LTE, and 5G base stations
It also supports 5G demodulation.
- TX spurious measurement up to 54 GHz

Use case 1: 5G NR Base Station Measurement

3GPP TS 38.104 V15 gNB Base Station Performance Evaluation

- Frequency error · Occupied bandwidth
- Time offset · Adjacent channel leakage ratio
- Cell/Sector ID · Tx spurious up to 12.75 GHz
- Modulation quality · EIRP
- Unwanted emissions · Synchronization Signal Block (SSB)
- FR1 & FR2 · Up to 64 beams supported

Use case 2: 5G Coverage Mapping

Plot field radio strength at certain points in the map by continuously measuring channel power, EIRP or RF data including RSRP. Also, measurement results are indicated in digital map and/or on the building top view.



Automotive Test Solutions

Wireless Connectivity & Infotainment



MT8000A
5G RF/Protocol



MD8475B
e.g eCall/HO/T-put



MT8821C
RF/OTA w/signalling



MT8870A
Production



MT8852B
BT incl. audio



MT8862A
WLAN w/ signalling



MS2690A/MS2830A
RF/HW w/o signalling

ADAS



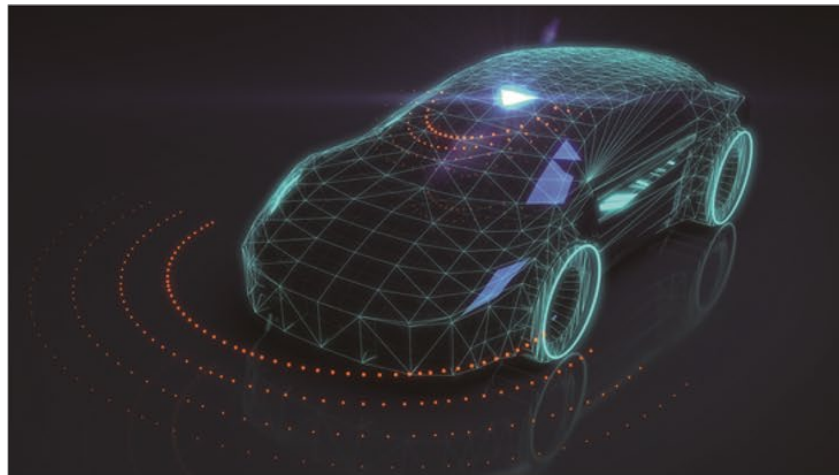
MS2690A/MS2830A
RF/HW w/o signalling

TPMS

Power vs Time



MS464X
Vector Star e.g. Radar



Intelligent Transport System



MS2690A/MS2830A
V2X Message evaluation software



MT8870A
C-V2X RF Testing

EMC/EMI



MS2720T
Spectrum Master



MS2830A
Spectrum Analyzer

Ethernet/CAN



MS9740B
Optical module test



MP1900A
PCIe Test



S331E
Cable & Antenna



MS46122B
Vector Network
Analyzer

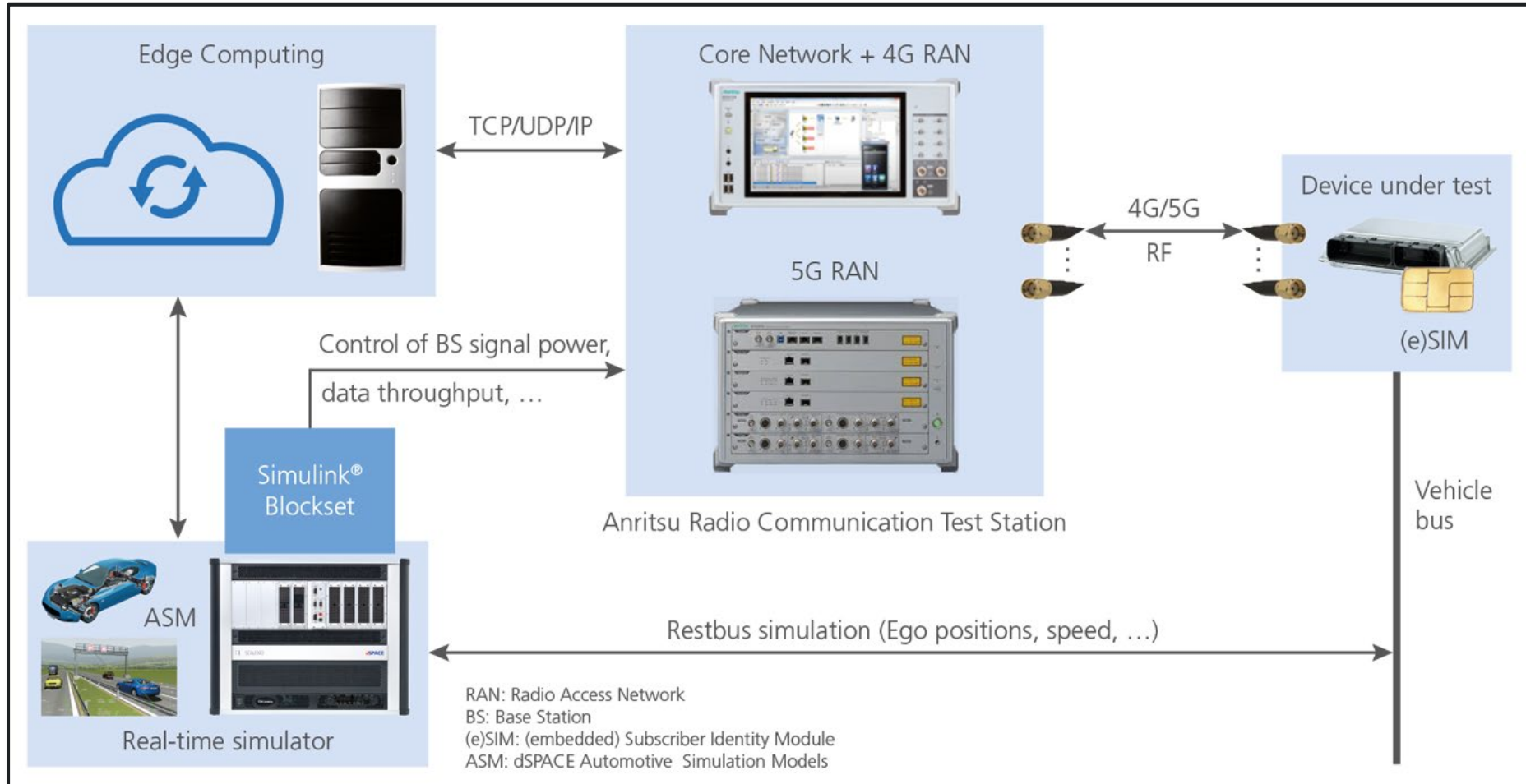
Datcom



MT1000A
Latency test

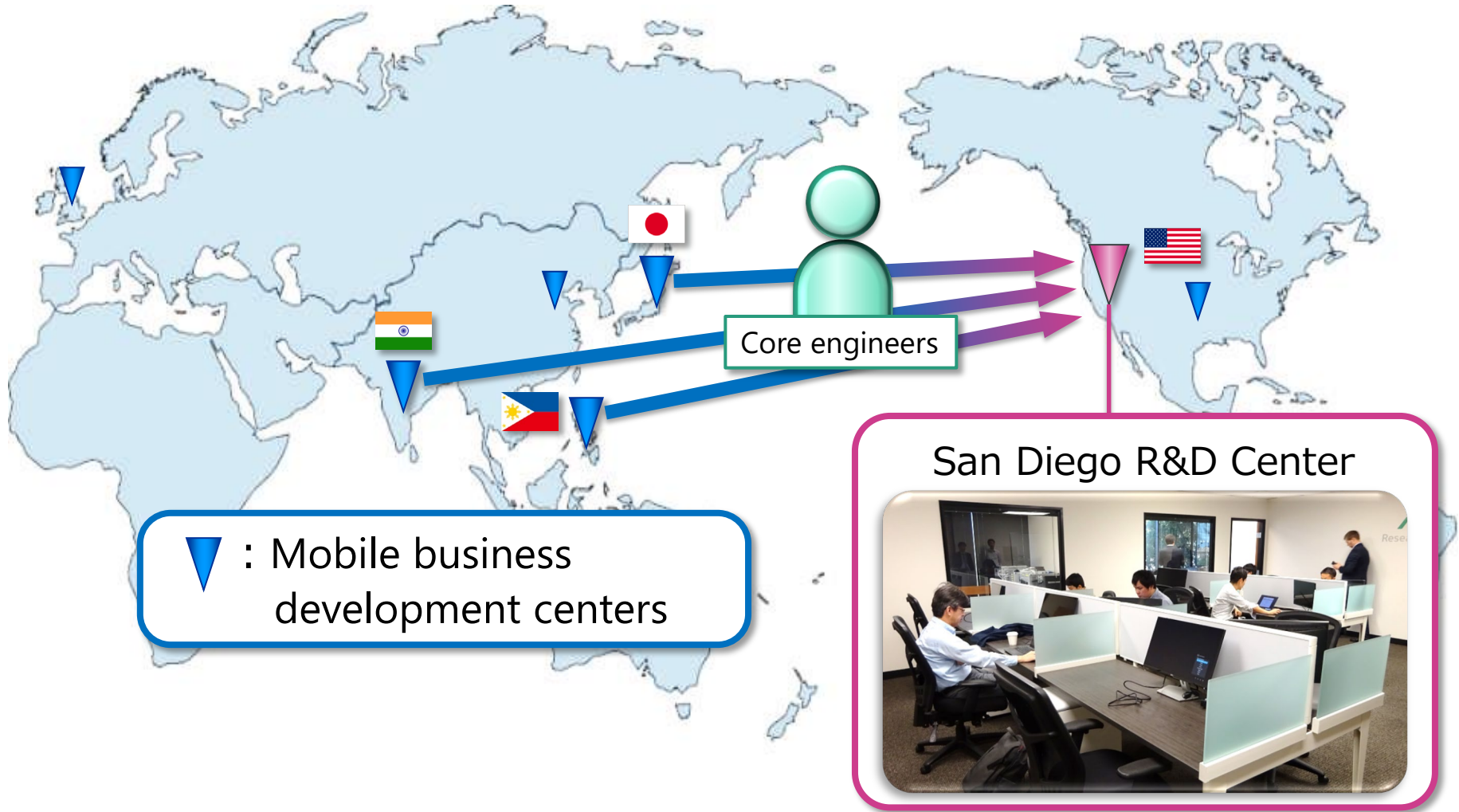
Testing Cutting-Edge V2N/V2Cloud Applications

MT8000A is integrated with HIL Simulator from dSPACE, enabling realistic testing of 5G based V2Cloud Applications



San Diego R&D Center opened

Supporting development proximate to customers on leading edge





In the field of communication measurement, Anritsu has provided testing solutions that meet the needs of customers' development processes, thereby contributing to the early commercialization of 5G. In the future, we will continue to build our technical knowledge to support the spread and evolution of 5G, followed by Beyond5G, and work closely with our customers to contribute to the development of society.

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