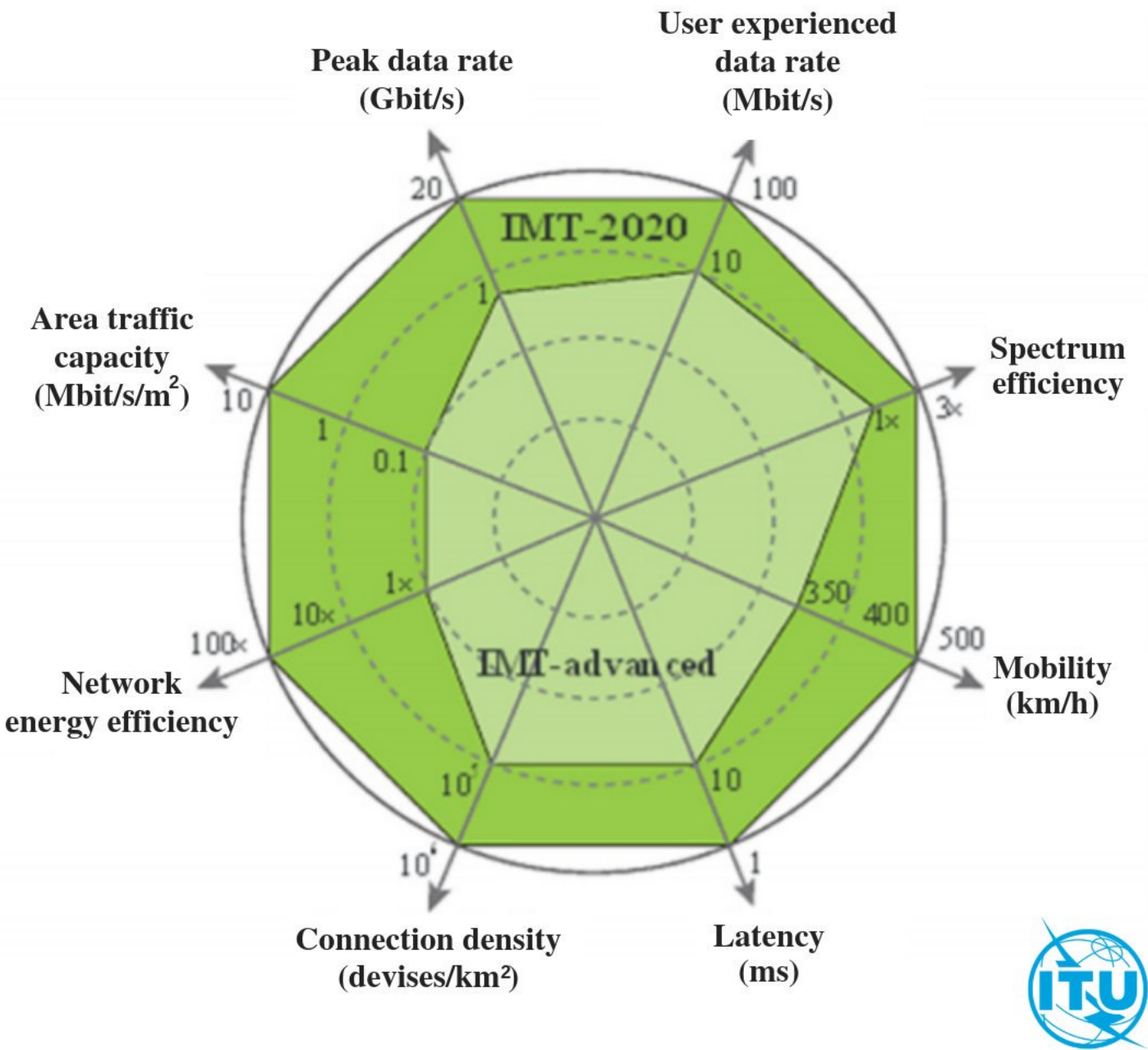# 5G for FWA & private industrial networks

Matúš Turcsány
Chief Technology Officer
Czech, Hungary, Slovakia, Slovenia

October 2019
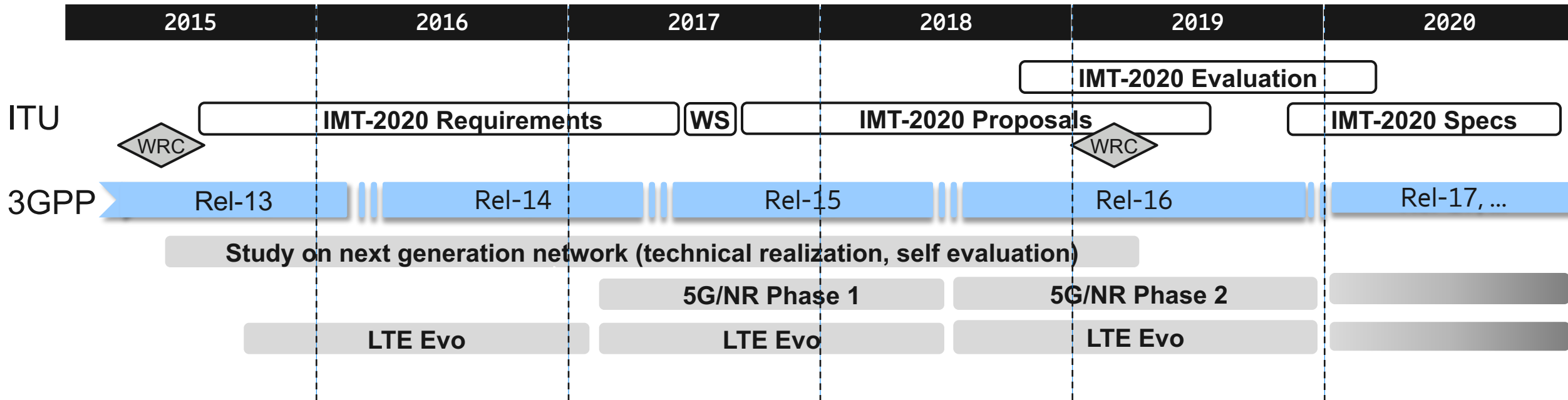
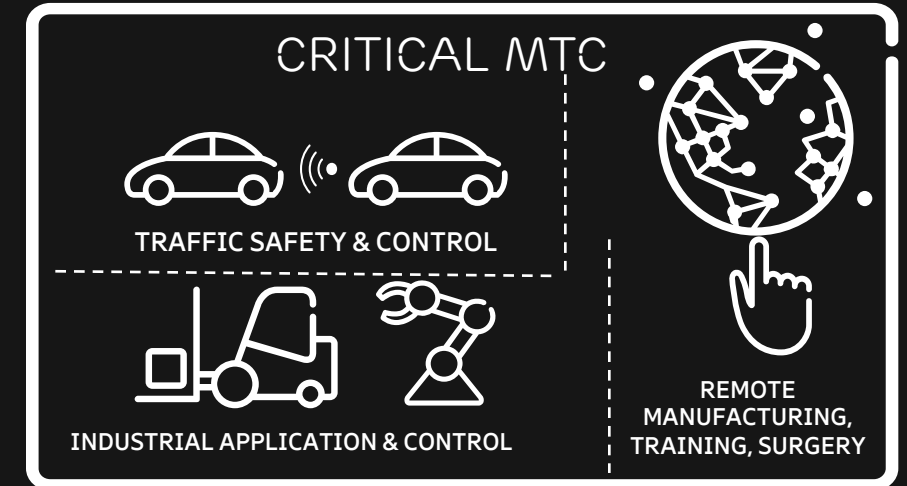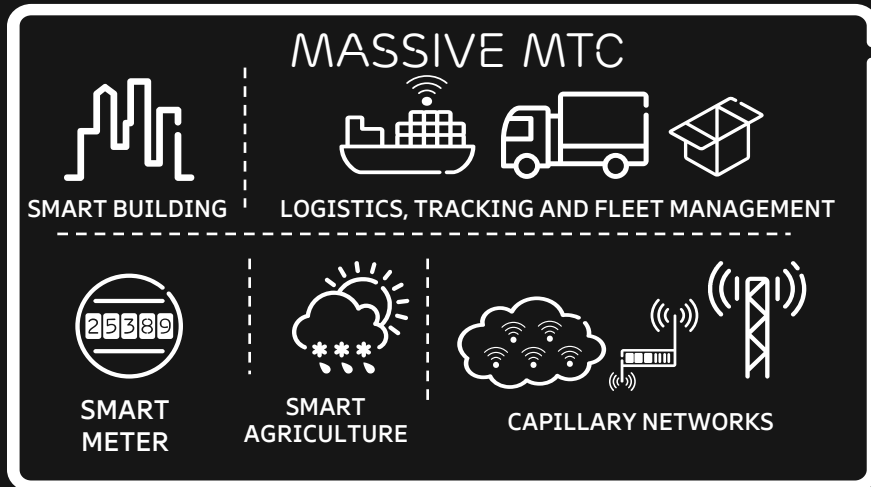**Enhancement of key capabilities from IMT-Advanced to IMT-2020**

What is a 5G network?

3GPP view

5G — use case driven technology

MASSIVE MTC

SMART BUILDING

LOGISTICS, TRACKING AND FLEET MANAGEMENT

SMART METER

SMART AGRICULTURE

CAPILLARY NETWORKS

CRITICAL MTC

TRAFFIC SAFETY & CONTROL

INDUSTRIAL APPLICATION & CONTROL

REMOTE MANUFACTURING, TRAINING, SURGERY

ENHANCED BROADBAND

Smartphones

Home, Enterprise, Venues, Mobile/Wireless/Fixed
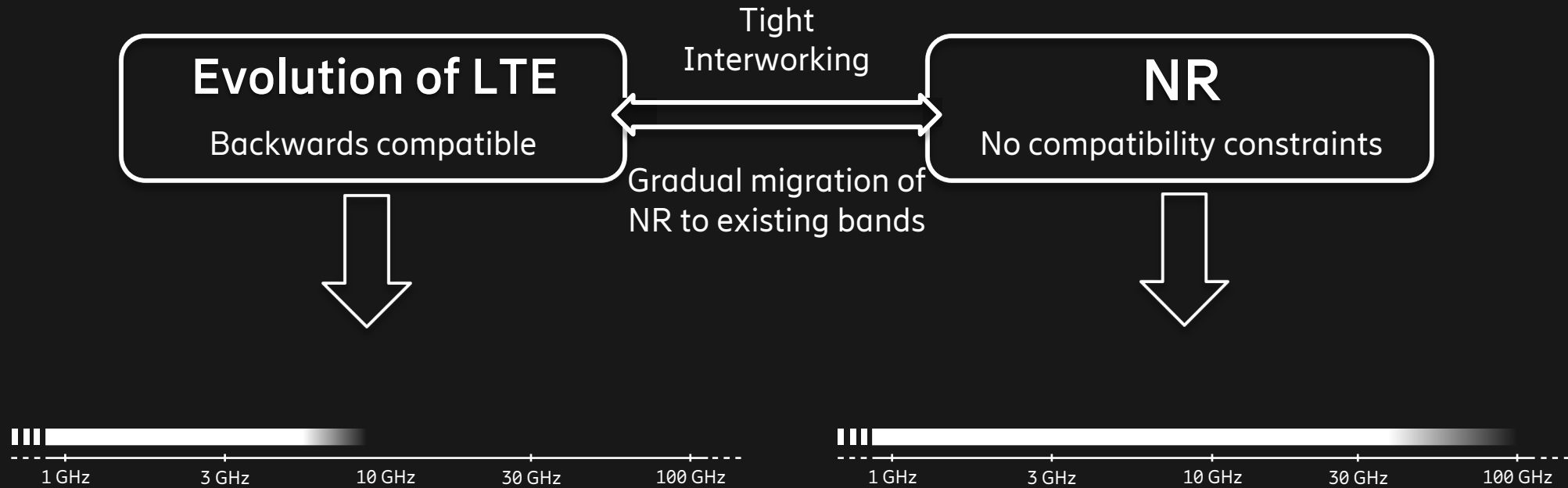
SIM less devices

4k/8k UHD, Broadcasting, VR/AR,

LOW COST, LOW ENERGY
SMALL DATA VOLUMES
MASSIVE NUMBERS

ULTRA RELIABLE
VERY LOW LATENCY
VERY HIGH AVAILABILITY

5G radio access

Evolution of LTE
Backwards compatible

Tight Interworking

NR
No compatibility constraints

Gradual migration of NR to existing bands

1 GHz 3 GHz 10 GHz 30 GHz 100 GHz

1 GHz 3 GHz 10 GHz 30 GHz 100 GHz

5G spectrum

Low band NR: Bands below 3 GHz (2600, 2100, 1800, 900, 800, 700, ...)

Mid band NR: Bands between 3 GHz & 6 GHz (3500, 3700, ...)

High band NR: Bands above 24 GHz (26, 28, 39, ...)

+

License assisted access (5 & 6 GHz)
Standalone unlicensed (5 & 6 GHz)

Spectrum above 50 GHz
Spectrum above 95 GHz
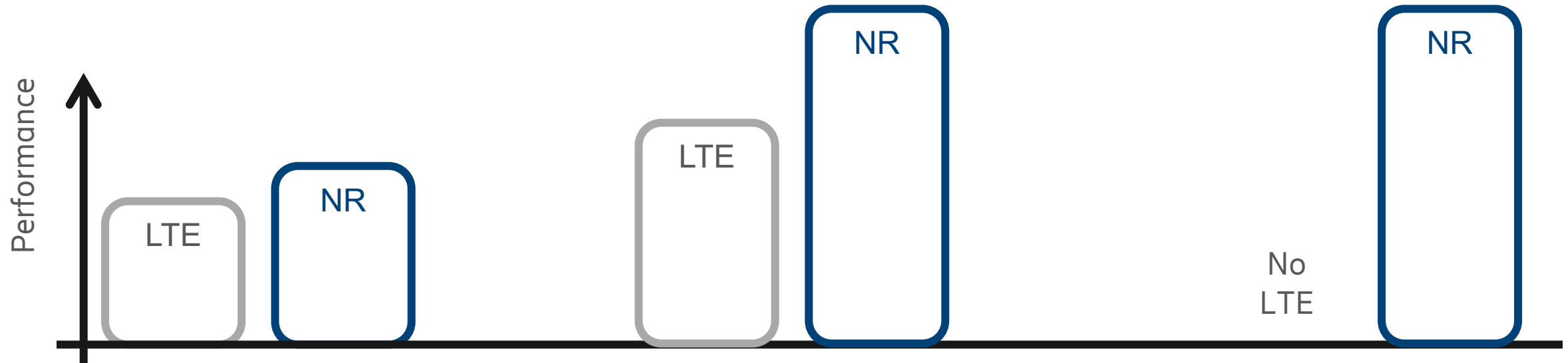
5G/NR vs LTE

All deployments

› 20% higher utilization

› Faster response times
  —40% faster download of 1MB

› 3x more efficient for URLLC

› Increased energy efficiency

› 3x cell-edge at low load

With Massive MIMO

› Better coverage

› Better mobility

› More flexible

mmW

› Optimized numerology

› Support for analogue BF

5G toolbox

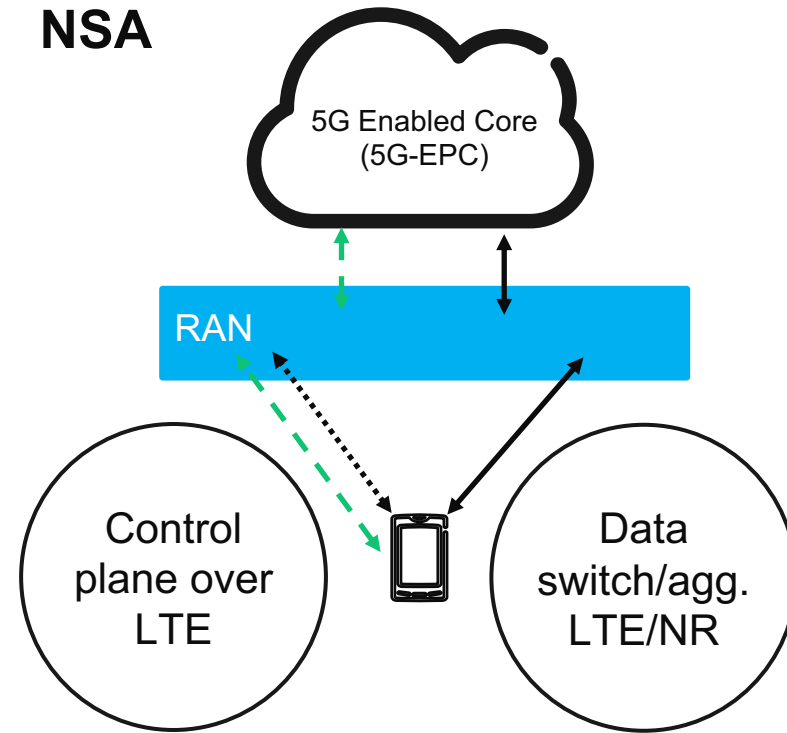|	
Low latency nationwide coverage	sub 1 GHz
Enhanced MBB experience	up to 2,6 GHz with spectrum sharing
Urban capacity booster & FWA	3 GHz + low band coverage booster
Multi-Gigabit pipes	mmwaves
Private industrial networks	3 GHz, mmwaves

NonStandAlone & StandAlone operation

NSA

5G Enabled Core
(5G-EPC)

RAN

Control plane over LTE

Data switch/agg. LTE/NR

Tight interworking with LTE
→ Fastest TTM

SA

5G Core
(5GC)

RAN

Control plane over NR

Data over NR
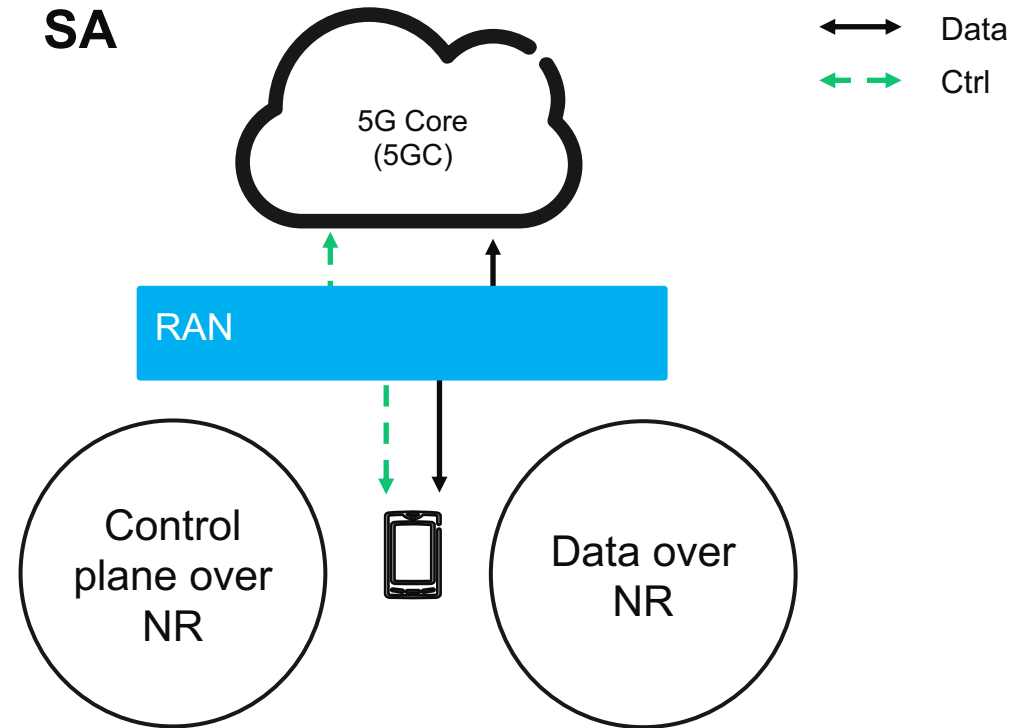
"Independent" overlay
Totally new CN architecture
→ Highest performance potential

Data
Ctrl

First with commercial 5G live networks in 4 continents
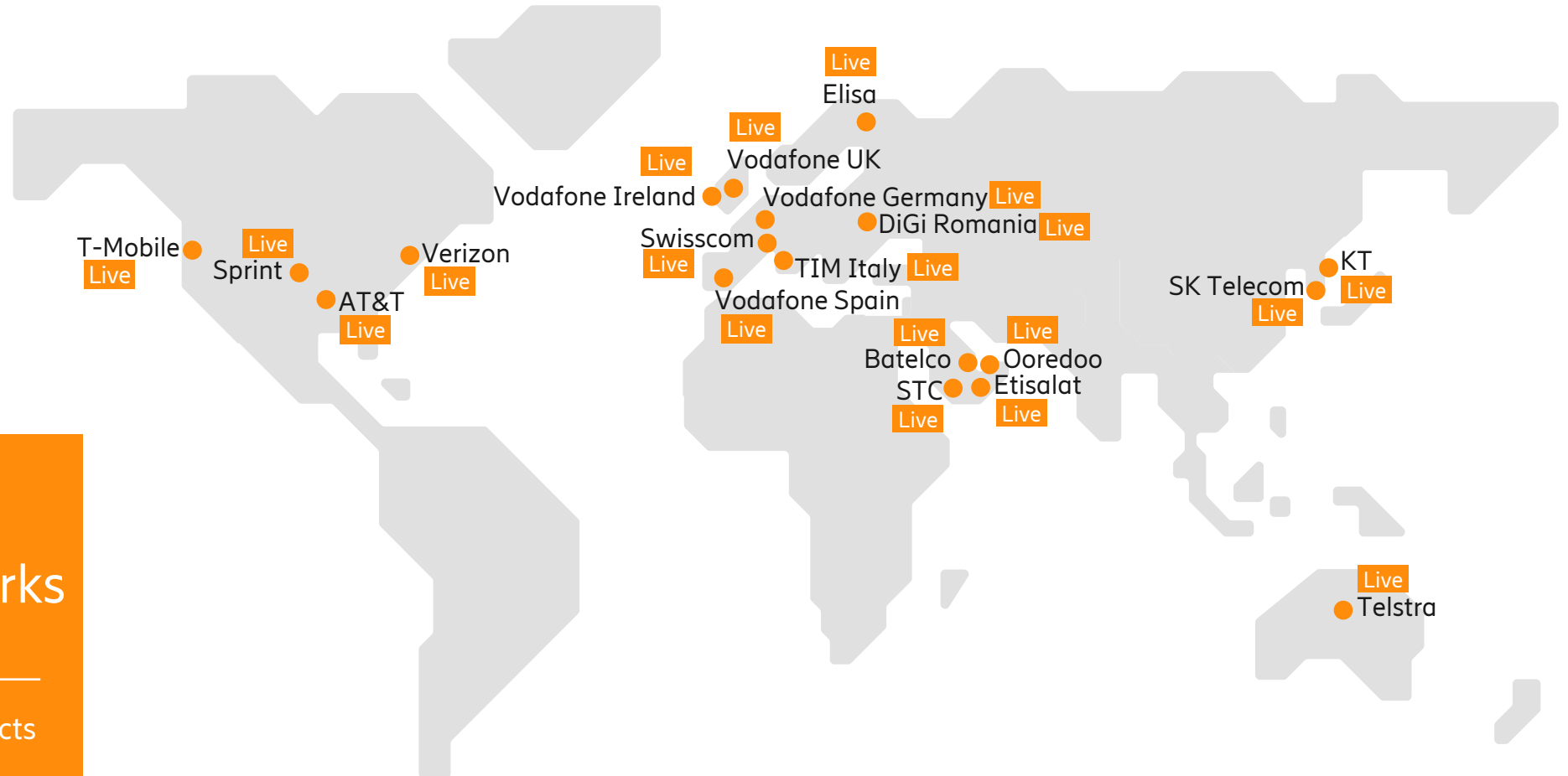
19 Live networks

25 Announced 5G contracts

Live — Elisa
Live — Vodafone UK
Live — Vodafone Ireland
Live — Vodafone Germany
Live — DiGi Romania
Live — Swisscom
Live — TIM Italy
Live — Vodafone Spain
Live — Batelco
Live — Ooredoo
Live — STC
Live — Etisalat
Live — SK Telecom
Live — KT
Live — Telstra
Live — T-Mobile
Live — Sprint
Live — Verizon
Live — AT&T

*As of September 2019

5G in Korea

Faster uptake than LTE in 2011.

More than 3 million 5G subscribers with average **data consumption** from 9 GByte on 4G to more than **25 GByte** on 5G.
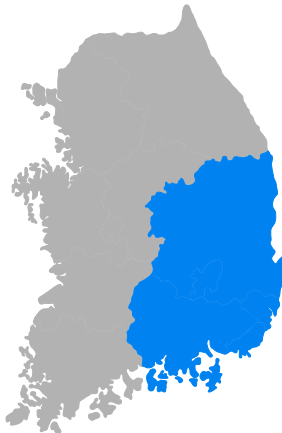
A lot of this increased consumption is coming for **VR & AR applications**.

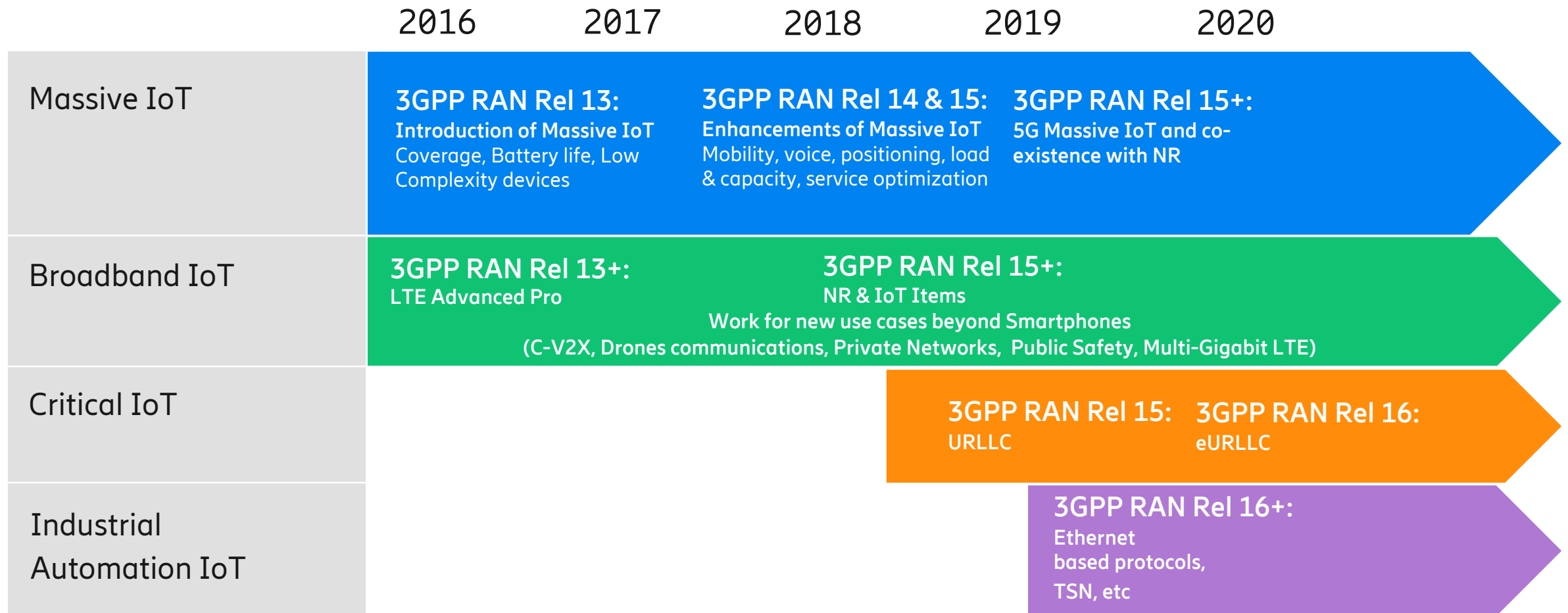**190 000 radio units** have been deployed so far.

Population coverage of **93%** by the end of 2019**.**

Focus on innovation around **industry applications:**
— smart manufacturing
— transportation
— public safety

3GPP and Cellular IoT – proven standards

	2016	2017	2018	2019	2020

Massive IoT

3GPP RAN Rel 13:
Introduction of Massive IoT
Coverage, Battery life, Low
Complexity devices

3GPP RAN Rel 14 & 15:
Enhancements of Massive IoT
Mobility, voice, positioning, load
& capacity, service optimization

3GPP RAN Rel 15+:
5G Massive IoT and co-existence with NR

Broadband IoT

3GPP RAN Rel 13+:
LTE Advanced Pro

3GPP RAN Rel 15+:
NR & IoT Items
Work for new use cases beyond Smartphones
(C-V2X, Drones communications, Private Networks, Public Safety, Multi-Gigabit LTE)

Critical IoT

3GPP RAN Rel 15:
URLLC

3GPP RAN Rel 16:
eURLLC

Industrial Automation IoT

3GPP RAN Rel 16+:
Ethernet
based protocols,
TSN, etc

Spectrum options for industries

1

SLAs provided by MNOs

— Short term vs long term expectations
— SLAs fulfillment: i.e. production stop or safety issues

2

Lease Spectrum

— Not an established market
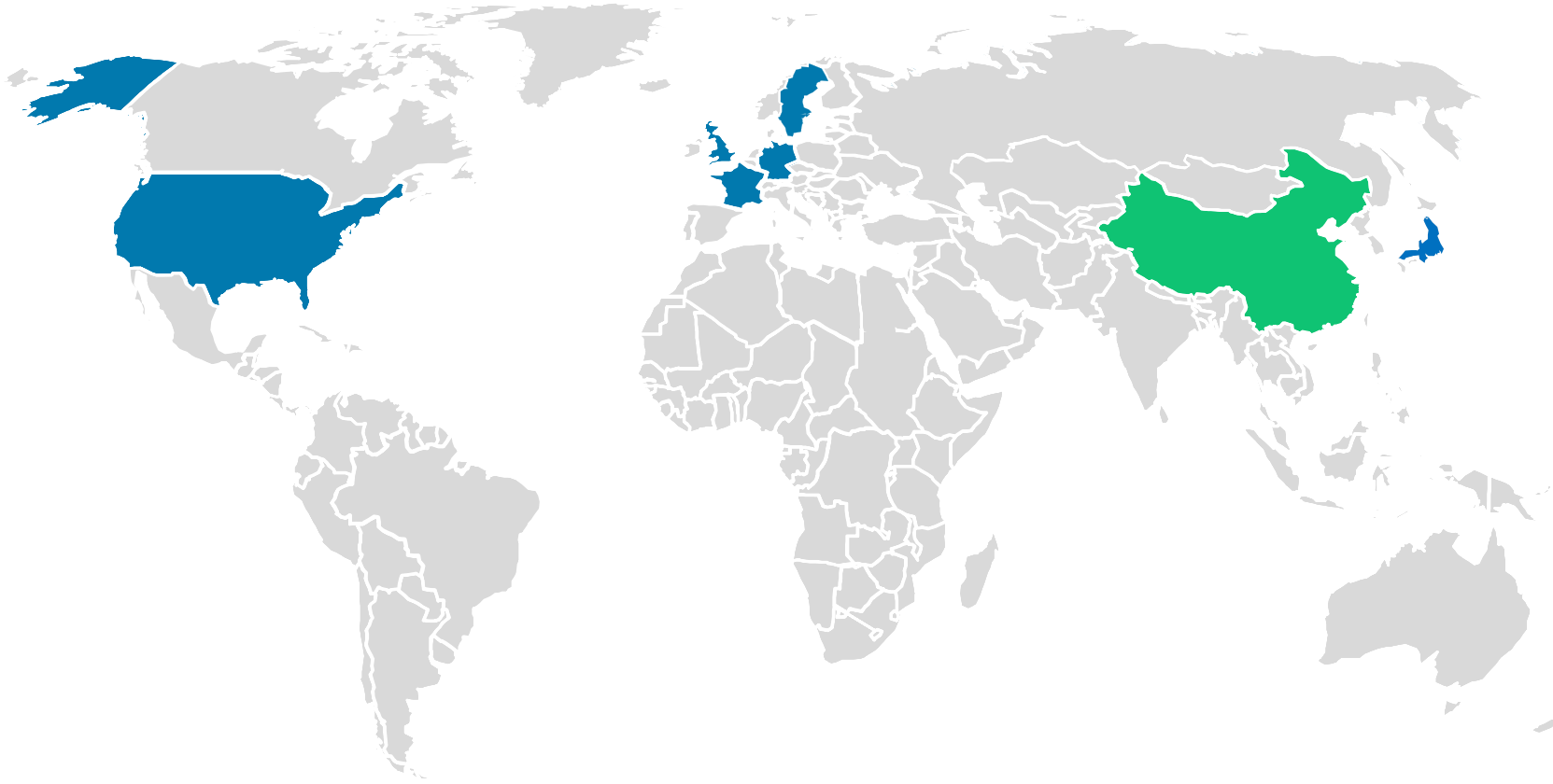— New rules & business case

3

New regulated licenses

— Driven by e.g."5G ACIA". Getting traction in e.g. EU

4

Unlicensed Spectrum

— Useful in many applications, but it can't offer full URLLC
— Risk of costly outages due to interference

Dedicated spectrum for industries and private networks

3.7-3.8 GHz in Sweden, Germany

3.8-4.2 GHz, 1800 MHz in UK

2.6 GHz TDD in France

4.6-4.8 GHz in Japan
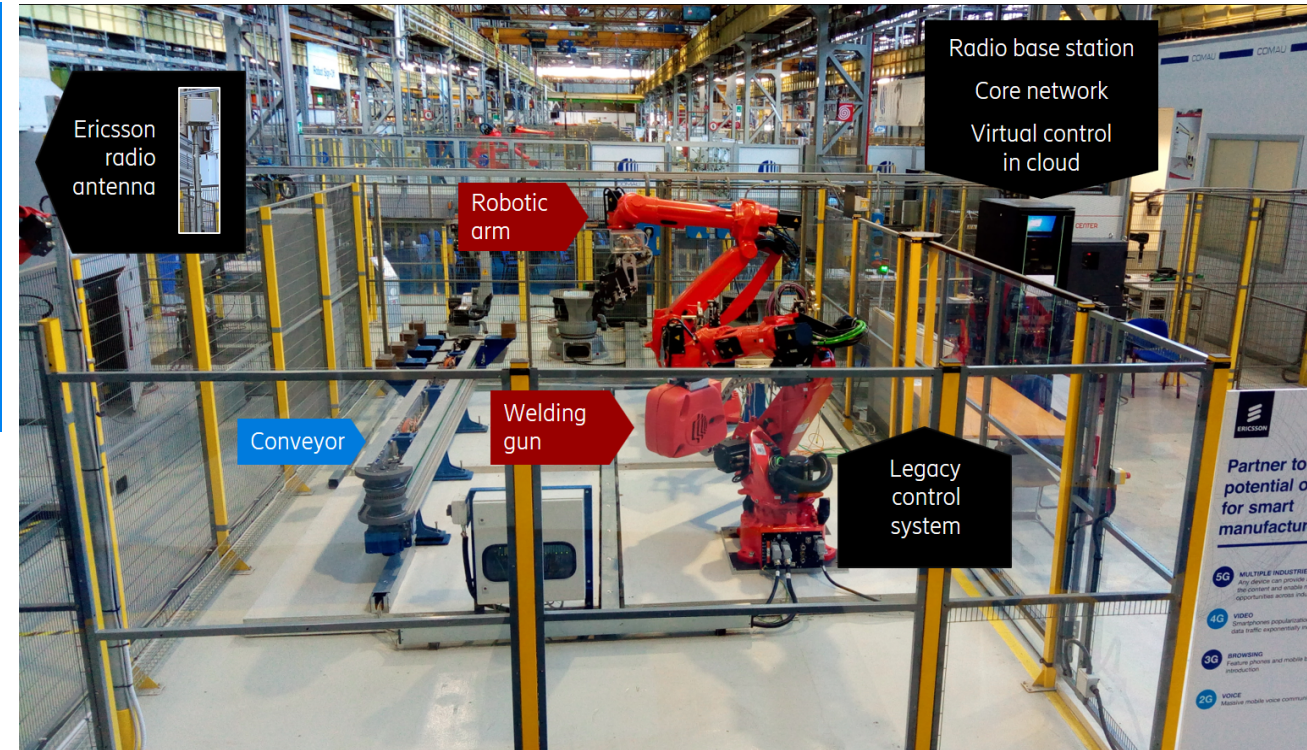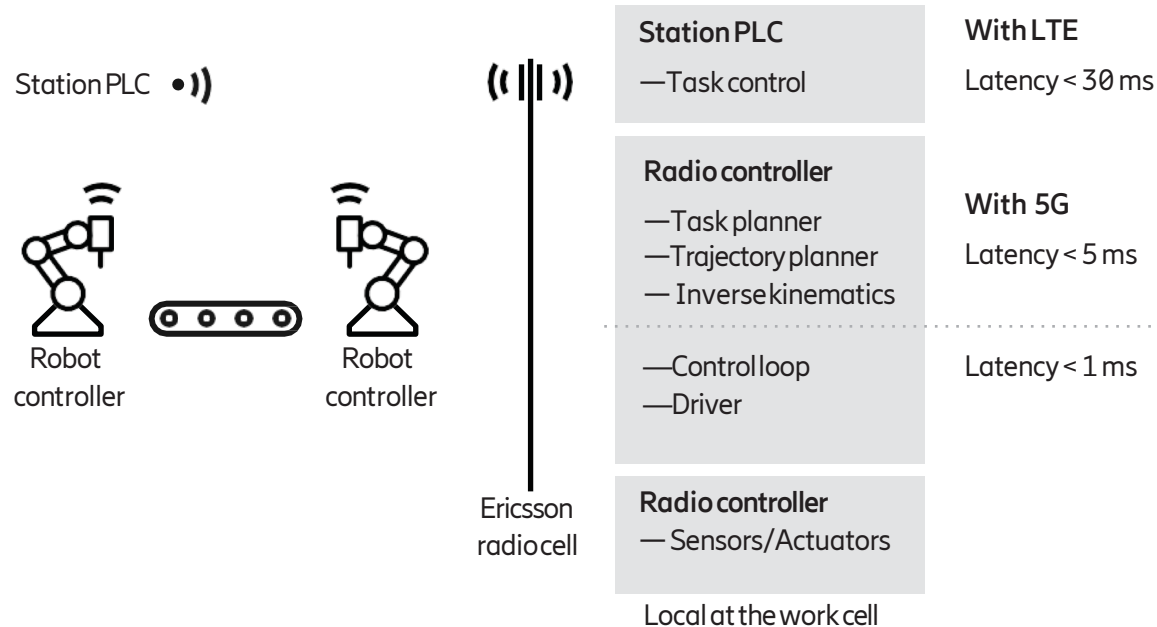
28.2-29.1 GHz in Japan

37 GHz in US

3.55-3.7 CBRS in US

Flexible robotics: 5G-enabled factory in Comau

— Reduction of cabling in new plants or existing plants with help of cellular

— Remote monitoring of robots for preventive maintenance

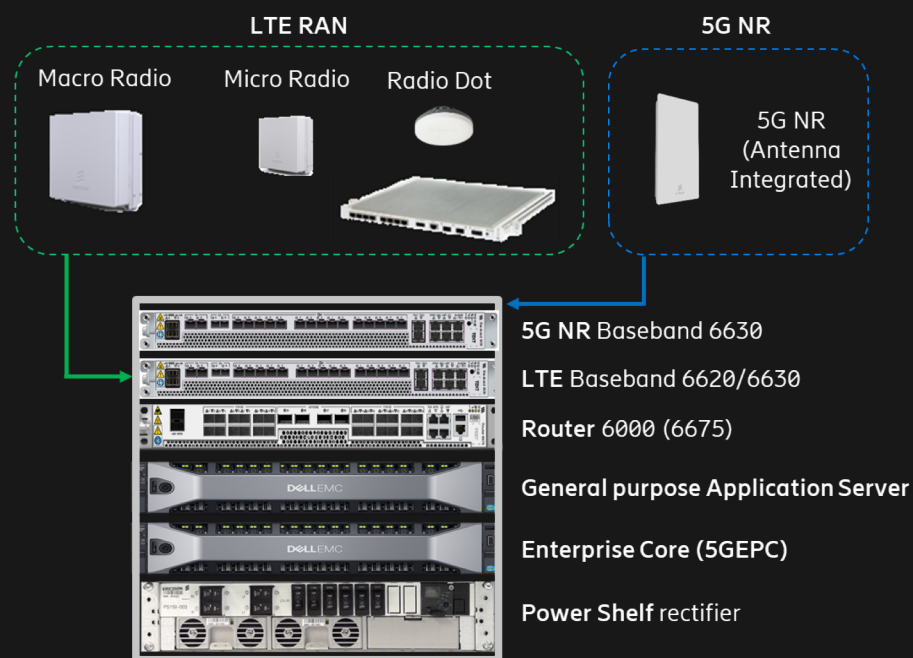— Move nodes computing to reduce installation costs (remote virtual PLC)

Ericsson radio antenna

Radio base station
Core network
Virtual control in cloud

Robotic arm

Conveyor

Welding gun

Legacy control system

Station PLC

Robot controller

Robot controller

Ericsson radio cell

Station PLC
— Task control

With LTE
Latency < 30 ms

Radio controller
— Task planner
— Trajectory planner
— Inverse kinematics

With 5G
Latency < 5 ms

— Control loop
— Driver

Latency < 1 ms

Radio controller
— Sensors/Actuators

Local at the work cell

Private Networks & Industry Connect

Private Networks
(4G & 5G stand-alone package)

LTE RAN

Macro Radio   Micro Radio   Radio Dot

5G NR

5G NR
(Antenna
Integrated)

5G NR Baseband 6630

LTE Baseband 6620/6630

Router 6000 (6675)

General purpose Application Server

Enterprise Core (5GEPC)

Power Shelf rectifier

Industry connect

Radio Dot
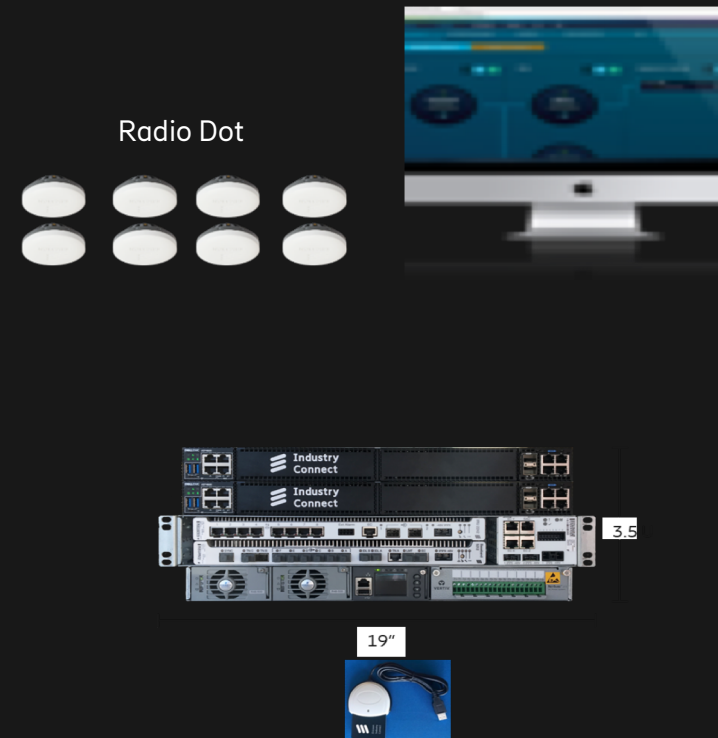
Industrial O&M

RD2243 (for LTE & 5G)

Network Controller on
2x Dell VEP 4600
in active / hot-standby
configuration
Chassis: RBS 6601
Baseband: IDU 5209 (LTE)
Distribution: IRU2242

Rectifier

3.5

19"