

September 2022

@Seoul

Qualcomm

Connected Intelligent Edge via 5G PN, mmW, C-V2X

Andy Park
Qualcomm Korea

Leading mobile innovation for over 30 years



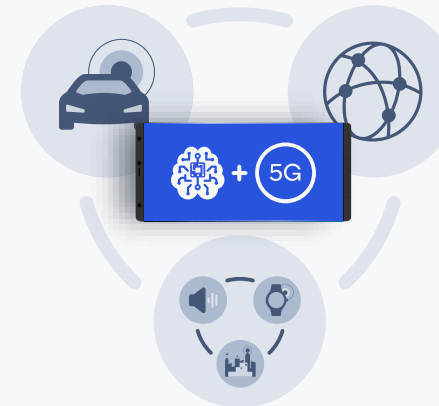
Digitized mobile communications

Analog
to digital



Redefined computing

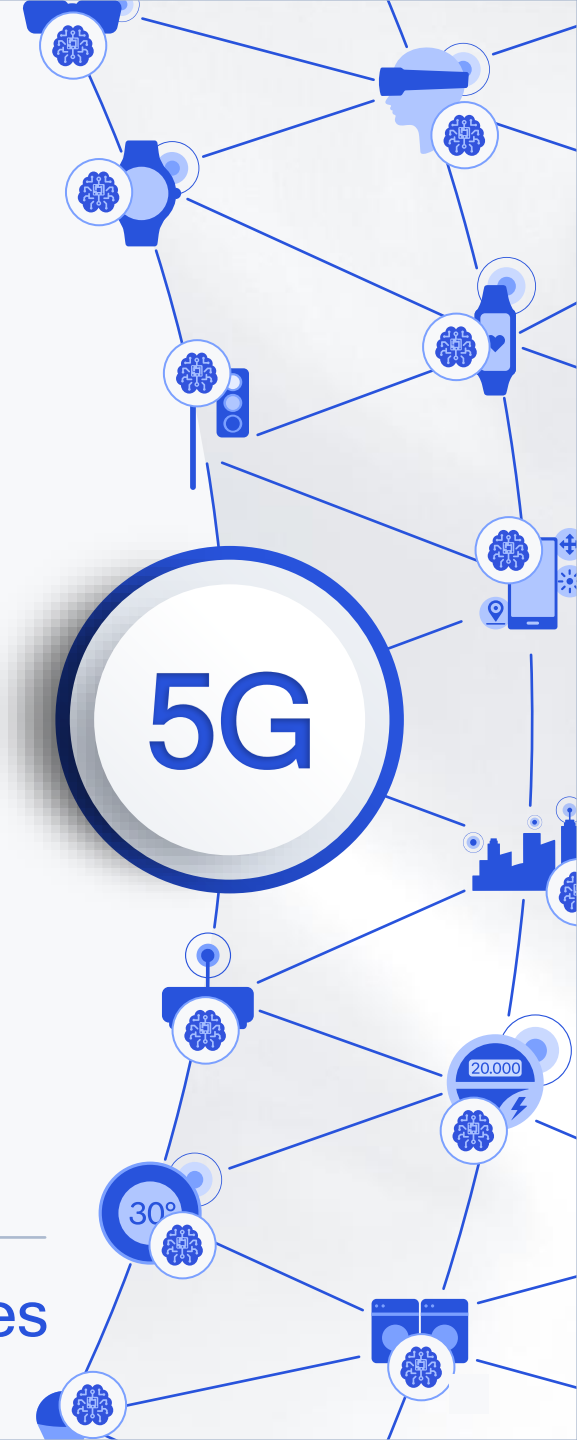
Desktop to
smartphones



Transforming industries

Connecting virtually everything
at the wireless edge

Transforming how the world connects, computes and communicates



5G Accelerating Globally

205+

Operators with
5G commercially
deployed

280+

Additional
operators
investing in 5G

750M+

5G smartphones
to ship in 2022

1B+

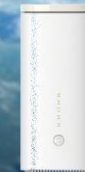
5G connections
by 2023 – 2 years
faster than 4G

5B+

5G smartphones
to ship between
2020 and 2025

1275+

5G designs
launched or in
development



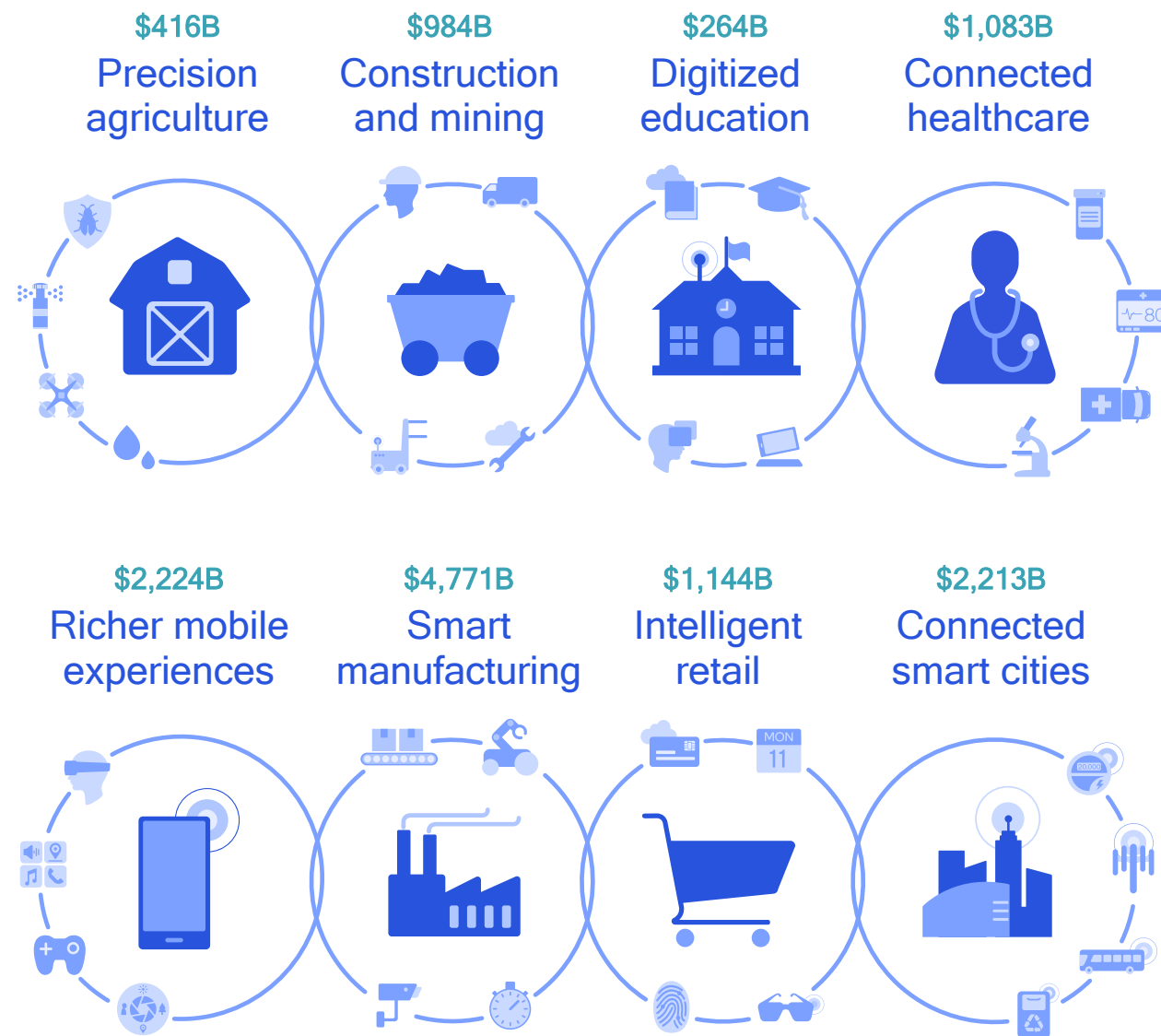


5G will expand the mobile ecosystem to new industries

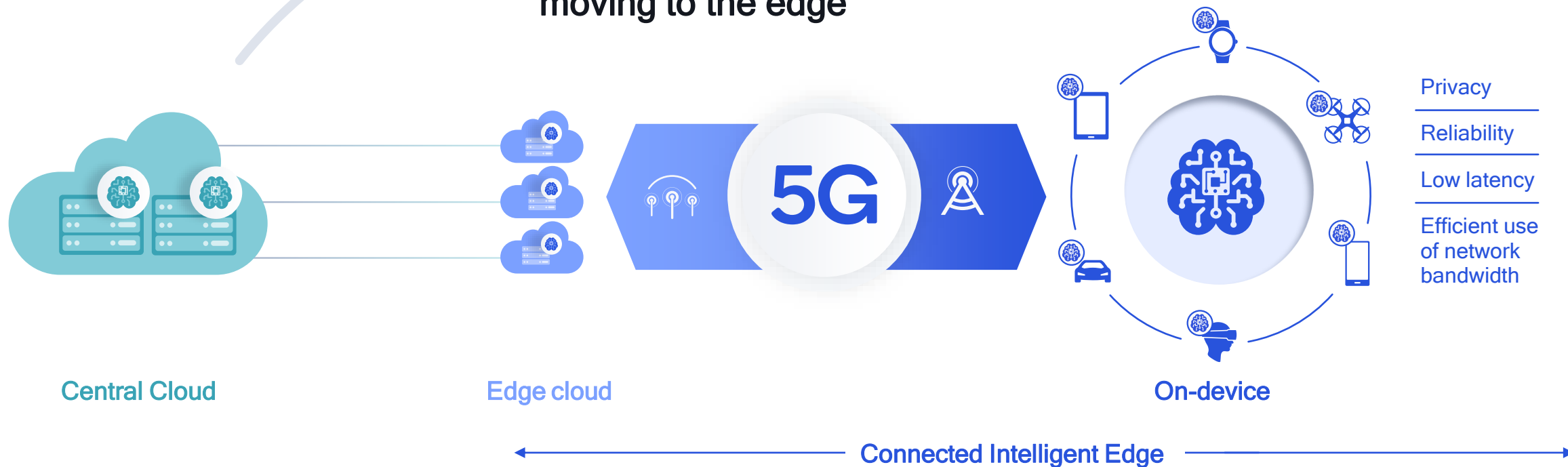
Powering the digital economy

\$13.1
Trillion In global economic value by 2035*

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



To scale, the center of gravity of AI processing is moving to the edge

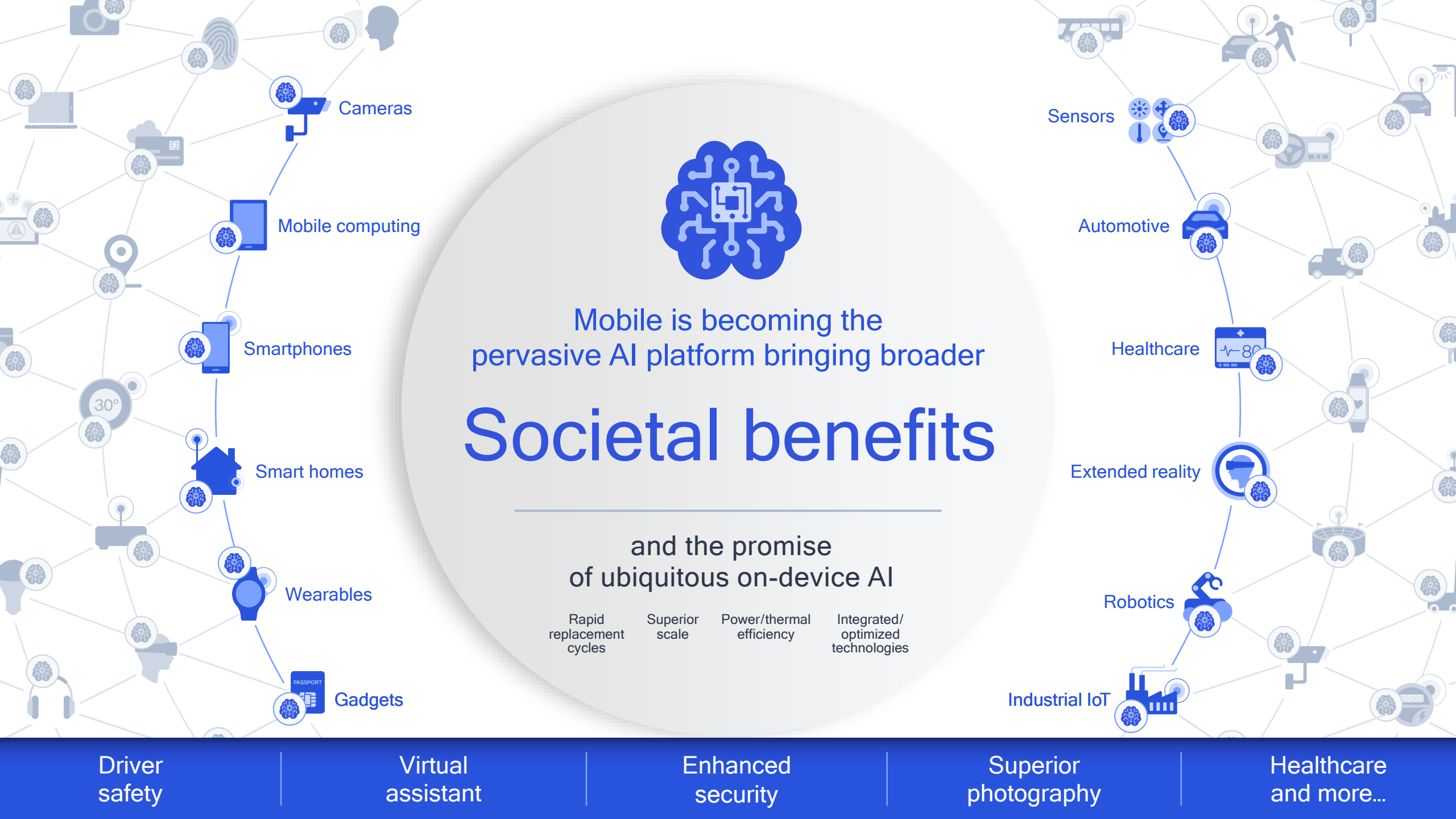


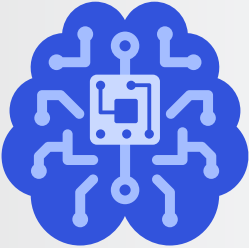
Qualcomm is leading the realization of the Connected Intelligent Edge

Convergence of:

Wireless connectivity
Efficient computing
Distributed AI

Unlocking the data that will fuel our digital future





Mobile is becoming the
pervasive AI platform bringing broader

Societal benefits

and the promise
of ubiquitous on-device AI

Rapid
replacement
cycles

Superior
scale

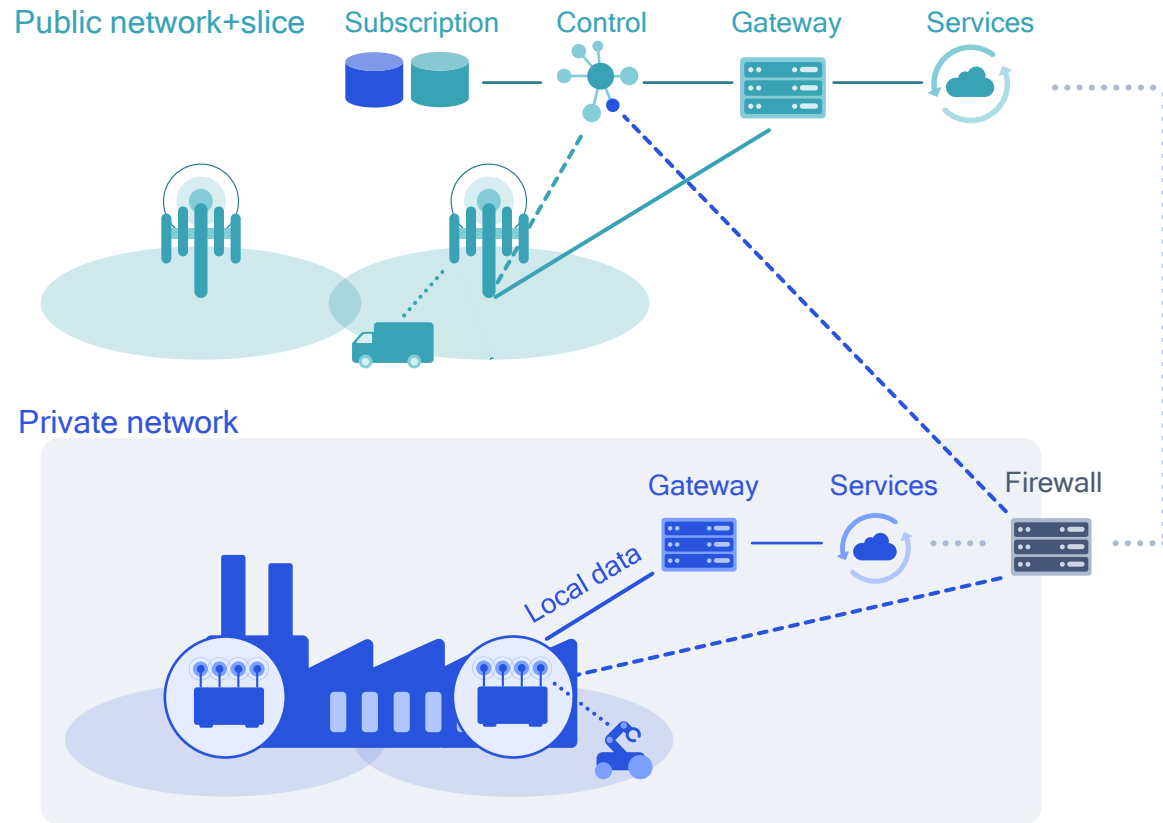
Power/thermal
efficiency

Integrated/
optimized
technologies

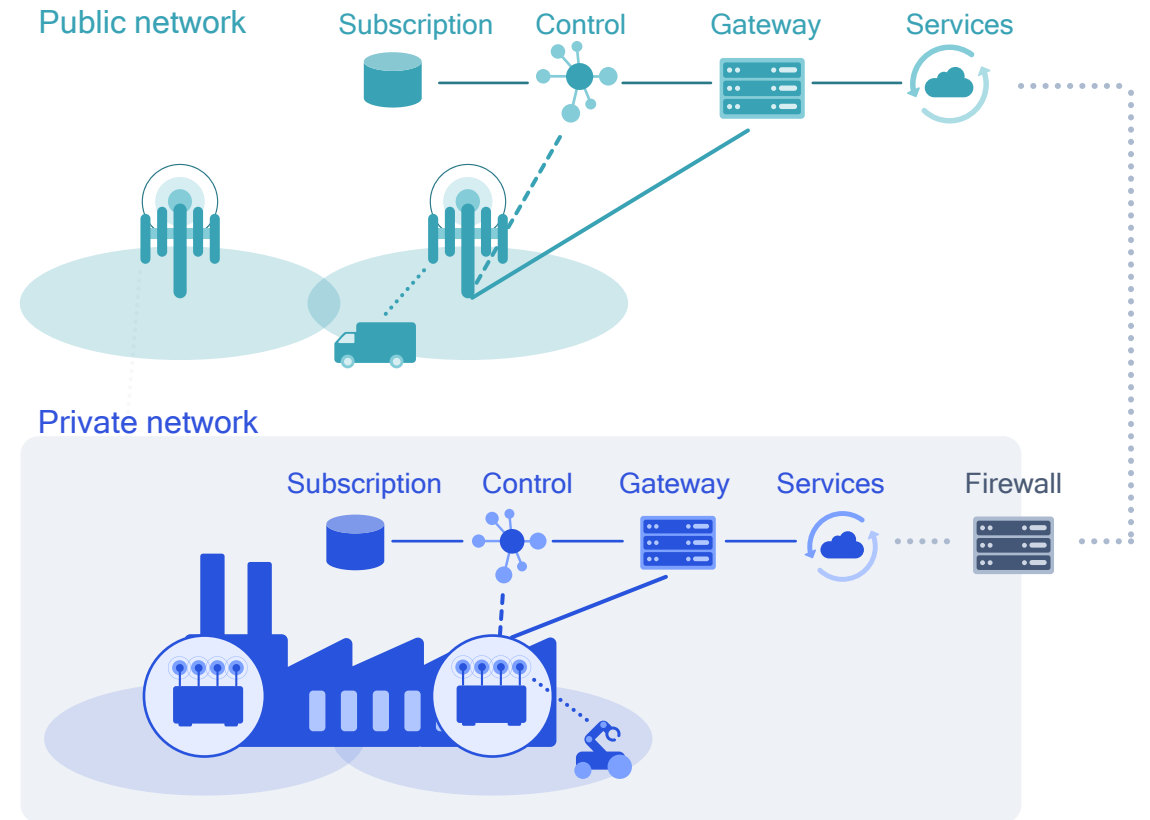


Private Network

Integrated private network



Independent private network¹



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

Multiple private network architectures for flexible deployments

Container ports



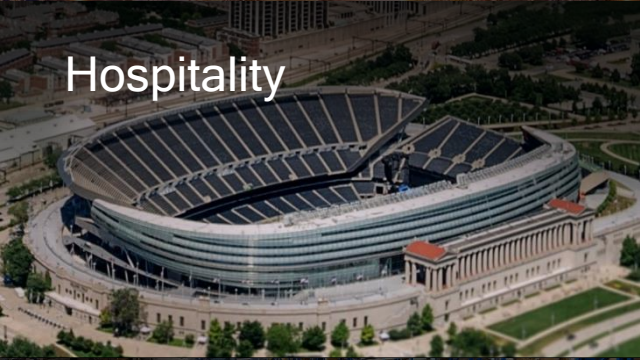
Oil refineries



Manufacturing



Hospitality



Mines



Warehouse



Airports



Hospitals



5G private networks will expand the market

Wide range of industries from manufacturing and seaports to venues and enterprise

>\$3.5B

global private LTE/5G market size by 2026 ¹

18% CAGR

1. Mobile Experts, "Private LTE/5G 2021" (Feb. 2021)

Global snapshot of spectrum optimized for industrial IoT / vertical / private network use – local licensing or sharing

USA



- 3.5 GHz CBRS, exclusive & shared licenses, deployments in 2H19
- 37 - 37.6 GHz shared spectrum/local licenses, under evaluation

Germany



- 3.7 - 3.8 GHz
- 24.25 - 27.5 GHz, local licenses, expected Q4 2020
- Local licenses. Assignment complete; available 2H 2019

U.K.



- 3.8 - 4.2 GHz
- 24.25 - 26.5 GHz, local licenses, applications open since end of 2019
- Local licenses (50 meters square); regulator database; decision formalized; applications invited from end 2019

Sweden



- 3.72 - 3.8 GHz, in consultations

Finland



- Sub-licensing of 3.4 - 3.8 GHz
- Local permission via operator lease; assignment complete

Netherlands



- 3.5 GHz for local industrial use; 3.7 - 3.8 GHz (in consultations); 2.3 - 2.4 GHz (licensed shared access online booking system)
- 3.5 GHz for local industrial use; however, users may need to move to 3.7 - 3.8 GHz, if allocated; 2.3 GHz approved for PMSE

France



- 2.6 GHz, regulator database & approval. Up to 40 MHz approved for Professional Mobile Radio

Czech Republic



- 3.4 - 3.44 GHz for private networks

Brazil



- 3.7 - 3.8 GHz, under consideration
- 27.5 - 27.9 GHz, allocation completed

Chile



- 3.75 - 3.8 GHz, allocation completed at end of 2019

Australia



- 24.25 - 27.5 GHz and 27.5 - 29.5 GHz for local licensing
- 3.7 - 4.0 GHz for local area wireless broadband licensing in 2022

New Zealand



- Licenses in 2575 - 2620 MHz may be assigned for localized use

Malaysia



- 26.5 - 28.1 GHz will be assigned for the deployment of local/private networks

Singapore



- Each operator has acquired 800 MHz of 26/28 GHz spectrum to deploy local networks

Hong Kong



- 24.25 - 28.35 (400 MHz) available for local licenses

Japan



- Phase 1: 2,575 - 2,595 MHz (NSA anchor) and 28.2 - 28.3 GHz; local licenses, legislated in December 2019
- Phase 2: 1888.5 - 1916.6 MHz (NSA anchor), 4.6 - 4.9 GHz (4.6 - 4.8 GHz indoor only, 4.8 - 4.9 GHz outdoor possible) & 28.3 - 29.1 GHz (150 MHz outdoor; total 250 MHz 28.2 - 28.45 MHz); local license. Legislation in 4Q20. Uplink heavy TDD config. using semi-sync allowed in sub-6 & 28 GHz

South Korea



- 28.9 - 29.5 GHz for 5G specialized local applications in 1H21

Taiwan



- 4.8 - 4.9 GHz for 5G local private and enterprise licenses

5G private networks poised for growth

Growing momentum with early commercial deployments

A vibrant, global ecosystem led by 5G-ACIA, ready to scale

Comprehensive support for 5G private networks in 3GPP Rel-16

<https://www.5g-acia.org/>

General Motors, Honeywell

19 Nov. 2020 

Verizon Business deploys 5G Ultra Wideband indoors at General Motors and Honeywell

<https://www.verizon.com/about/news/verizon-5g-ultra-wideband-general-motors-honeywell>

Deutsche Messe

18 Feb. 2021 

Deutsche Telekom to build 'a million square metres' of private 5G at Hanover Fairground

<https://enterpriseiotinsights.com/20210217/channels/news/deutsche-telekom-to-build-private-5g-at-hannover-fair>

Toyota

23 Jun. 2020 

Toyota to assess 5G private network in Japanese manufacturing center

<https://www.lightreading.com/private-networks/toyota-to-assess-5g-private-network-in-japanese-manufacturing-center/d/d-id/761904>

Yangquan Coal Industry

3 Jun. 2020 

China goes deep, with 5G network in coal mine

<http://www.chinadaily.com.cn/a/202006/03/WS5ed78e2da310a8b24115aad1.html>

Ford

25 Jun. 2020 

How Ford and Vodafone are creating the 5G 'factory of the future'

<https://newscentre.vodafone.co.uk/news/how-ford-and-vodafone-are-creating-the-5g-factory-of-the-future/>

Group ADP, Hub One & Air France

10 Jul. 2020 

ADP Group company Hub One, gets 10 year licence to operate 4 & 5G mobile network covering Paris-Charles de Gaulle, Paris-Orly and Paris-Le Bourget airports.

<https://www.air101.co.uk/2020/02/adp-group-company-hub-one-gets-10-year.html>

ASE

18 Aug. 2020 

Chunghwa Telecom, ASE and Qualcomm Jointly Introduce Made-in-Taiwan Small Cell Base Stations for the First 5G mmWave Smart Factory in Taiwan

https://ase.aseglobal.com/en/press_room/content/5g_smart_factory_en

5G-Alliance for Connected Industries and Automation (5G-ACIA)

Ensure the best possible applicability of 5G technology for connected industries, in particular the manufacturing and process industries

Manufacturing and
process operators

Technology
providers

Network
operators

Spectrum
advocacy

Collaboration with
global industry bodies

Enhanced mobile broadband

Computer Vision

Security camera
Latency: 50ms
Availability: 99.9%
Rate: Mbps



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



Automated guided vehicle (AGV)

Co-operative driving
Latency: 20ms
Availability: 99.9999%
Rate: Mbps



5G

Ultra reliable low latency



Industrial robot

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



Sensors

Process Monitoring
Latency: 100 ms
Availability: 99.99%
Rate: kbps

Wireless edge analytics





mmWave



Global mobile data traffic
is expected to grow by
665% from 2019 to 2026

~226B Gigabytes

Monthly global mobile data traffic in 2026



In 2026, video traffic will account for
~77% of overall mobile data traffic



In 2026, 54% of mobile data traffic will be
carried by 5G networks – over 2x more
than 4G/3G/2G traffic today

New frontier of mobile broadband – mobilizing mmWave for vast bandwidth



Multi-Gbps data rates

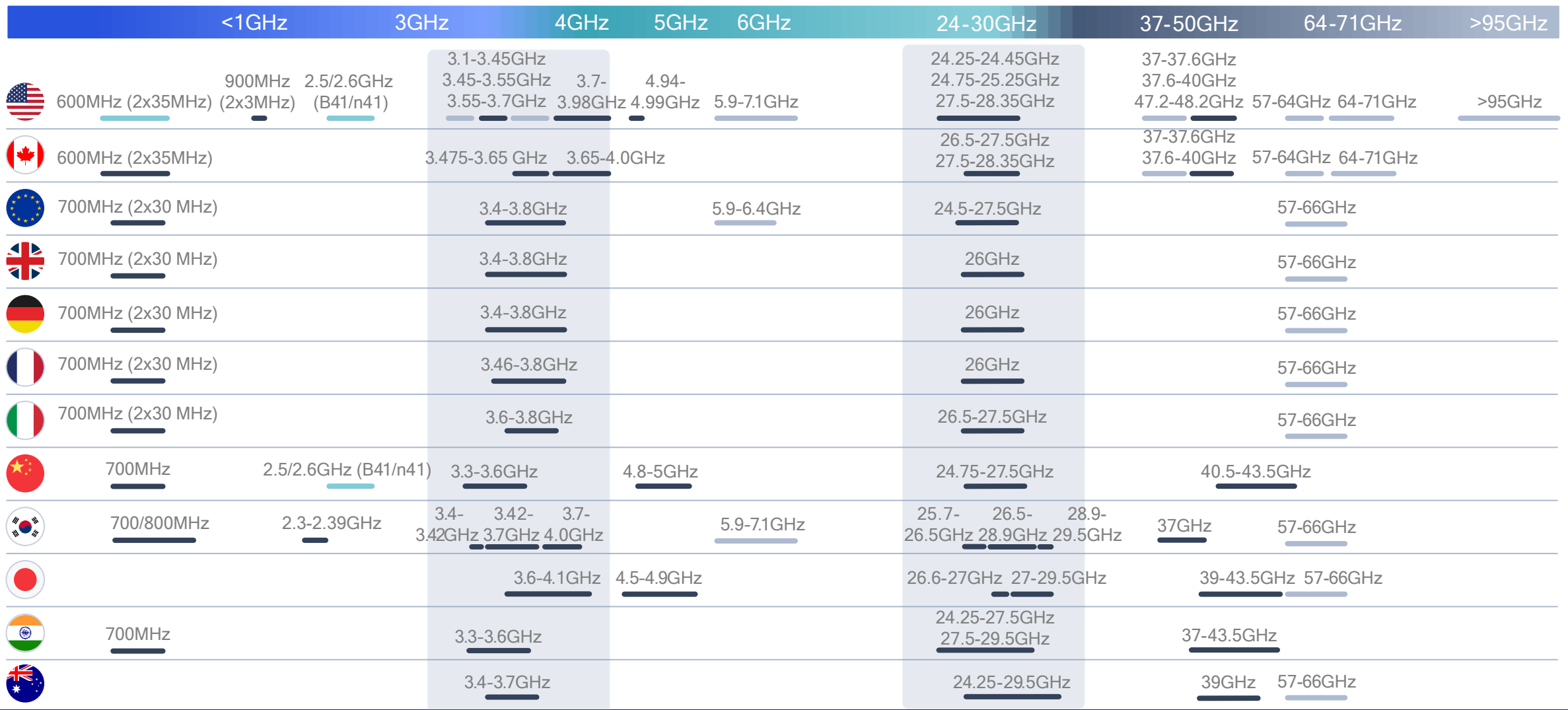
With large bandwidths (100s of MHz)

Much more capacity

With dense spatial reuse

Lower latency

Bringing new opportunities



Global snapshot of allocated/targeted 5G spectrum

5G is being designed for diverse spectrum types/bands

New 5G band

