Qualcomm

Abril 2021

5G

Audiência Pública - GT5G

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Vice-presidente de Relações Governamentais para América Latina
Qualcomm

Leading wireless innovation for 35 years

Digitized mobile communications

Analog to digital

Redefined computing

Desktop to smartphones

Transforming industries

Connecting virtually everything

The R&D Engine

$64B+

in cumulative R&D

140,000+

Granted patents / pending applications

300+

License agreements

37,000

Employees

Source: Company data as of Q3 FY20; R&D is cumulative expenditure since 1985

Mobile has made a leap every ~10 years

Mobile voice communication

1G

1980s

Analog voice

AMPS, NMT, TACS

Efficient voice to reach billions

2G

1990s

Digital voice

D-AMPS, GSM, IS-95 (CDMA)

Focus shifts to mobile data

3G

2000s

Wireless Internet

CDMA2000/EV-DO WCDMA/HSPA+,

Mobile broadband and emerging expansion

4G

2010s

Mobile broadband

LTE, LTE Advanced, Gigabit LTE

A unified future-proof platform

2020s

Wireless Edge

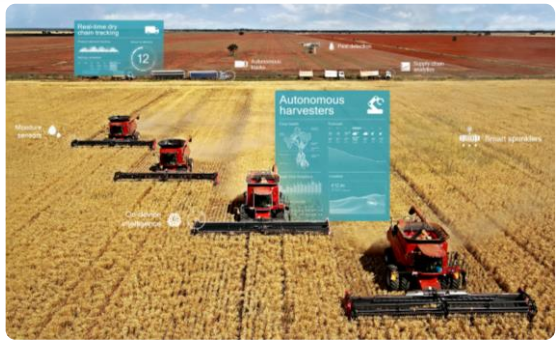
5G New Radio (NR)

5G will expand the mobile ecosystem to new industries

Powering the digital economy

$13.1 Trillion

in global economic value by 2035*



Precision agriculture
$416B

Construction and mining
$984B

Digitized education
$264B

Connected healthcare
$1,083B

Richer mobile experiences
$2,224B

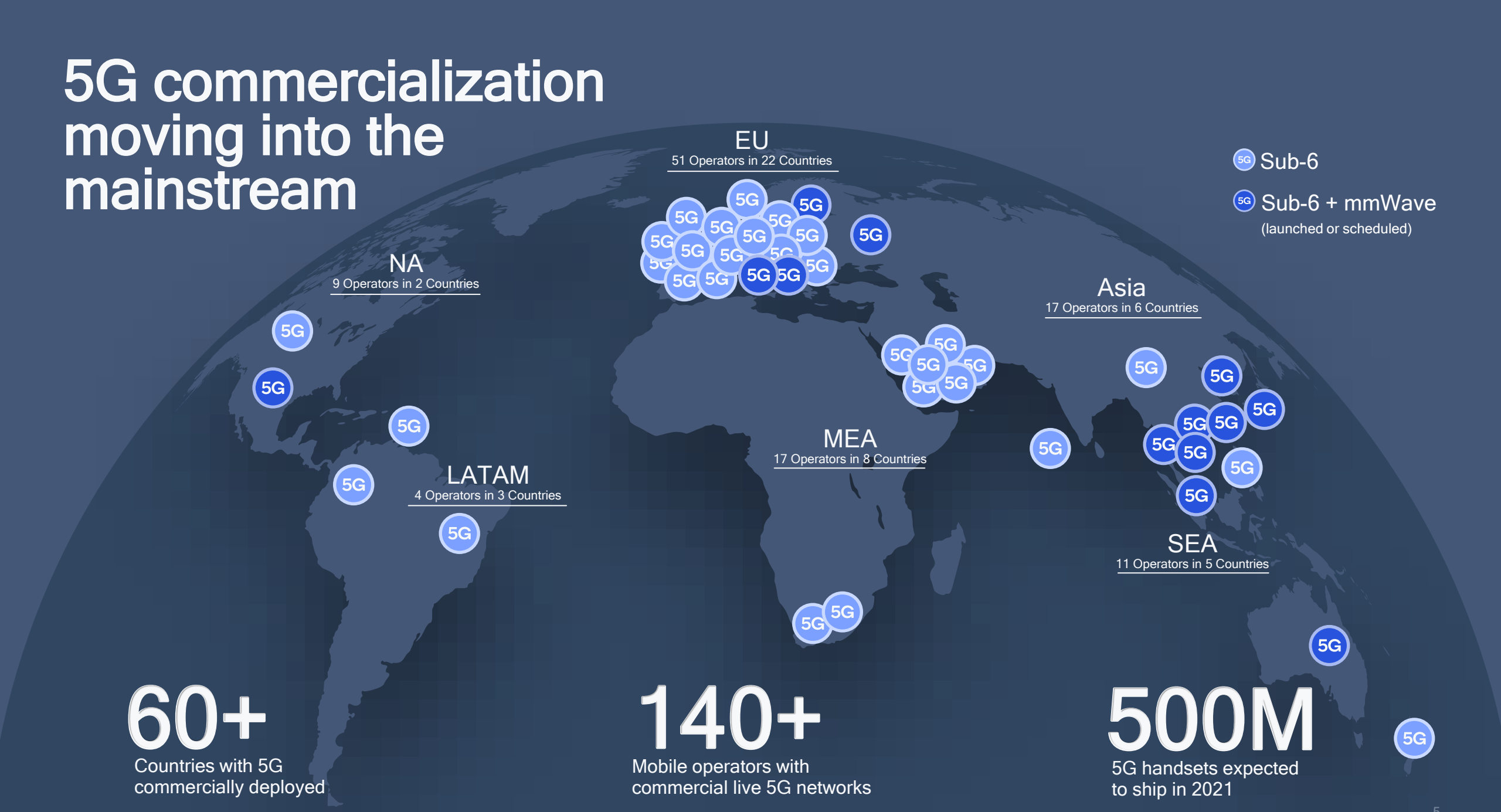
Smart manufacturing
$4,771B

Intelligent retail
$1,144B

Smart city
$2,213B

* The 5G Economy in a Post-COVID-19 Era - an independent study from IHS Markit, commissioned by Qualcomm Technologies, Inc.

5G commercialization moving into the mainstream



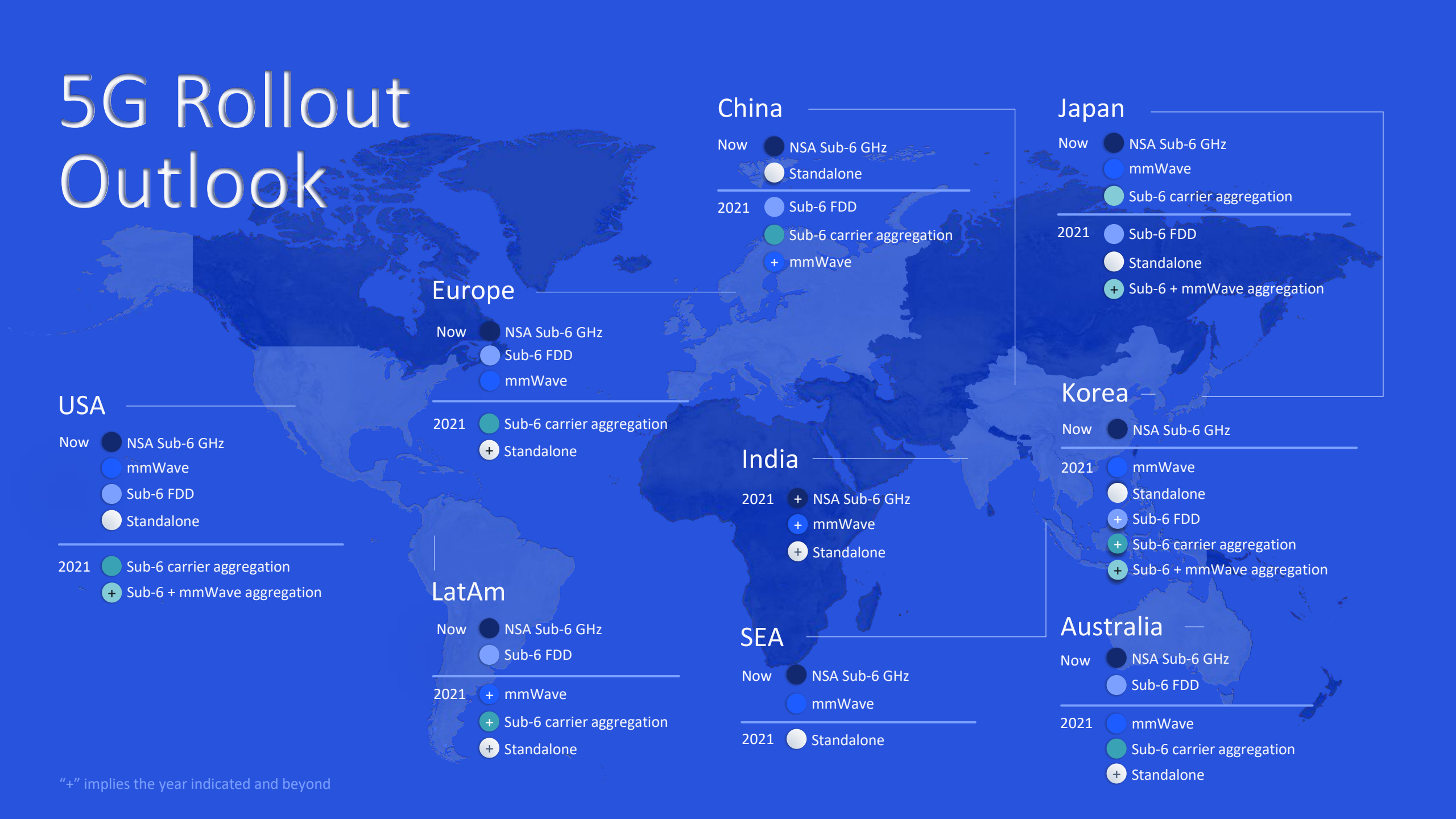
60+
Countries with 5G commercially deployed

140+
Mobile operators with commercial live 5G networks

500M
5G handsets expected to ship in 2021

Sources - GSA: 5G Market Snapshot Member Report - June 2020; Qualcomm estimates (2021 projection is at mid-point of guidance range), Nov. '20

5G Rollout Outlook



China

Now
- NSA Sub-6 GHz
- Standalone

2021
- Sub-6 FDD
- Sub-6 carrier aggregation
- \+ mmWave

Japan

Now
- NSA Sub-6 GHz
- mmWave
- Sub-6 carrier aggregation

2021
- Sub-6 FDD
- Standalone
- \+ Sub-6 + mmWave aggregation

Europe

Now
- NSA Sub-6 GHz
- Sub-6 FDD
- mmWave

2021
- Sub-6 carrier aggregation
- \+ Standalone

USA

Now
- NSA Sub-6 GHz
- mmWave
- Sub-6 FDD
- Standalone

2021
- Sub-6 carrier aggregation
- \+ Sub-6 + mmWave aggregation

India

2021
- \+ NSA Sub-6 GHz
- \+ mmWave
- \+ Standalone

Korea

Now
- NSA Sub-6 GHz

2021
- mmWave
- Standalone
- \+ Sub-6 FDD
- \+ Sub-6 carrier aggregation
- \+ Sub-6 + mmWave aggregation

LatAm

Now
- NSA Sub-6 GHz
- Sub-6 FDD

2021
- \+ mmWave
- \+ Sub-6 carrier aggregation
- \+ Standalone

SEA

Now
- NSA Sub-6 GHz
- mmWave

2021
- Standalone

Australia

Now
- NSA Sub-6 GHz
- Sub-6 FDD

2021
- mmWave
- Sub-6 carrier aggregation
- \+ Standalone

"+" implies the year indicated and beyond

5G

Advancing 5G for the new decade

Release 15

Established 5G NR technology foundation

- eMBB — enhanced mobile broadband services
- 5G core network
- Sub-6 GHz with massive MIMO
- Advanced channel coding
- Scalable OFDM-based air interface
- Mobile mmWave
- Flexible framework
- LTE integration

Release 16

Expanding to new use cases and industries

- 5G broadcast[1]
- In-band eMTC/NB-IoT & 5G Core[2]
- 5G NR IIoT with eURLLC
- Positioning across use cases
- eMBB evolution - improved power, mobility, more[3]
- 5G NR Cellular V2X
- Better coverage with IAB, uplink MIMO
- 5G NR in unlicensed spectrum
- IAB — integrated access/backhaul
- Private Networks, SON, satellites[4]

Release 17

Continued expansion and enhancements

- Enhanced DL/UL MIMO, multiple transmission points[5]
- NR-Light for wearables, industrial sensors
- Unlicensed spectrum across all use-cases
- More capable, flexible IAB
- New spectrum above 52.6 GHz
- Centimeter accuracy IIoT with mmWave
- Expand sidelink for V2X reliability, P2V, IoT relay
- Enhancements to 5G NR Industrial IoT
- Continued eMBB enhancements, XR, others[4]
- Rel-15 deployment learning, XR, drones, others[6]

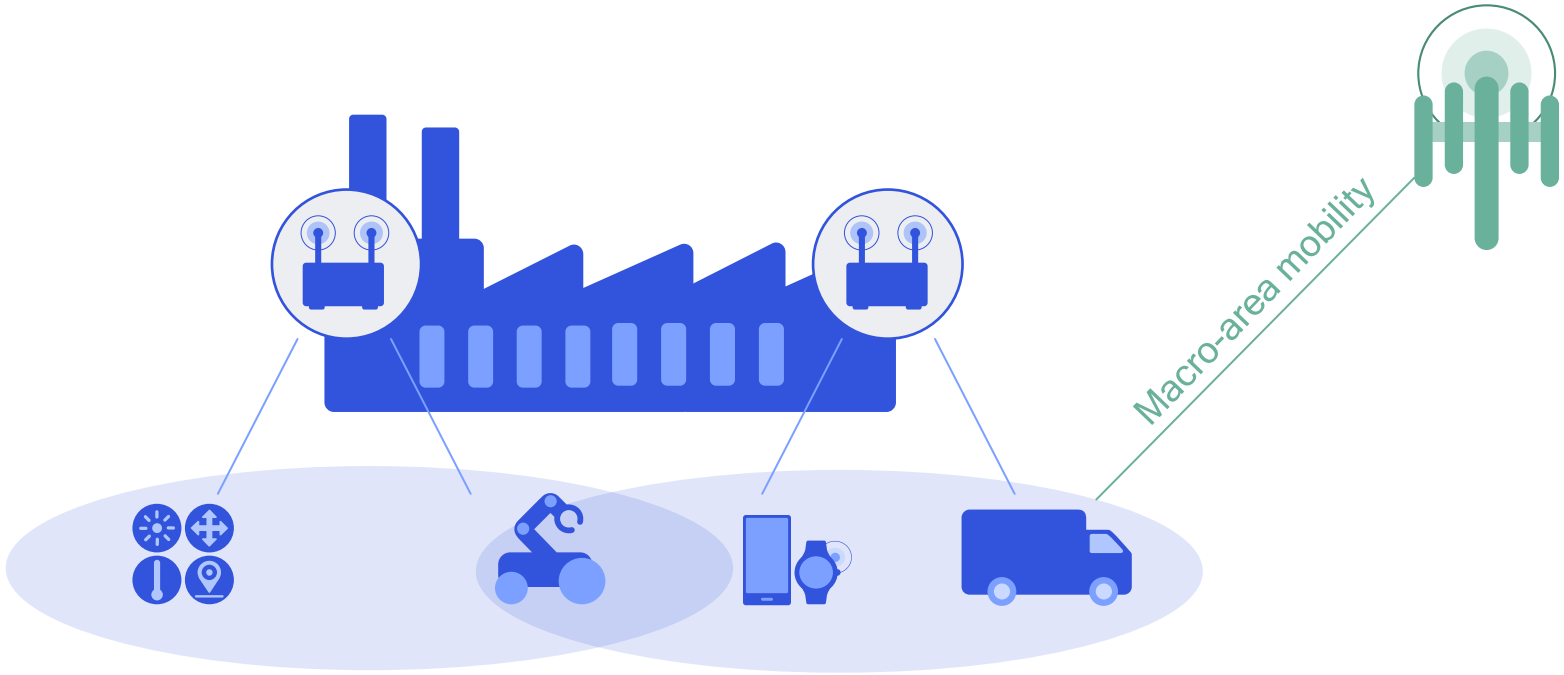
Release 18

Potential projects (nominal work expected to start in 2022)

- Further eMBB enhancements
- Full-duplex MIMO
- Extended reality
- Higher mmWave frequencies
- Automotive & NR V2X enhancements
- Non-terrestrial acces
- 5G NR-Light expansion for IoT
- AI/ML data-driven designs
- Broadcast enhancements
- Sidelink in unlicensed spectrum

1. Enhancing Rel-14 LTE enTV to meet 5G requirements; 2. eMTC/NB-IOT in-band 5G NR and connected to 5G core; 3. MIMO, power consumption, mobility, MR DC/CA, interference management and more; 4. Non-terrestrial networks, non-public networks (private networks), NR SON/MDT and more; 5. further improvements to capacity, coverage, mobility, power consumption, spectral efficiency; 6. mixed-mode multicast, small data transmission, multi-SIM, satellite, multimedia

Private 5G networks for Industrial IoT use cases



Optimized

Tailored for industrial applications, e.g., QoS, latency

Dedicated

Local network, easy to deploy, independently manage

Secure

Cellular grade security and keeping sensitive data local

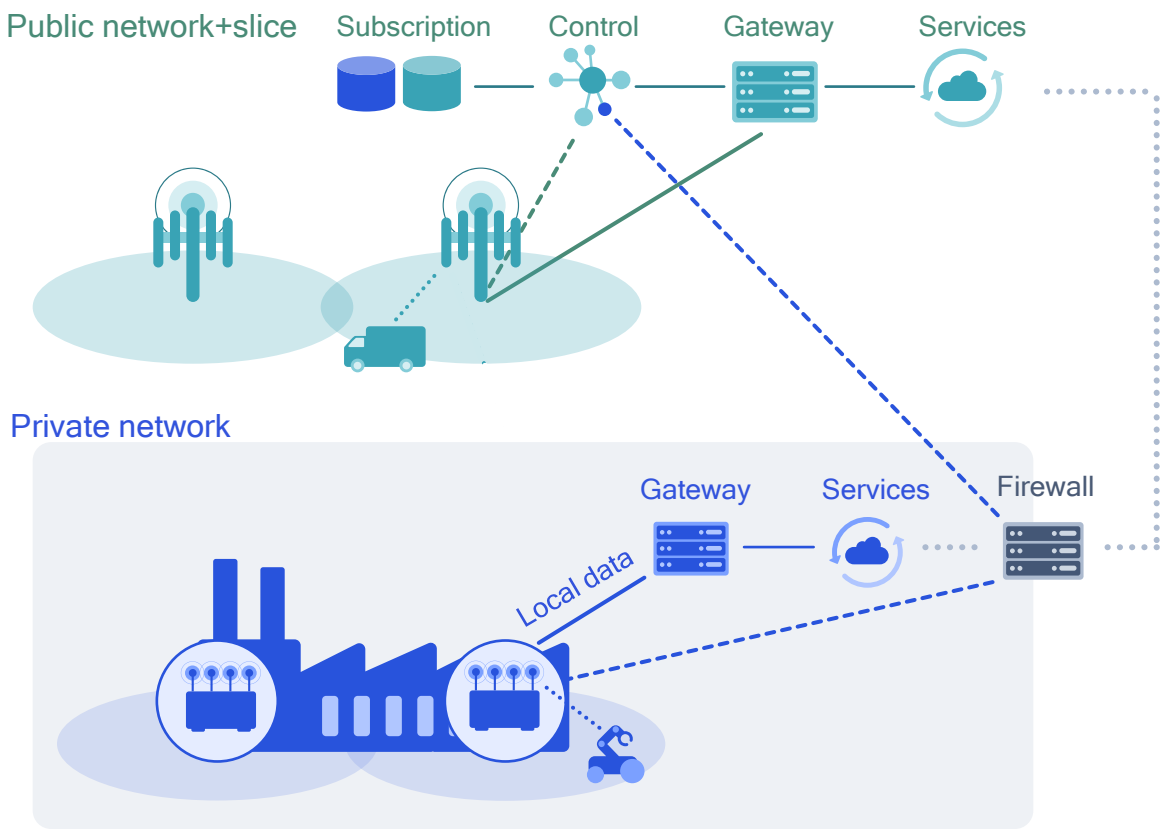
Optimizing private LTE for Industrial IoT today

New opportunities and scalability with 5G NR capabilities

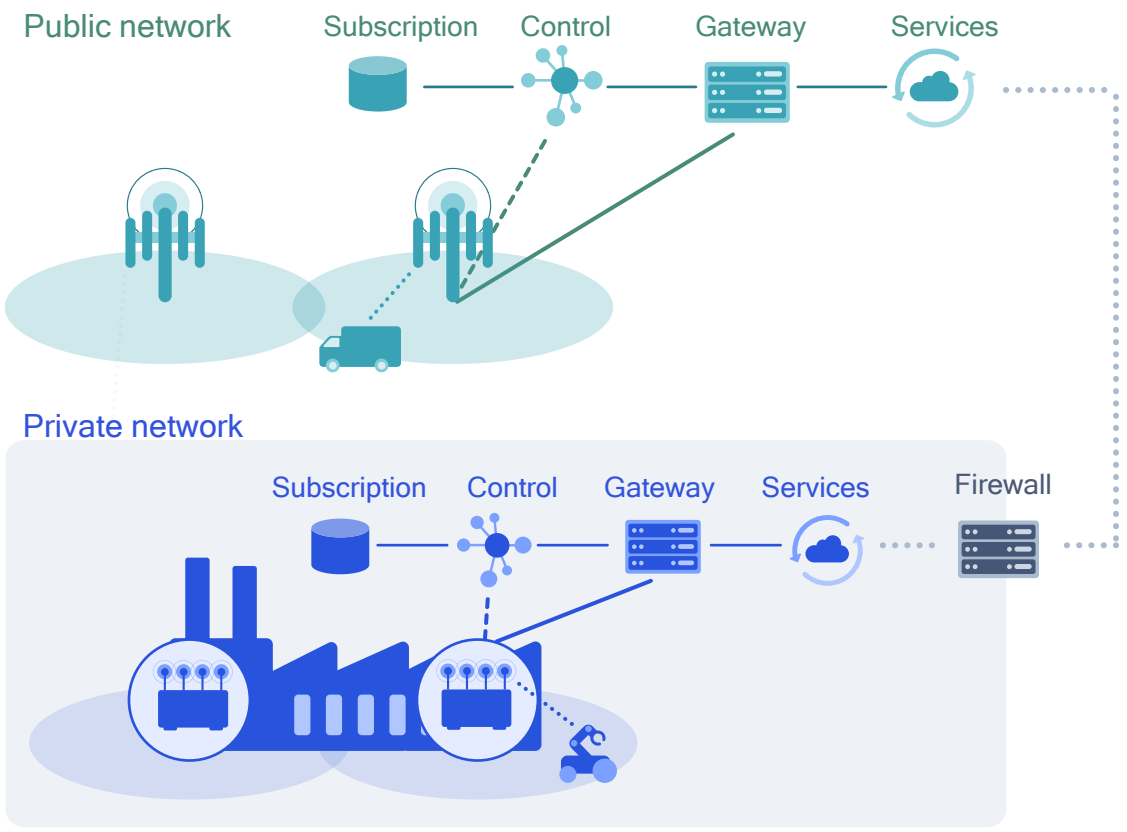
3GPP roadmap with regular releases providing new features

1. Also referred to as non-public network (NPN)

Integrated private network



Independent private network[1]

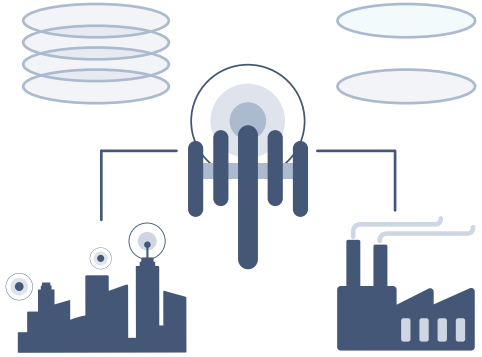


1) Mobility between private and public networks can still be supported via dual subscriptions

Multiple private network architectures for flexible deployments

5G private networks: An opportunity for mobile operators

To deploy, manage, or offer as a service, both in licensed and unlicensed spectrum

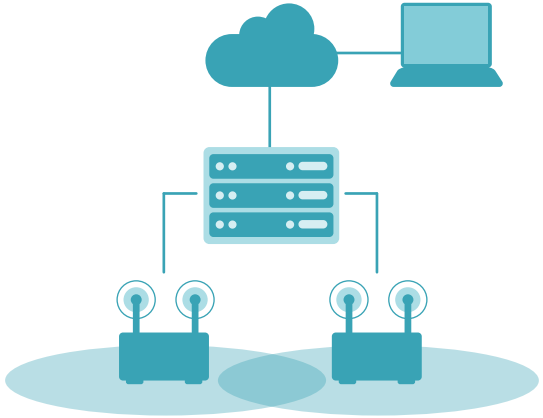


Licensed spectrum assets

Dedicate a portion for private networks

Spectrum may be under-utilized in industrial areas

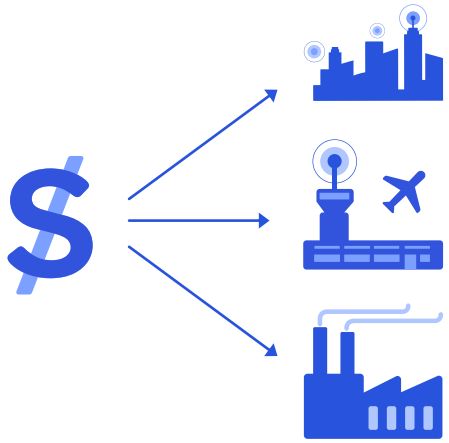
Reuse mmWave spectrum indoors, such as for private enterprise network



Expertise in mobile networks

Relevant expertise in deploying, optimizing, operating mobile networks

Existing ecosystem relationships



Existing sales channels

Already provide services to many industrial and enterprise customers

Multiple business opportunities, from deploy to offer private network as a service

5G + Wi-Fi 6E

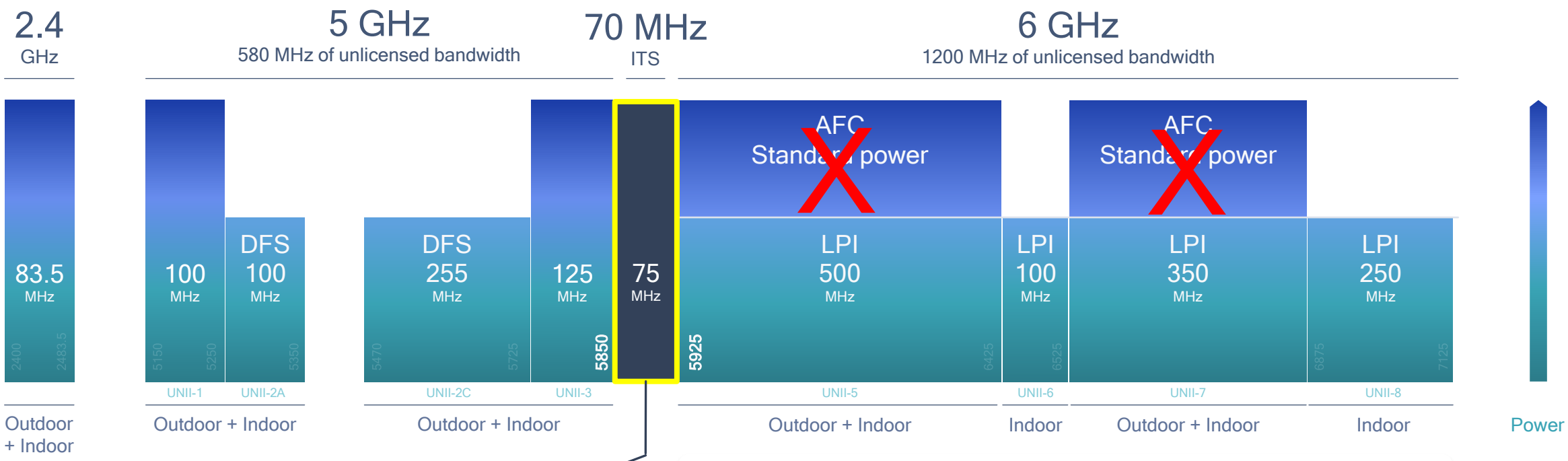
A powerful combination

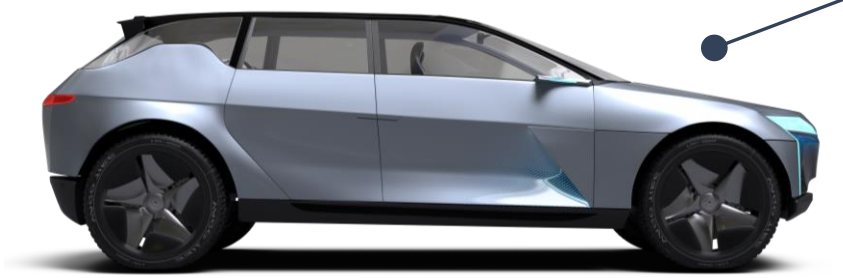
95% 5G CPEs developed with Wi-Fi 6

Qualcomm Snapdragon and Qualcomm Networking Pro 1200 platform are products of Qualcomm Technologies, Inc. and/or its subsidiaries

6 GHz brings new unlicensed bandwidth for Wi-Fi and 5G

Standardized for 5G NR-U in Brazil





ITS: Intelligent Transportation Systems

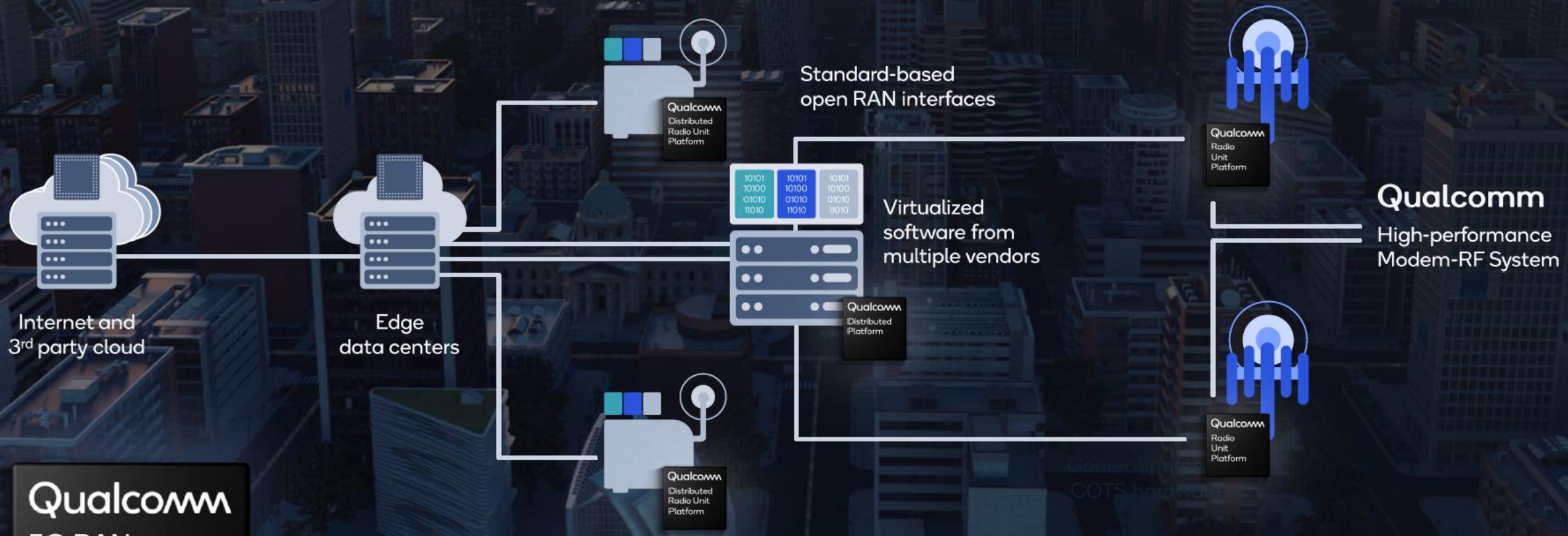
1200 MHz

A massive amount of new unlicensed spectrum is now available in Brazil for Wi-Fi 6E and 5G

AFC= Automated frequency control, DFS= Dynamic Frequency Selection, LPI= Low power indoor

Driving transition to Infrastructure 2.0

Powered by extended portfolio of Qualcomm® 5G RAN platforms



Qualcomm
5G RAN Platforms

High performance Modem-RF

Virtualization with hardware acceleration

Flexible, scalable, O-RAN compatible

From Macro to Small Cells

Integrated Sub-6 and mmWave solution

Delivering on the 5G vision

Where virtually everyone and everything is intelligently connected

Qualcomm

Obrigado!

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