Qualcomm

Aug. 4th 2022

Leading 5G Advanced technology innovations into the 6G era

根本 健二
Qualcomm CDMA Technologies
マーケティング・ビジネス開発 本部長

本日の内容

- クアルコムの会社紹介
- クアルコムの6Gに向けての5G Advanced
- クアルコムはTechnology Enabler
- クアルコムとのパートナーシップ

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- クアルコムの会社紹介
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- クアルコムとのパートナーシップ

会社概要

クアルコムは半導体を設計・開発する（ファブレス）会社です。

※ファブレスとは、自社工場を持たないメーカーや製造業の業態のことを言います。fab（fabrication）がないのでファブレス（fabless）という言葉が使われています。

クアルコム

- 社員数：44,574名
  ※ 2022年4月時点
- 所在地：5775 Morehouse Drive
  San Diego, CA 92121 USA
- 売上高：335億ドル＝約3兆7千億円
  ※2021年度（2021年9月期）実績
- 2021年において925百万台のスマホ向け半導体チップを出荷
  ※2021年度（2021年9月期）実績

クアルコムジャパン

- 社員数：176名
  ※ 2022年4月時点
- 所在地
  - 東京：東京都港区南青山1丁目1-1 新青山ビル西館18F
  - 名古屋：愛知県名古屋市中村区平池町4-60-12 グローバルゲート 11F
  - 大阪：大阪府大阪市北区梅田2-6-20 パシフィックマークス西梅田 11F

国内事務所

【Nagoya office】
HW/TAM: 1
SW: 1
Total: 2

【Tokyo office】
TAM/HW: 16
SW: 64+7
Total: 80+7

Tokyo
Nagoya
Osaka

【Osaka office】
HW/TAM: 2
SW: 8
Total: 10

2020年の半導体売上高ランキング

Qualcomm

世界半導体メーカー別売り上げランキング トップ10【確定値】(単位:百万米ドル)

2020年順位	2019年順位	メーカー名	2020年売上高	2020年市場シェア	2019年売上高	成長率(2019年比)
1	1	Intel	72,759	15.6%	67,754	7.4%
2	2	Samsung Electronics	57,729	12.4%	52,389	10.2%
3	3	SK hynix	25,854	5.5%	22,297	16.0%
4	4	Micron Technology	22,037	4.7%	20,254	8.8%
5	6	Qualcomm	17,632	3.8%	13,613	29.5%
6	5	Broadcom	15,754	3.4%	15,322	2.8%
7	7	Texas Instruments	13,619	2.9%	13,364	1.9%
8	13	MediaTek	10,988	2.4%	7,958	38.1%
9	16	NVIDIA	10,643	2.3%	7,331	45.2%
10	14	キオクシア	10,374	2.2%	7,827	32.5%
—	—	その他	208,848	44.8%	194,228	7.5%
合計			**466,237**	**100.0%**	**422,337**	**10.4%**

出典:Gartner(2021年4月)

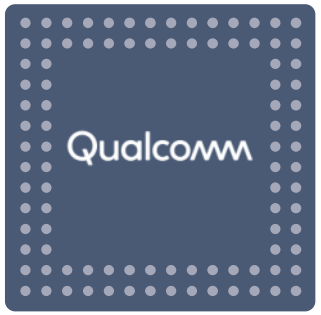
20年のファブレス売上高ランキング

順位	社名(国)	売上高(百万ドル)	前年比伸び率%
1	クアルコム(米)	19,407	33.7
2	ブロードコム(米)	17,745	2.9
3	エヌビディア(米)	15,412	52.2
4	メディアテック(台)	10,929	37.3
5	AMD(米)	9,763	45.0
6	ザイリンクス(米)	3,053	△ 5.6
7	マーベル(米)	2,942	8.7
8	ノバテック(台)	2,712	30.1
9	リアルテック(台)	2,635	34.1
10	ダイアログ(英)	1,376	△ 3.2
10社 計		85,974	26.4

(出所:トレンドフォース)

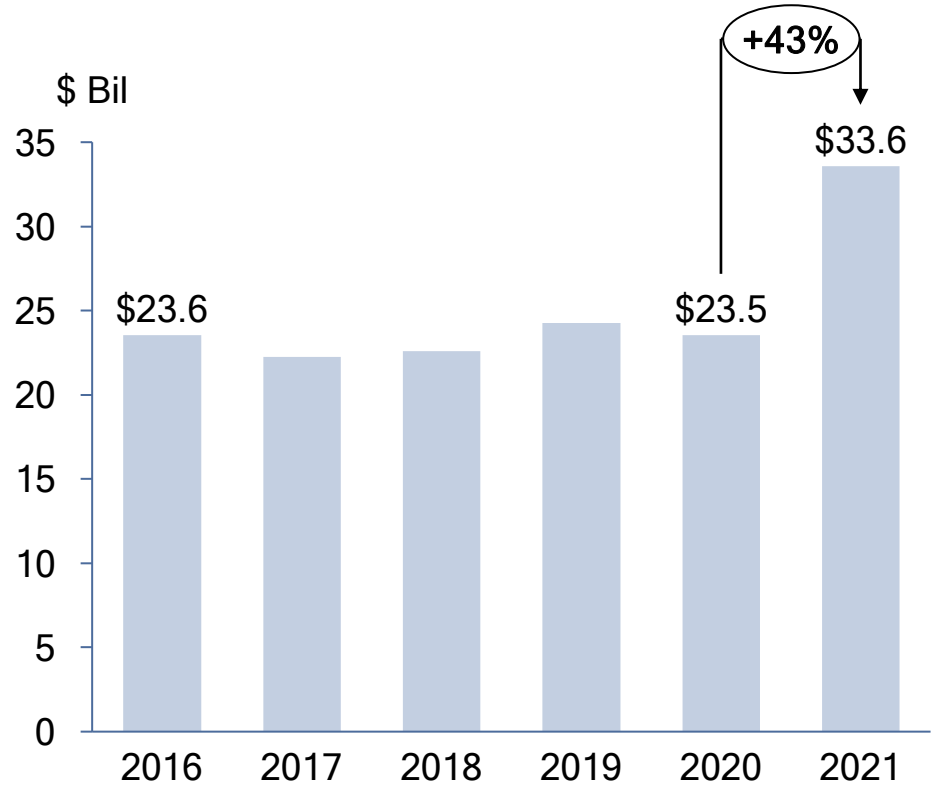
クアルコムのビジネスモデル

- 研究開発が事業のベース
- 研究開発の成果を業界へ幅広く提供
  - ➢ ライセンス
  - ➢ 半導体
  - ➢ ソフトウェア・アプリケーションなど
- 自社では最終製品を提供しない
- 継続的に研究開発に再投資

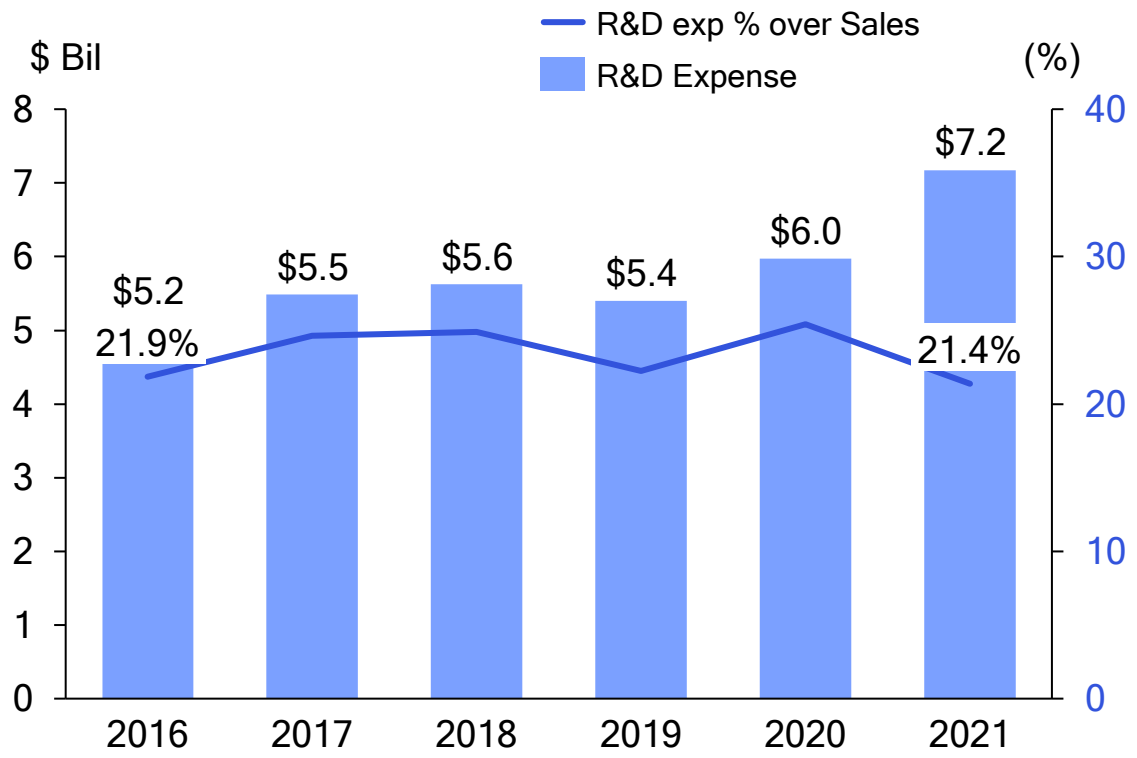


クアルコムの売上高と研究開発費

- 売上高の推移
  ✓2021年度は5G市場のけん引に伴い大きく成長



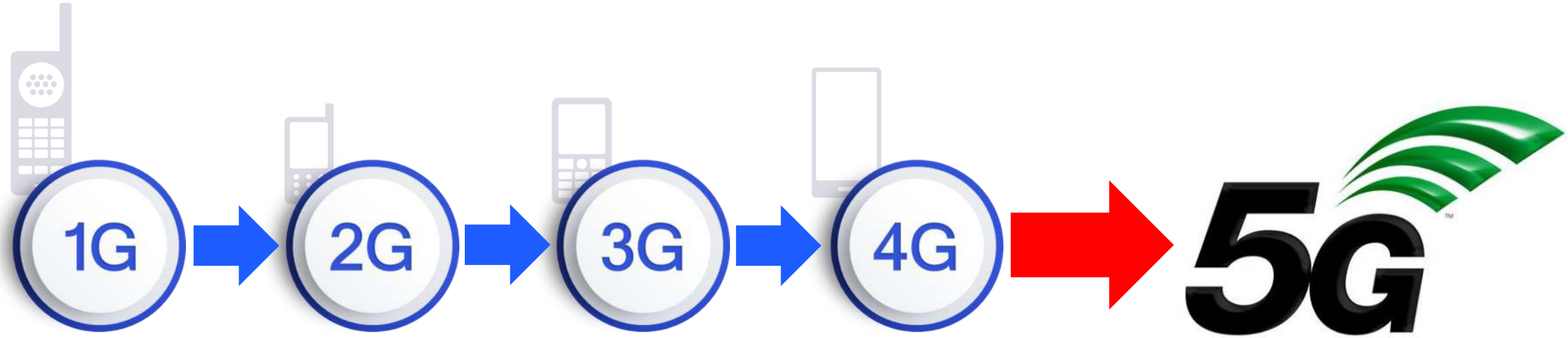
- 研究開発費の推移
  ◦ 研究開発費は売上対比20%以上をキープ



Source sample text

“G”の進化をリード

- クアルコムは先進的な研究開発によりGenerationの進化をリード



1980年代
アナログ音声
AMPS, NMT, TACS

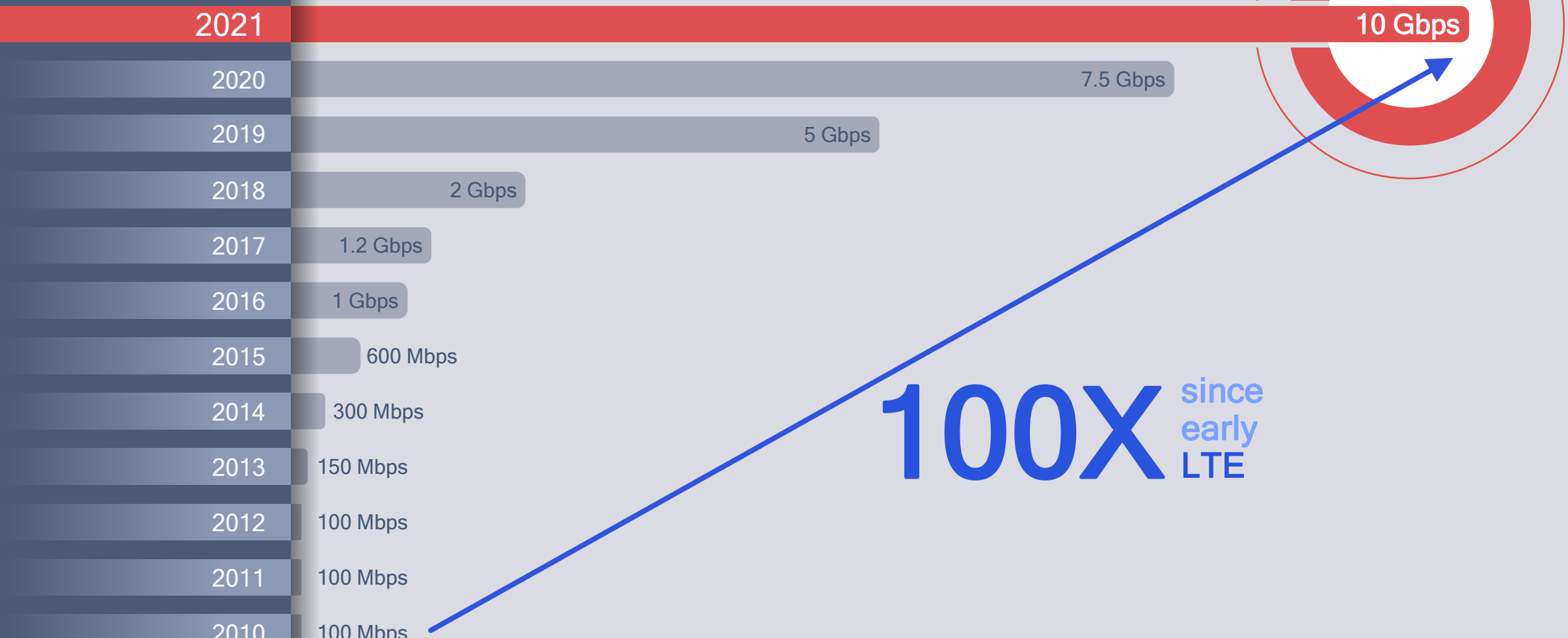
1990年代
デジタル音声
D-AMPS, GSM,
IS-95 (CDMA)

2000年代
モバイルデータ
WCDMA/HSPA+,
CDMA2000/EV-DO

2010年代
モバイルブロードバンド
LTE, LTE Advanced, Gigabit LTE

Qualcomm snapdragon

X65 5G modem-RF



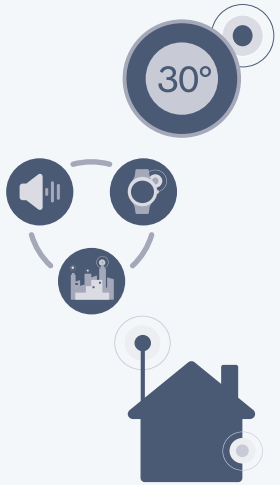
100X since early LTE

クアルコムにおけるBusiness Unit

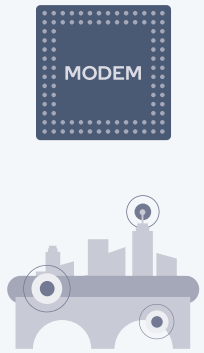
Mobile, Compute & XR (MCX)

RF Front end

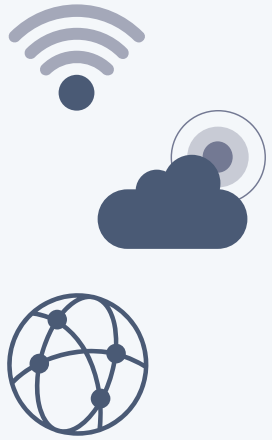
Connected Smart Systems (CSS)



Cellular Modems & Infrastructure (CMI)



Connectivity, Cloud & Networking (CCN)



Automotive

Licensing

モバイル以外にも、Compute & XR, RF Front end, Connected Smart Systems, Cellular Modems & Infrastructure, Connectivity, Cloud & Networking, Automotive等のBusiness Unitと、QTL(ライセンス部門)を有する

クアルコムにおけるBusiness Unit

Consumer

Compute

XR

Wearables

Consumer electronics

Edge Networking

5G wireless fiber

Wi-Fi access points

vRAN infrastructure

Industrial

Retail

Smart cities

Energy

Manufacturing

モバイル以外の領域においても、製品展開を急速に拡充

クアルコムにおけるBusiness Unit

オートモーティブ領域は、戦略エリアとして位置付け

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Leading wireless innovation for more than 35 years

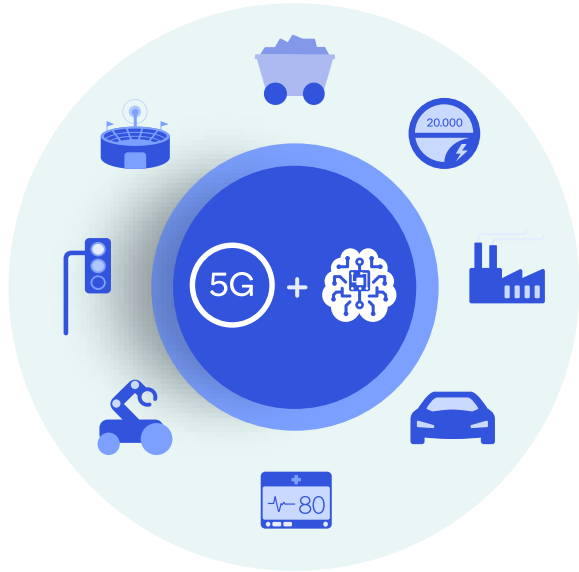
Digitized mobile communications

Analog to digital

Redefined computing

Desktop to smartphones

Transforming industries



Connecting virtually everything

5G Accelerating Globally

210+
Operators with 5G commercially deployed

275+
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

1,330+
5G designs launched or in development

Sources – 5G commercial networks, operators investing in 5G: GSA, May '22. 5G device shipment projections: Qualcomm estimates, Feb '22. 2023 5G connection projections: average of ABI (Sep '21), Ericsson (Jun '21) and GSMA Intelligence (Sep '21). 5G cumulative smartphone shipments: average of CCS Insight (Sept '21), Counterpoint Research (Dec '21), IDC (Nov '21), Strategy Analytics (Oct '21); Launched / announced devices: GSA, May '22.

Transportation

Manufacturing

Industrial

Retail

Energy

Driving digital transformation across industries

5G will enable $13.1 Trillion in global sales activity in 2035

Agriculture

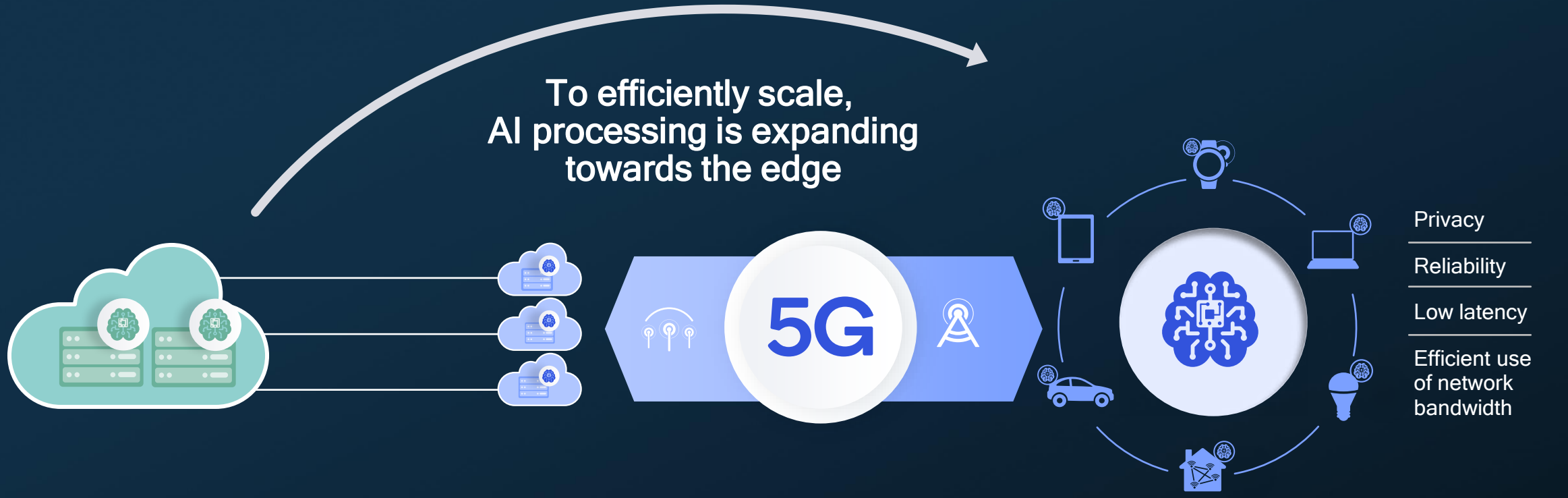
Public safety

Smart cities

Healthcare

Entertainment

Source: The 5G Economy, an independent study from IHS Markit, commissioned by Qualcomm Technologies, Inc., November 2020



Qualcomm is leading the realization of the Connected Intelligent Edge

Convergence of:

Wireless connectivity

Efficient computing

Distributed AI

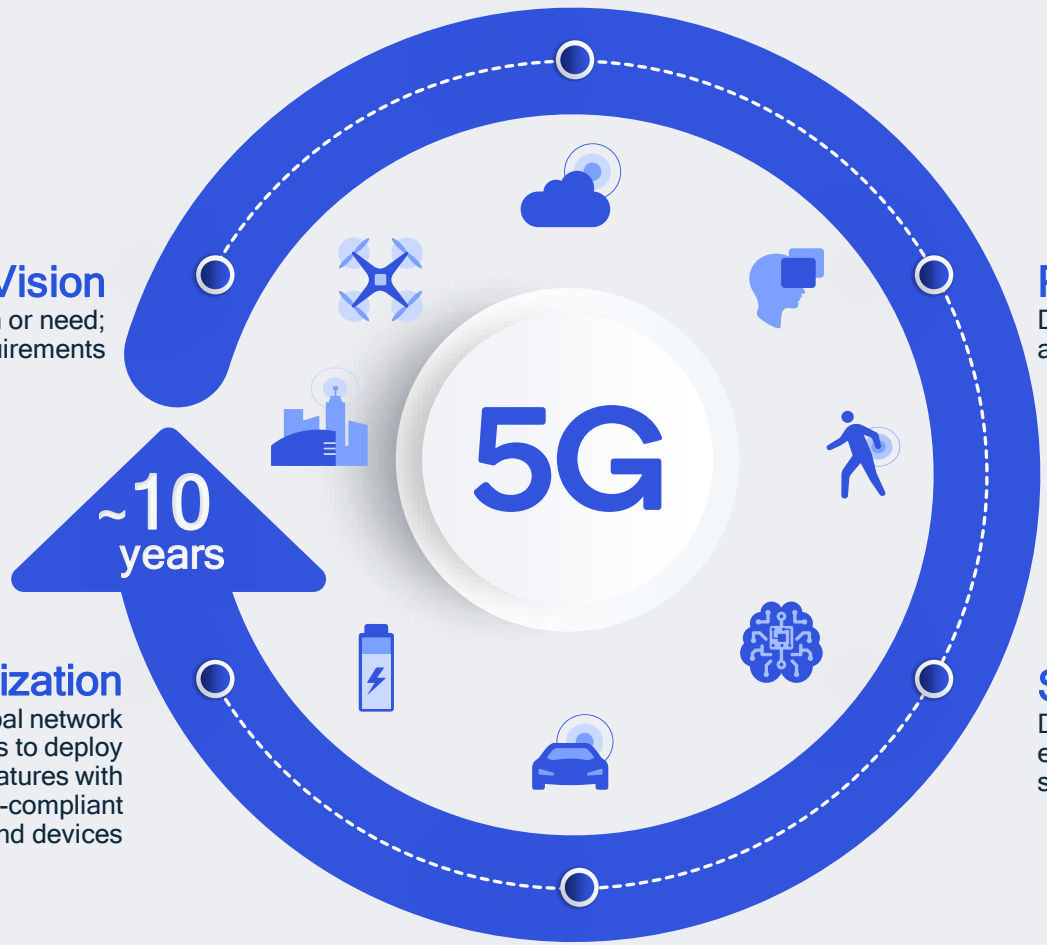
Unleashing massive amount of data to fuel our digital future

Bringing greater capabilities to the intelligent edge

- Connectivity
- Processing
- Sensing
- Intelligence

Foundation to 5G leadership is technology leadership

Early R&D and technology inventions essential to leading ecosystem forward



Invention
Invent new technologies and e2e system architecture

Proof-of-concept
Deliver end-to-end prototypes and impactful demonstrations

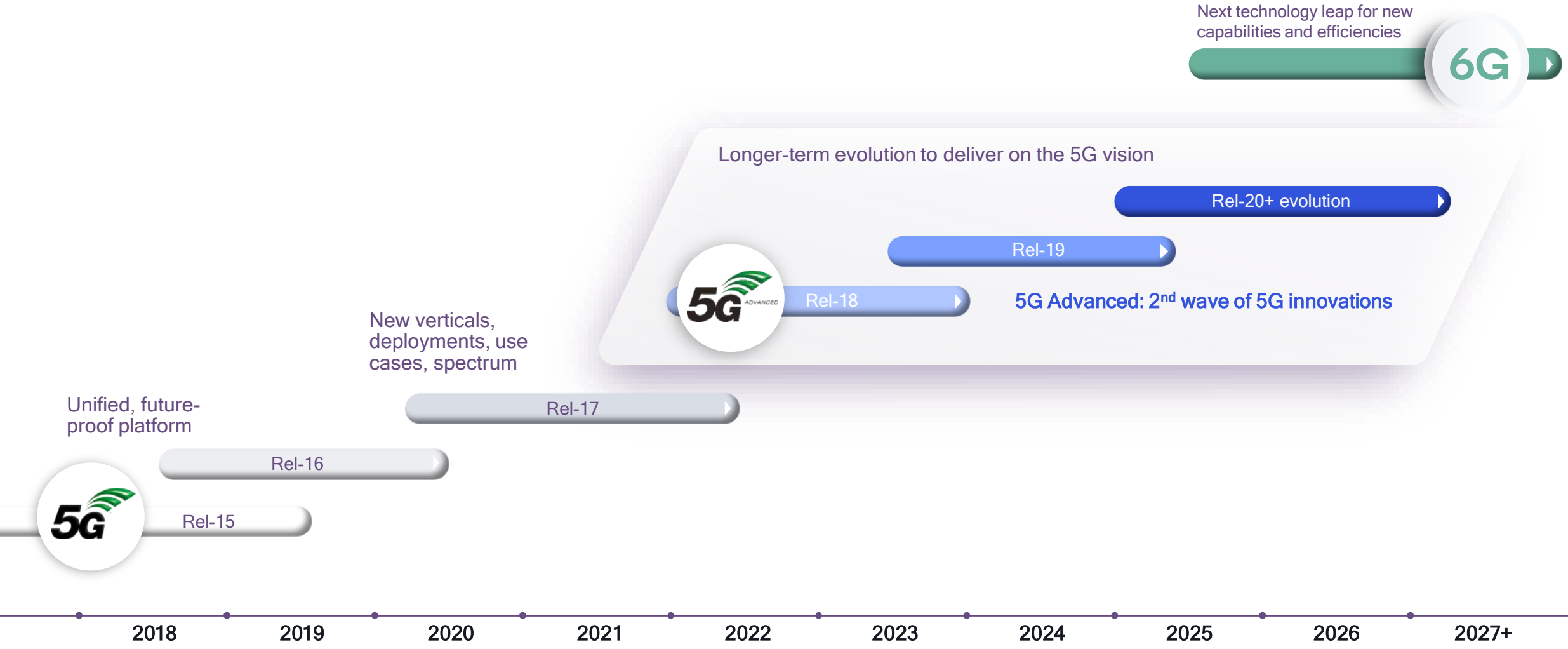
Standardization
Drive e2e design with ecosystem and through standards process

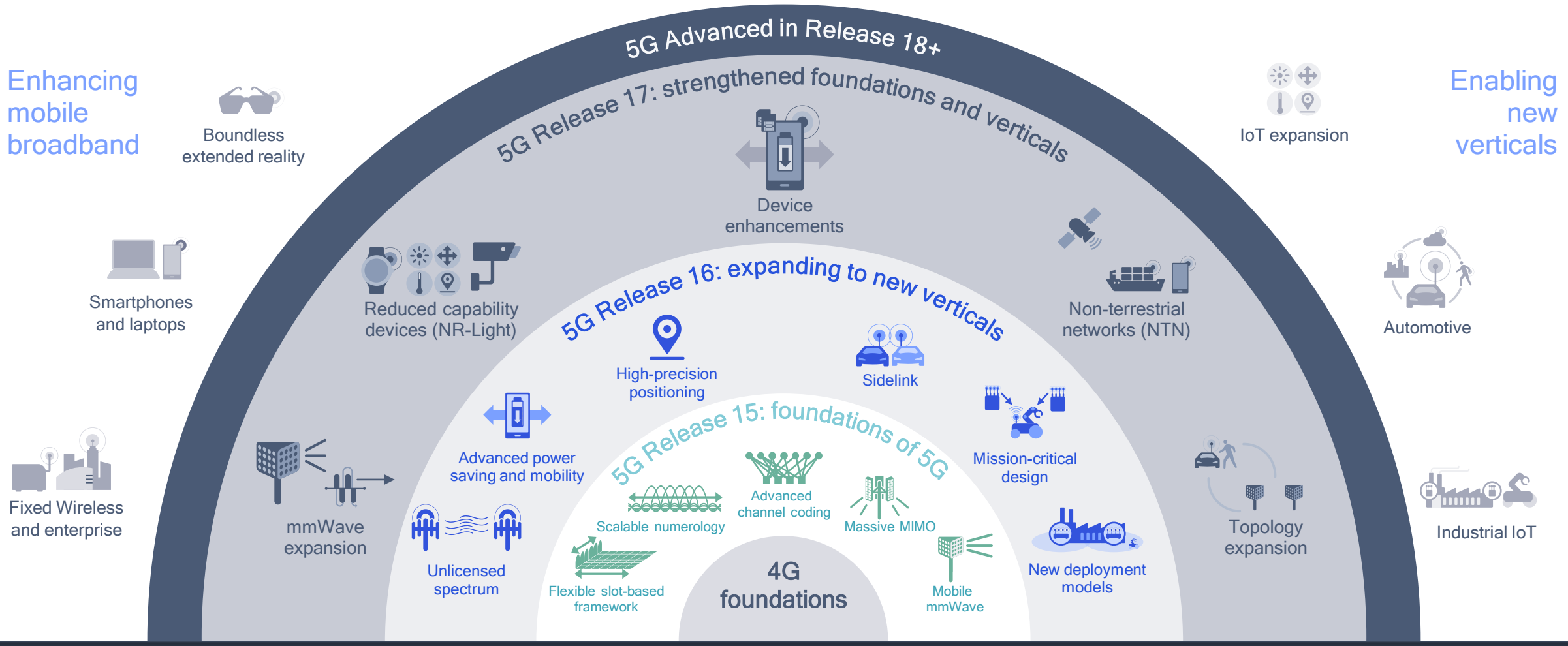
Trials
Collaborate on OTA field trials that track 3GPP standardization and drive ecosystem towards rapid commercialization

Commercialization
Engage with global network operators to deploy new features with standards-compliant infrastructure and devices

Vision
Identify a problem or need; establish requirements

Driving 5G Advanced for a full decade of 5G technology evolution



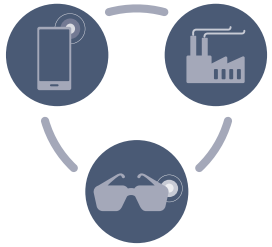


Our innovations expand the foundation of 5G

Foundational Qualcomm innovations lead 3GPP Releases 15,16 and 17

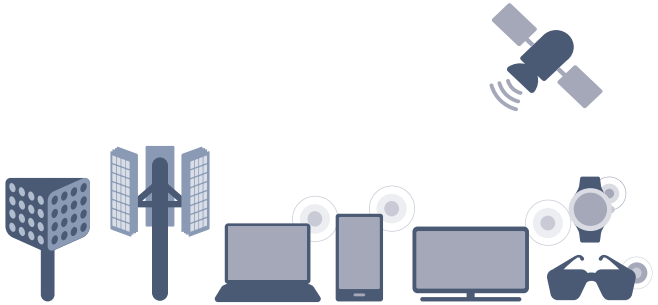
Driving a balanced 5G Advanced evolution across key technology areas

Mobile broadband evolution and further vertical expansion



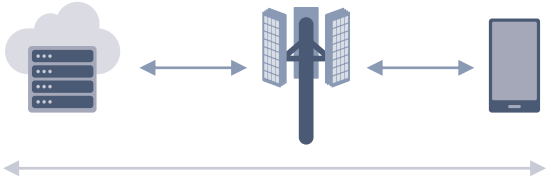
Deliver enhanced mobile broadband experiences and extend 5G's reach into new use cases

Immediate commercial needs and longer-term 5G vision



Drive new value in commercialization efforts and fully realize 5G's potential with future deployments

New and enhanced devices and network evolution



Focus on the end-to-end technology evolution of the 5G system to bring new levels of performance

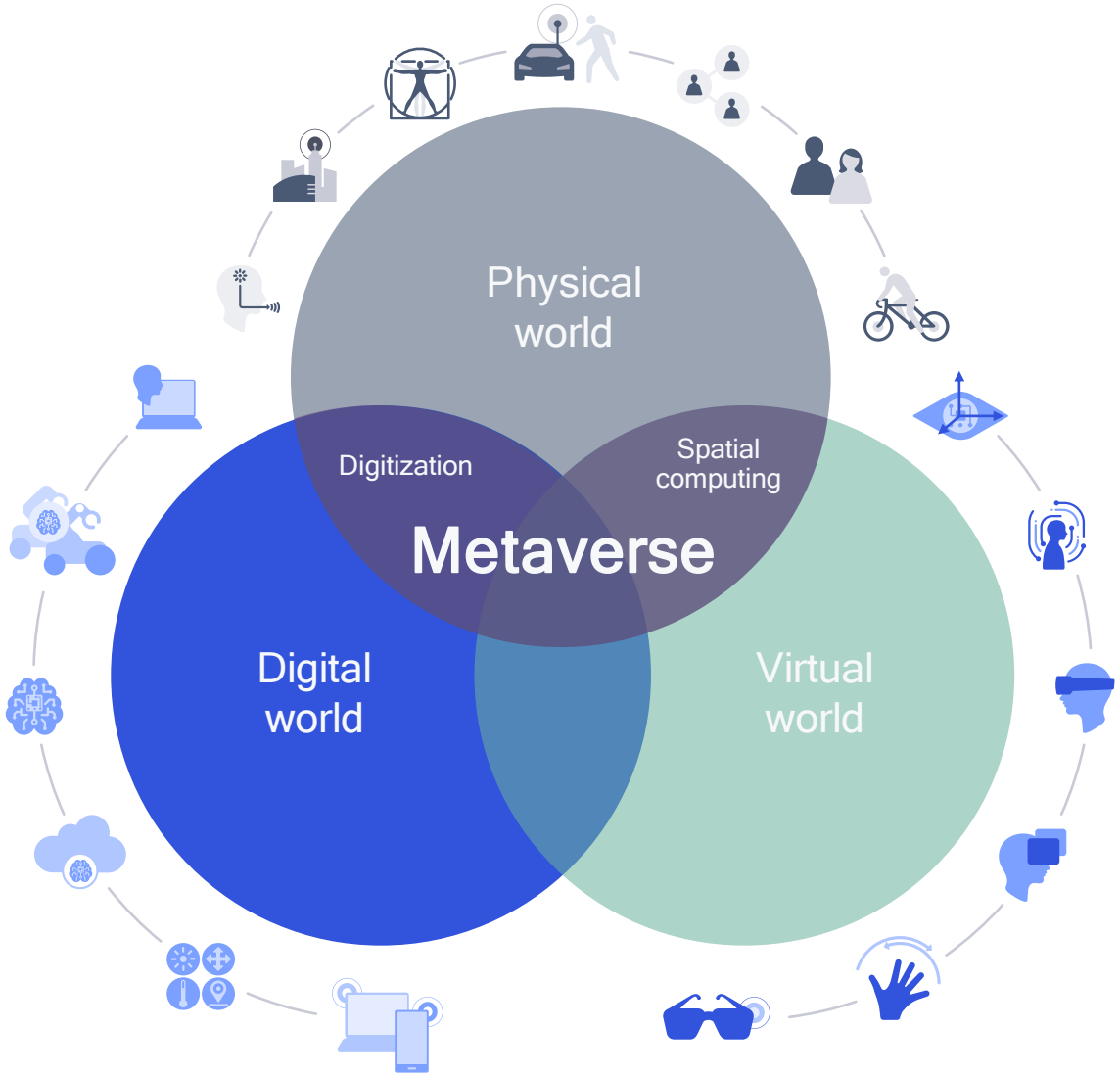
Release 18 starts the 5G Advanced evolution and it prepares for new and enhanced features coming in subsequent releases

New interface opportunities through

Merging worlds

The

New human interface



Ubiquitous, low-power sensing and monitoring with near real-time actions

Immersive interactions take human augmentation to the next level

Building the wireless system of the next decade and beyond

Driving the continued evolution of wireless and adjacent technologies

Advanced RF
Even higher bands, faster switching, improved PA efficiency

Extreme RAN disaggregation
Horizontal and vertical ecosystems, richer mix of new vendors

Silicon / material technology
Faster and more efficient baseband processing, meta-surfaces

Power management
More efficient battery charging, energy storage, energy harvesting

Compute topology
Virtualization, containerization for end-to-end system in cloud, edge, device

Machine learning / AI
Distributed / federated learning, network automation and optimization

Human interface
More immersive experiences (e.g., XR evolution), biological implants

Multimedia and display
Higher resolution, richer color, lower latency, 3D holography

6G

Fueling next-gen devices and use-cases

- Extreme evolution of XR experiences
- Increasing role of smarter verticals
- Future markets and services not yet fully known today

6G

Design goals and performance vectors

Capacity	Latency	Spectral efficiency	Connection density	User experience	Ease of onboarding
Data rate	Reliability	Mobility		Intelligence	Positioning capability
Coverage	Security	Energy efficiency	Cost efficiency	Scalability	And others…

Key research vectors enabling the path towards 6G

AI/ML powered E2E communications

Data-driven communication and network design, with joint training, model sharing and distributed inference across networks and devices

Spectrum expansion & sharing

Expanding to THz, wide-area expansion to higher bands, new spectrum sharing paradigm, dynamic coordination with environmental awareness

New radio designs

Evolution of duplexing schemes, Giga-MIMO, mmWave evolution, reconfigurable intelligent surfaces, non-terrestrial communications, waveform/coding for MHz to THz, system energy efficiency

Merging of worlds

Physical, digital, virtual, immersive interactions taking human augmentation to next level via ubiquitous, low-power joint communication and sensing

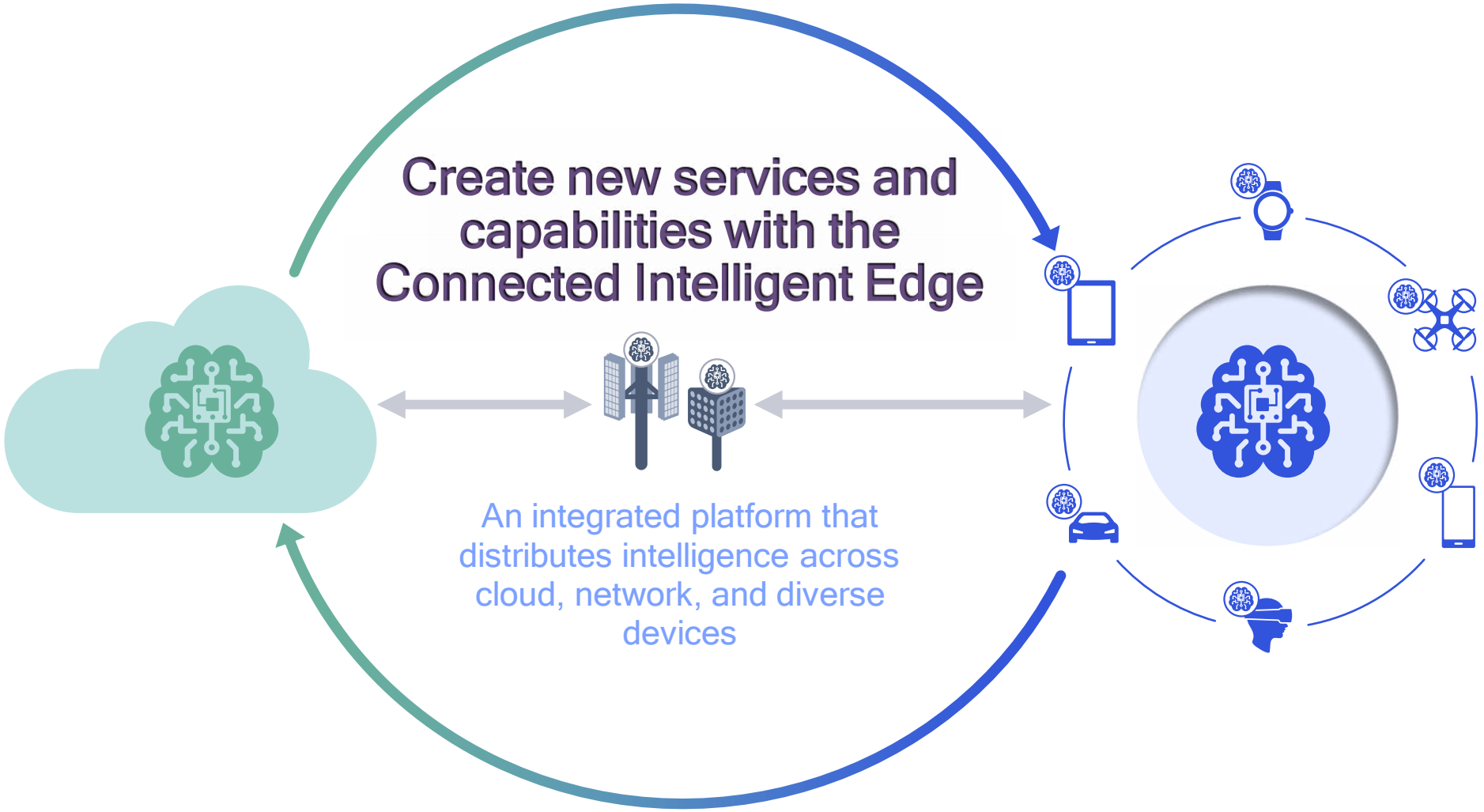
Scalable network architecture

Disaggregation and virtualization at the Connected Intelligent Edge, use of advanced topologies to address growing demand

Communications resiliency

Multifaceted trust and configurable security, post quantum security, robust networks tolerant to failures and attacks

Create new services and capabilities with the Connected Intelligent Edge



An integrated platform that distributes intelligence across cloud, network, and diverse devices

Connectivity
Transporting data across network, also enabling new types of services (e.g., positioning)

Compute
Hosting network functions across services, core and radio access network in a single cloud platform

Analytics
Enabling data analytics through sensing, including model collection and management across functions

Security
Providing data provenance (identity, attestation) and governance (security, privacy, consent)

New applications and technology convergence into cloud connected devices (e.g., smartphone, IoT)

+

Similar convergence is happening at the edge and infrastructure (e.g., network, RSU)

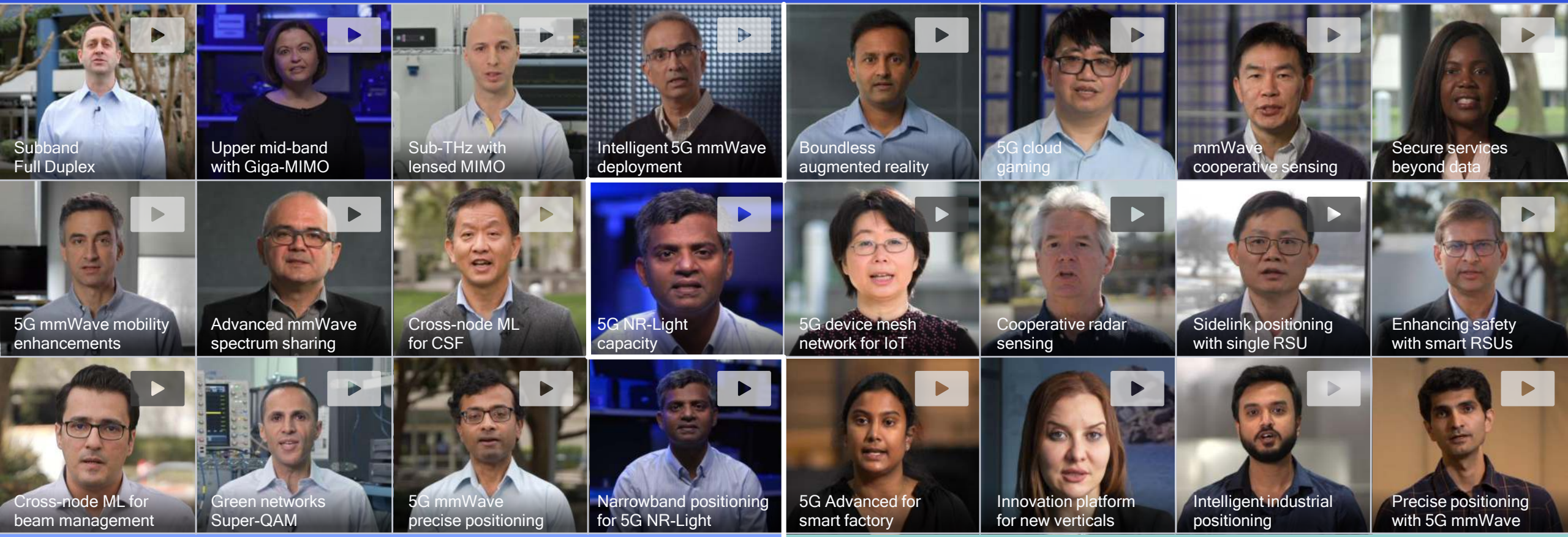
→

Emergence of new services and capabilities at the Connected Intelligent Edge

Qualcomm

Driving the 5G evolution with our advanced R&D demonstrations

Watch all on YouTube



Foundational Air Interface Innovations

Expansion to New Applications

Driving the 5G Advanced technology evolution into 6G

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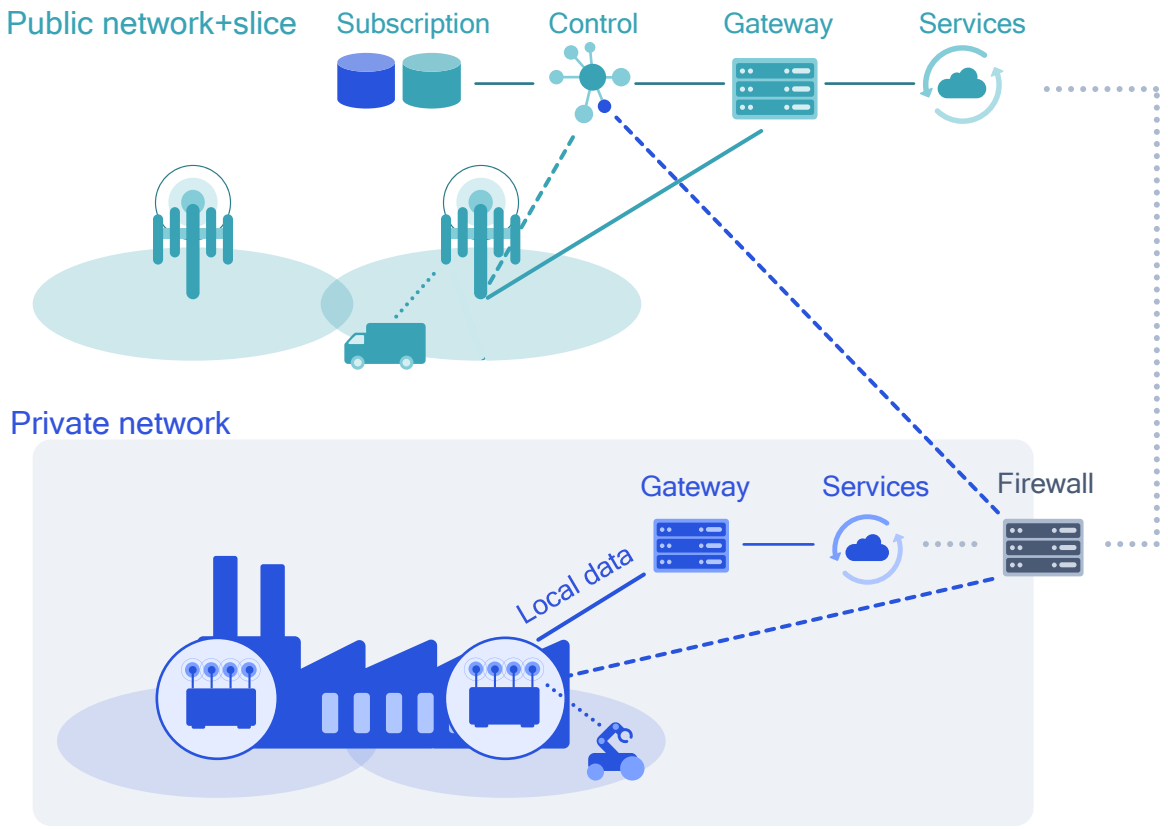
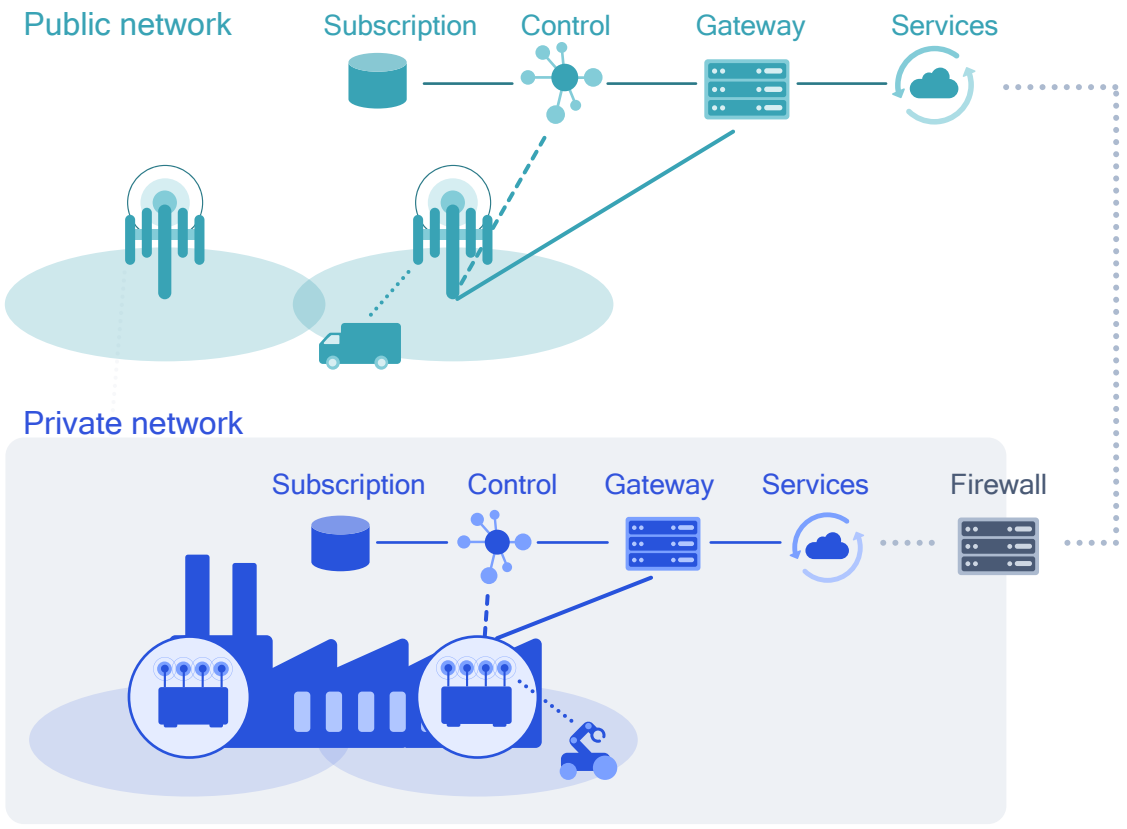
Integrated private network

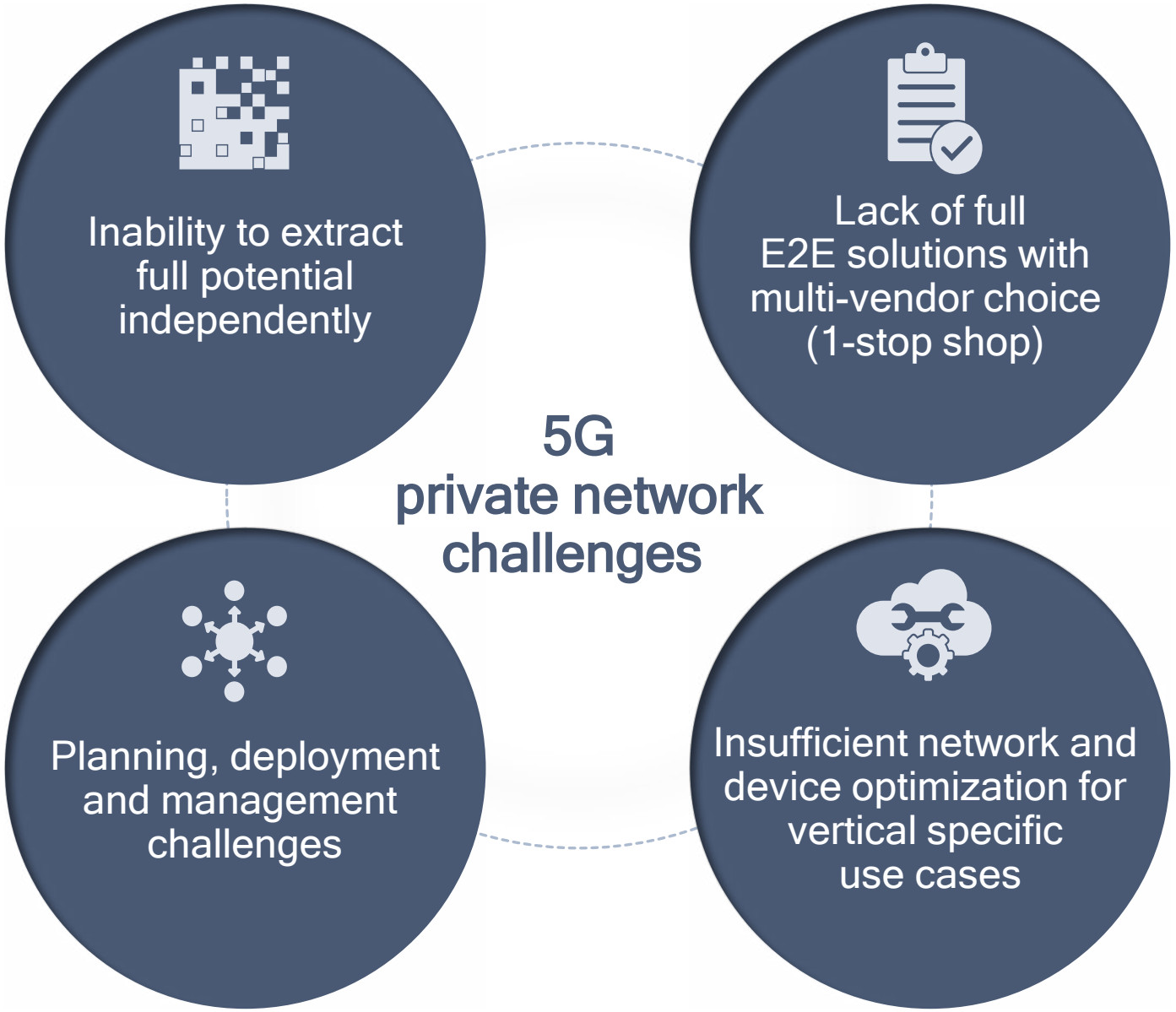


Independent private network[1]



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

Multiple private network architectures offer deployment flexibility

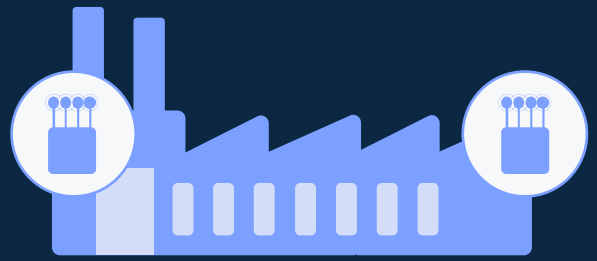


Challenges must be overcome to extract full potential of multiple types of 5G private networks

Powerful 5G network performance

Pre-integrated, multi-vendor solution for diversity of deployments and use cases

Significantly simplified deployment and management capabilities



Ecosystem needs in order to address common 5G private network challenges

Qualcomm® FSM™ 5G RAN Platforms

foundational RAN for 5G private networks

Leading power efficiency and form factor

Addresses challenging power, cost and size requirements for private network deployments

Enterprise-grade

Best-in-class power consumption and feature set for private networks

Full 5G spectrum support

Sub-6 GHz and mmWave bands

vRAN and O-RAN

Provides OEMs, Operators and System Integrators ultimate deployment flexibility

5G leadership factor

World renowned 5G expertise from mobile to infra, standards bodies to governments

Private Network Ecosystem Partner Program

Qualcomm Technologies validates solutions end-to-end for pre-integrated blueprints to partners

Choice of partner FSM powered small cells, core networks, other network functions, hosting, …

Selected by **17+** global Private Network innovators

Designed to remove deployment roadblocks from unwieldly cost to need for technical personnel

Ready to go RAN automation and 5G profiles - customizable for vertical/customer specific needs

Go-to-market

Qualcomm	System Integrator	End User
Provides RAN automation and e2e pre-integration with partner solutions	Integrates customer and vertical specific use cases, deploys and can manage networks	Receives 1-stop complete solution (clear accountability)

Qualcomm® Private Networks RAN Automation Technology

Spanning private 5G RAN planning and deployment to customizable & automated network management

Cloud-based SaaS solution for streamlined planning, deployment, and operations

Customizable and programmable pre-defined use case 5G profiles to meet customer needs

Automated operations to optimize and assure services to meet desired KPIs

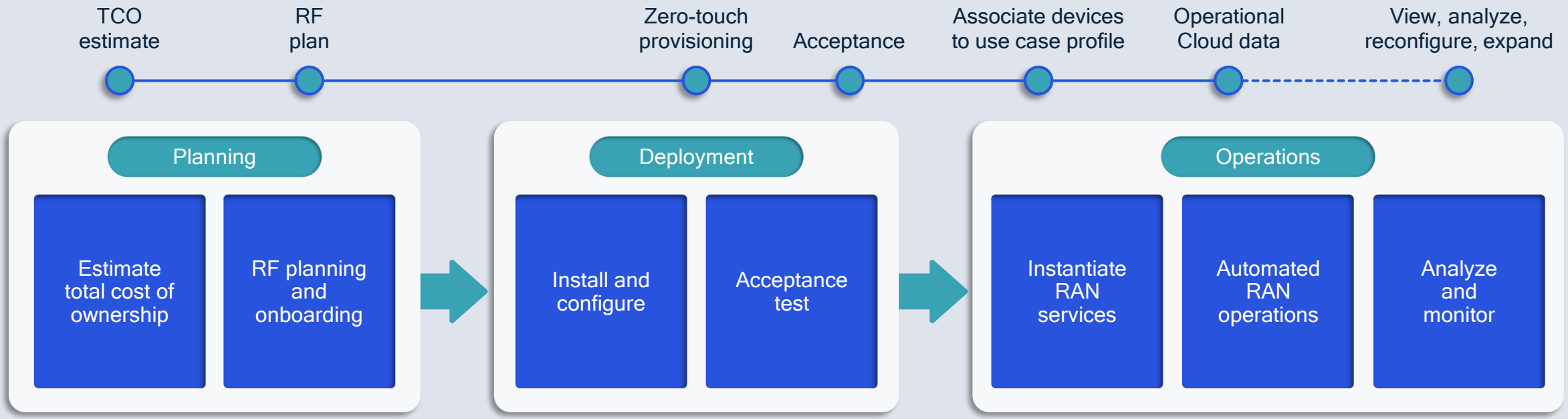
Horizontal single management across sites/types, multi-vendor RAN, access to device data

Path to zero-touch operations for simple self-management by enterprises

Working in conjunction with our 5G Private Networks Partners Program

Qualcomm Private Networks RAN Automation Technology

Spanning private 5G RAN planning and deployment to customizable and automated network management



Private Network Ecosystem Partner Spotlight

Announced Feb ‘22

Qualcomm

- Pre-validated infra with Qualcomm 5G RAN Platform
- Qualcomm Private Networks RAN Automation Platform

Microsoft

- Azure private multi-access compute (MEC) solution
- Azure Private 5G Core
- Azure Stack Edge

Delivering 5G private network foundation for simplified deployment and management by operators and system integrators

- Path to zero touch provisioning and operations
- Use-case optimized profiles
- Cloud-based delivery models
- Securely managed services
- Massive scalability opportunity, globally

Commercial availability through select operators and system integrators expected in Q3 2022

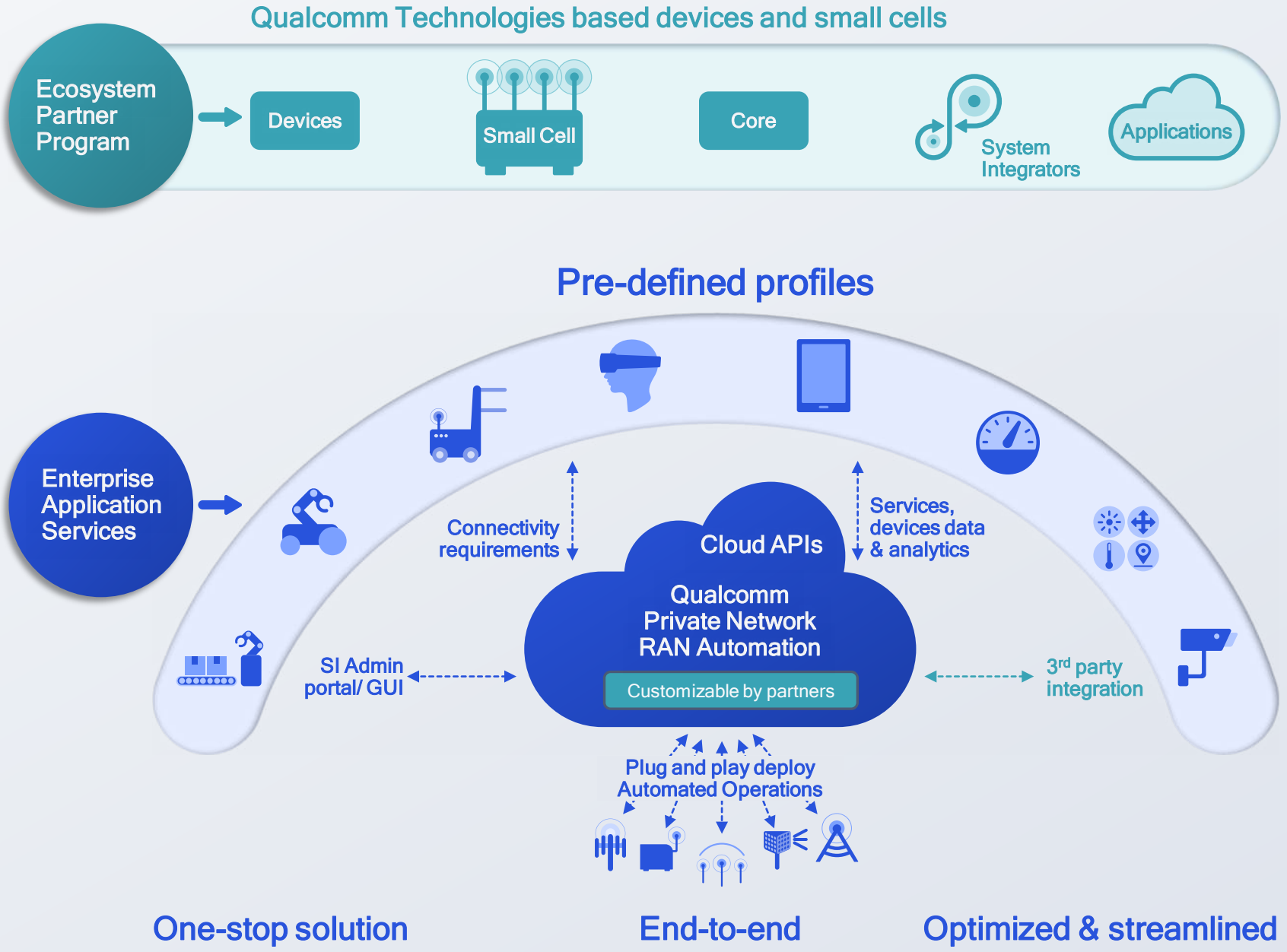
Digital transformation with 5G private networks, by Qualcomm Technologies

Horizontal cloud solution spanning automation, planning, deployment & operations

Validated end-to-end 5G private network solutions

Multi-vendor choice and ecosystem enablement

Device ecosystem and solutions



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Training & Deep dive

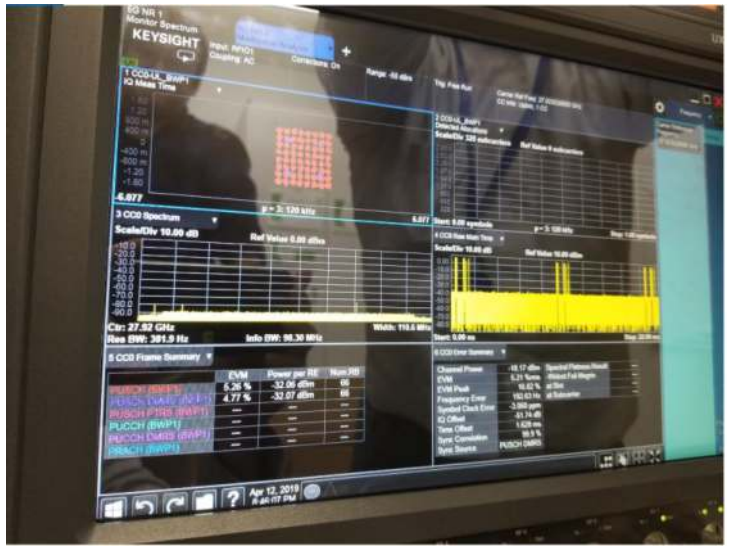
- Hardware / Software training
  - ✓ Some Japanese training video available
  - ✓ On site / online training if needed
    - ✓ Overview training
    - ✓ Specific technology training
    - ✓ Tool training

- Deep Dive
  - ✓ On site/online deep dive if needed
  - ✓ Q & A
  - ✓ Detail information

- On site training
  - 5G on site training
  - Thermal on-site training (mobile only)
  - Other training if needed

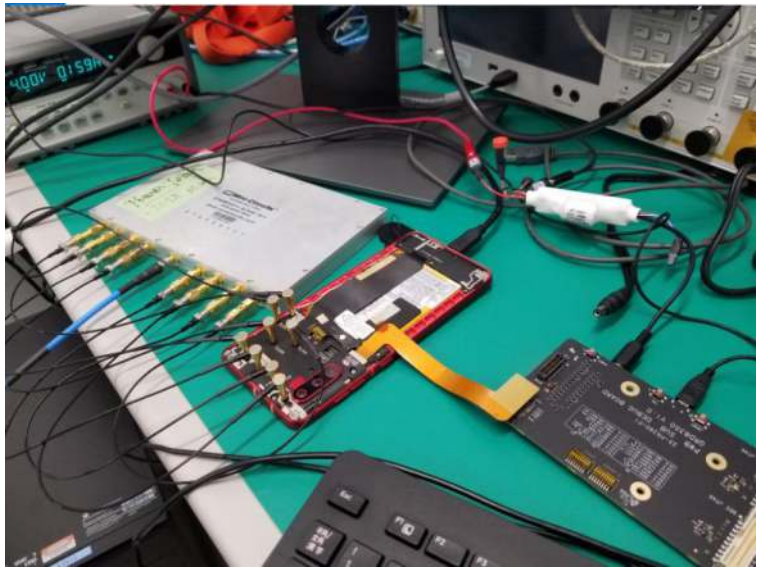
On site support & Lab support

- Bring up
  - Board bring up
  - RF bring up
  - Feature bring up
- Debug
  - Debugging WiFi
  - Debugging Multimedia
  - Debugging Factory Software
  - Power optimization
- Lab support
  - Thermal / Power measurement
  - RF calibration/Factory tools
  - 5G mmW support



Debug support

Bring up support

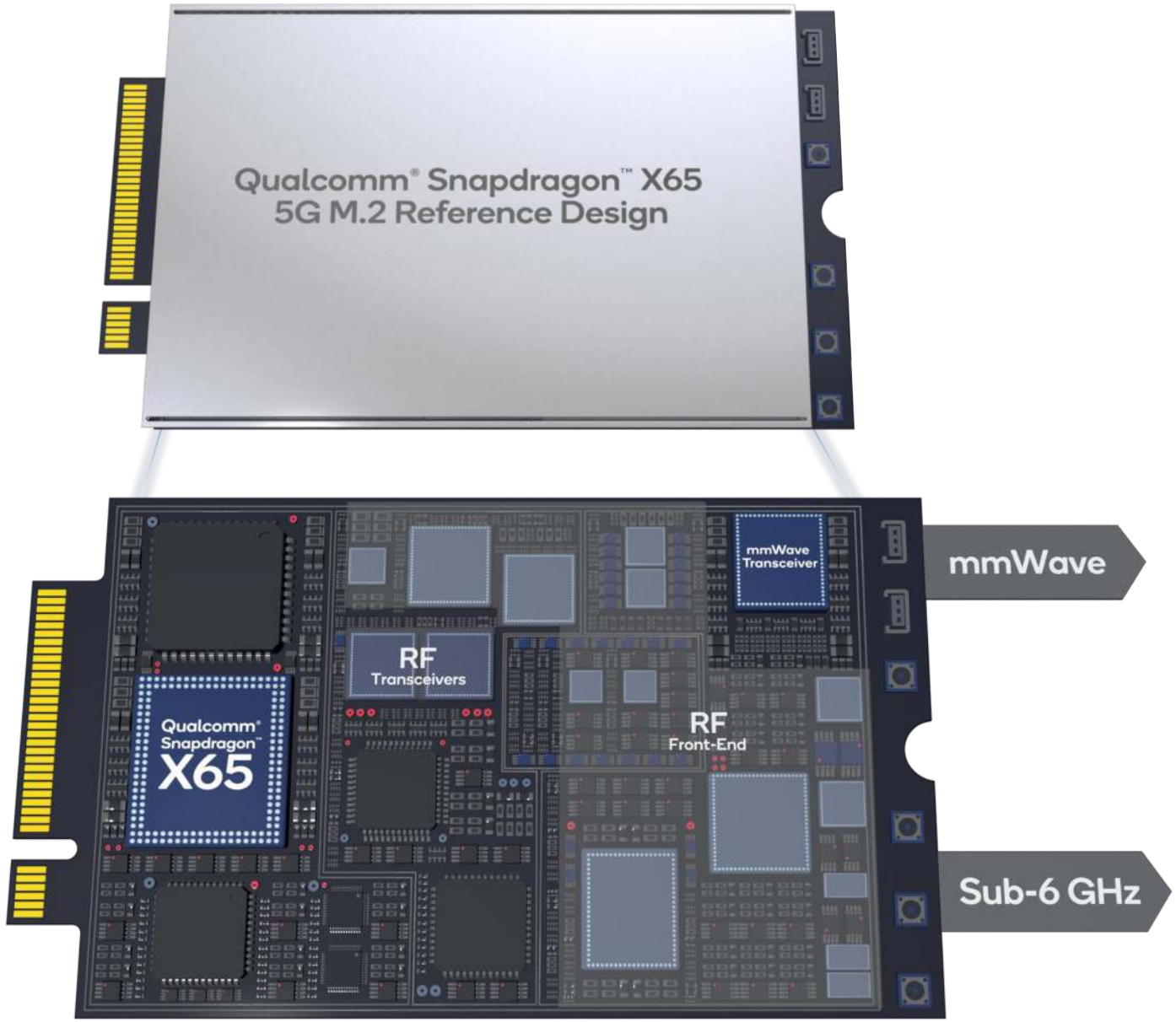


Thermal / power lab

Qualcomm® Snapdragon™

X65 and X62

5G M.2 Reference Designs



Qualcomm® 545 mmWave Antenna Module

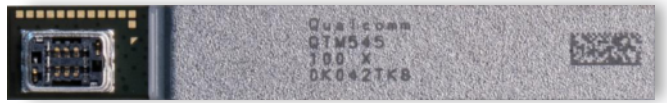
Qualcomm Technologies' 4th-generation mmWave module for mobile

Extended range
compared to previous gen

Added support for
41 GHz band (n259)

Qualcomm snapdragon X65 5G modem-RF

Qualcomm snapdragon X62 5G modem-RF

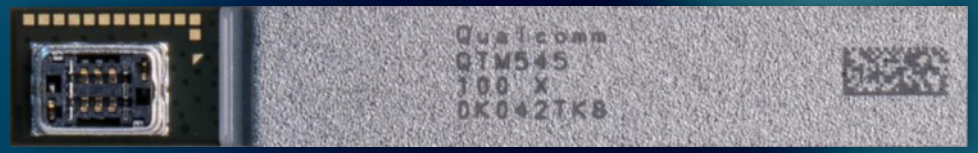


Global mmWave band support
26 GHz, 28 GHz, 39 GHz, 41 GHz
(North America, Korea, Japan, Europe, Australia, SEA)

端末向けミリ波帯ソリューション

[QTM525 mmWave antenna module]

[QTM545 mmWave antenna module]



Keysight様との取り組み事例

- 東京都立産業技術研究センター様の5Gミリ波ラボでの測定環境構築について，Keysight, Qualcomm, Thundercommが協業
  - Keysight様の測定環境において、Qualcomm 5G Modem/RFソリューション SDX55を搭載するThundercomm 5Gモジュール T55のミリ波ビームフォーミング調整を実施。

Press Note

Qualcomm, Thundercomm and Keysight Cooperate on the Launch of 5G mmWave Lab at Tokyo Metropolitan Industrial Technology Research Institute

– Tokyo Metropolitan Industrial Technology Research Institute Lab is Now Available to Help Companies in Japan to Design and Develop Private and Local 5G mmWave Products –

AUG 26, 2021 | TOKYO | Qualcomm products mentioned within this press release are offered by Qualcomm Technologies, Inc. and/or its subsidiaries.

Keysight 5G OTAチャンバー
F9650A

Keysight 5G NW エミュレータ
E7515B

Thundercomm 5Gモジュール
T55

総務省様の提案する準同期TDD1/2/3も動作確認済み！！

準同期の追加パターンの開発

令和２年12月、キャリア５ＧのTDDパターンとタイミングを一致させたまま上り/下りのスロットのみを一部変更したパターン（準同期TDD）を4.5GHz帯及び28GHz帯に一つずつ追加。しかしながら、更に多くの上りスロットを必要とするユースケースの需要への対応が必要。

例：4.7GHz帯

無線フレーム（10msec）

スロット番号	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
同期TDD	D	D	D	S	U	U	D	D	D	D	D	D	D	S	U	U	D	D	D	D
準同期TDD	D	D	D	S	U	U	D	S	U	U	D	D	D	S	U	U	D	S	U	U

同期区間　非同期区間　同期区間　非同期区間

③　近接する基地局で他への干渉を生じさせない準同期TDDの運用パターンを追加

追加が考えられる準同期運用パターン　既存のいずれの運用パターンとも準同期の関係となる以下の準同期２及び３といった運用パターンの追加が考えられる。

スロット番号	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
同期TDD	D	D	D	S	U	U	D	D	D	D	D	D	D	S	U	U	D	D	D	D	既存
準同期TDD 1	D	D	D	S	U	U	D	S	U	U	D	D	D	S	U	U	D	S	U	U	既存
準同期TDD 2	D	D	S	U	U	U	D	S	U	U	D	D	S	U	U	U	D	S	U	U	追加例
準同期TDD 3	D	S	U	U	U	U	D	S	U	U	D	S	U	U	U	U	D	S	U	U	追加例

※D:下りスロット、U:上りスロット、 S: DからUへの切替期間を含む特別スロット

『課題解決型ローカル５Ｇ等の実現に向けた開発実証
令和３年度実施方針』 資料より
https://www.soumu.go.jp/main_content/000745726.pdf

5G needs a new kind of network

Qualcomm
5G RAN Platforms

Densification and the importance of

Small cells

Open RAN and

Virtualization

Qualcomm®

FSM™ 200

Platform

Industry's first

Release 16 small cell platform

Designed to support Industry 4.0 including the Factory of the Future and other new segments

Unmatched data speeds and capacity

Support for speeds of up to 8 Gbps with 1 GHz bandwidth support on mmWave

Flexible and Open Architectures

O-RAN compliant solution with support for all key 5G functional split options

Outdoor / indoor solution

Optimized RF for Indoor vs Outdoor

Power efficiency

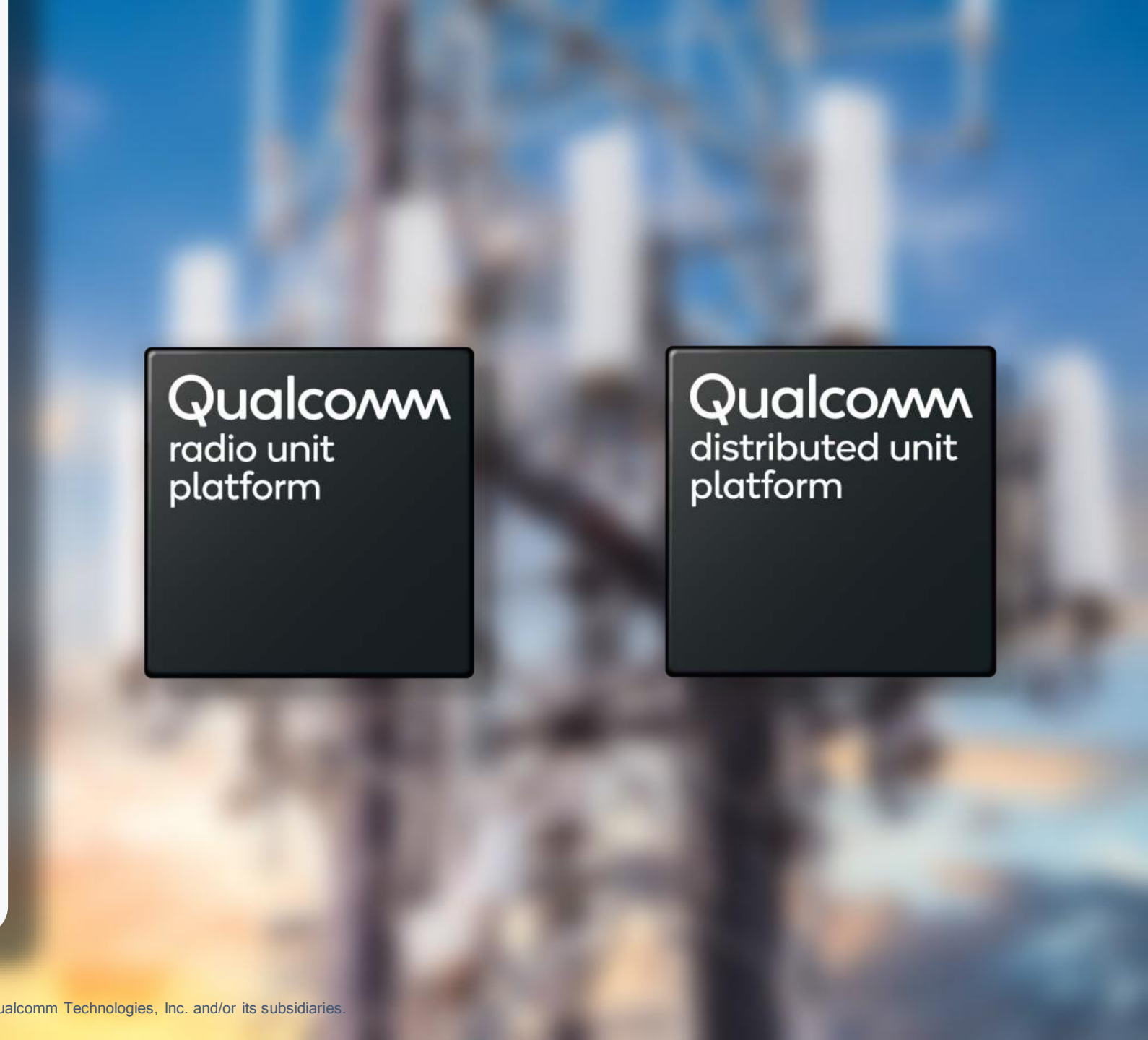
Leading 4nm process node for superior power efficiency

Global solution

Supports virtually all bands spanning mmWave and sub-6 GHz (FDD and TDD).

Qualcomm® 5G RAN Platforms

Building open and innovative cellular infrastructure with high performance Modem-RF System.



Layer 3
Processing

Layer 2
Processing

Layer 1 Processing

- Demodulation
- Beamforming
- Channel coding
- Massive MIMO computation

Qualcomm®

5G DU X100

Accelerator card

PCIe *inline accelerator* card with concurrent Sub-6 GHz and mmWave baseband support

Snapdragon
compute platforms

Windows Chrome

Snapdragon搭載パソコンの
ポートフォリオを拡大中
国内販売モデル

As of July 2022

Source sample text

- 8cx シリーズ -

Snapdragon 8cx Gen 3 / Snapdragon 8cx Gen 2 / Snapdragon 8cx Gen 1

5G


Lenovo
ThinkPad X13s (mmW, Sub6)

Lenovo
Flex 5G | Yoga 5G


Lenovo
IdeaPad 5G


Elite Folio
(Sub6)


acer
Spin 7


SAMSUNG
Galaxy Book Go 5G


Microsoft
Surface Pro X with
Microsoft SQ1


Microsoft
Surface Pro X with
Microsoft SQ2


Xiaomi
Book S 12.4"


SAMSUNG
Galaxy Book S

- 8c シリーズ-

Snapdragon 8c Gen 1


Lenovo
IdeaPad 4G


SAMSUNG
Galaxy Book2


HUAWEI
Matebook E


WEIBU
Prima


Envy x2


Lenovo
Yoga C630


ASUS
NovaGo


Lenovo
Miix 630

- 7c シリーズ-

Snapdragon 7c Gen 2 / Snapdragon 7c Gen 1


dynabook
Sharp Dynabook
Chromebook C1
(LTE)


acer
Chromebook
Enterprise
Spin 513
(LTE)


acer
Chromebook
Spin 513


acer
Chromebook
Spin 511


SAMSUNG
Galaxy Book Go


Lenovo
IdeaPad Duet 560
Chromebook


Lenovo
IdeaPad Duet 370
Chromebook


Lenovo
10W Tablet


Chromebook x2 11
(LTE)


HP Fortis 14" G10
Chromebook


HP Laptop 14"

Thank you

Qualcomm

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