Qualcomm

5G, IoT and AI

Pratik Das

September 16, 2024

Trends accelerating industry digitalization

Technology Innovation & Breakthroughs

Technology is driving exponential progress in tech sector and far beyond

EXAMPLES:

- Cloud and 5G
- EDGE AI
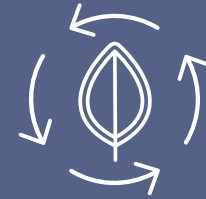- Robotics and automation

Demographics & Social Change

Longer lifespans and modern lifestyles are changing healthcare/ wellness and consumer preferences

EXAMPLES:

- Next-gen telemedicine devices
- Quality aging
- Hybrid shopping/modern store

Climate Change & Resource Scarcity

Demand for a clean, green tomorrow are advancing energy and conservation

EXAMPLES:

- Clean energy and smart utilities
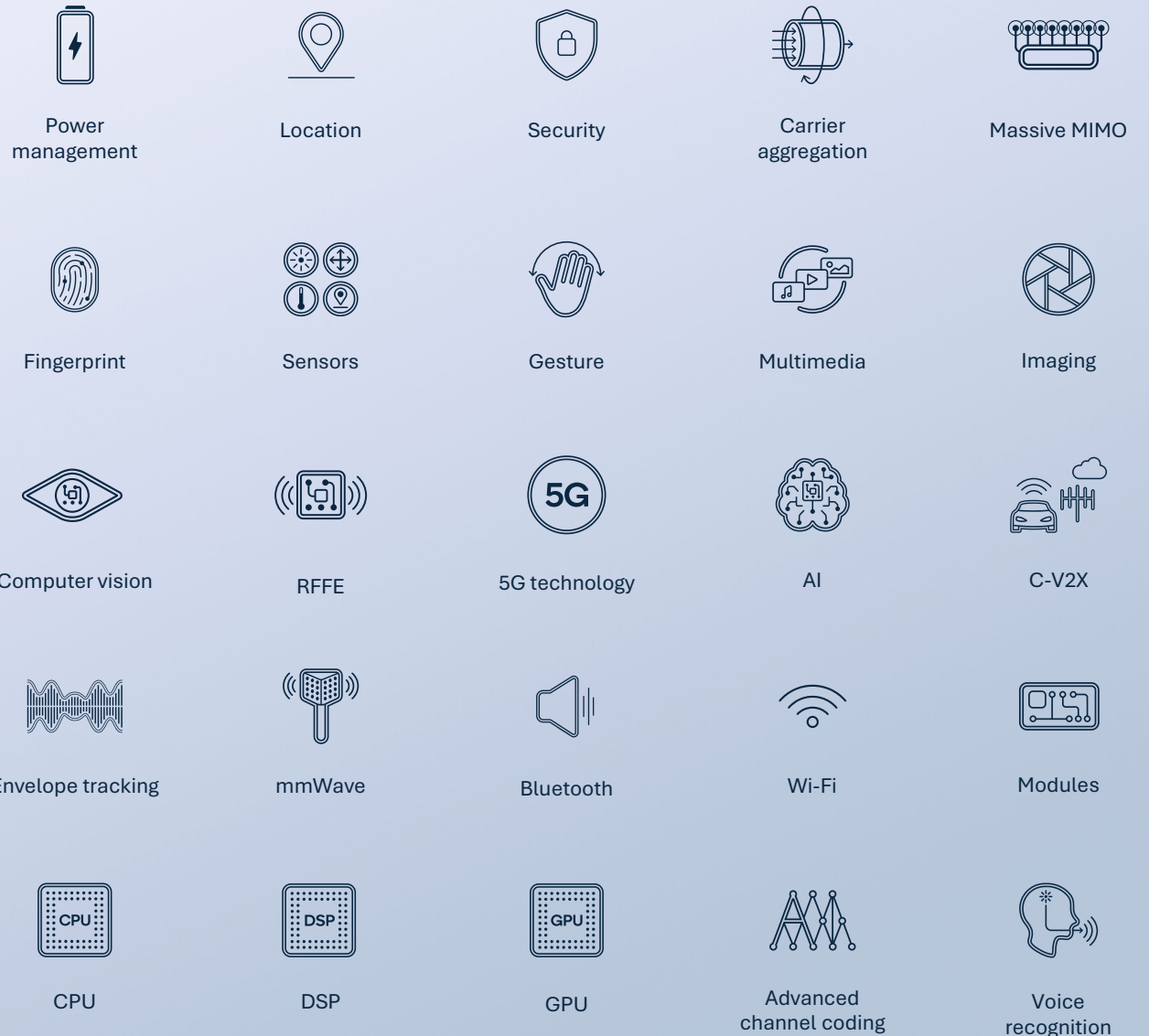- Sustainability in industries
- Electric vehicles

Qualcomm

Inventing the technologies shaping the digital future

$90+ billion
in cumulative R&D

140,000+
patents, patent applications

Power management

Location

Security

Carrier aggregation

Massive MIMO

Fingerprint

Sensors

Gesture

Multimedia

Imaging

Computer vision

RFFE

5G technology

AI

C-V2X

Envelope tracking

mmWave

Bluetooth

Wi-Fi

Modules

CPU

DSP

GPU

Advanced channel coding

Voice recognition

Our advanced wireless innovations lead the path to 6G

Enhancing mobile broadband

Boundless extended reality

Smartphones and laptops

Fixed Wireless and enterprise

Enabling new verticals

IoT expansion

Automotive

Industrial IoT

6G
Release 21+

5G Advanced
Release 18/19/20

5G New Radio (NR)
Release 15/16/17

4G
Foundations

A RICH ROADMAP OF

5G

TECHNOLOGY EVOLUTION

5G

Rel 15
Established 5G NR technology foundation

- eMBB — enhanced mobile broadband services
- 5G core network and enhanced E2E security
- Sub-6 GHz with massive MIMO
- Advanced channel coding
- 5G broadcast
- Scalable OFDM-based air interface
- Mobile mmWave
- Flexible framework
- LTE integration
- Private Networks, SON

Rel 16
Expanding to new use cases and industries

- In-band eMTC/NB-IoT and 5G Core
- Mission-critical services with eURLLC (e.g., 5G NR IIoT)
- Positioning across use cases
- eMBB evolution - improved power, mobility, more
- 5G NR Cellular V2X
- Better coverage with IAB, uplink MIMO
- 5G NR in unlicensed spectrum
- IAB integrated access/ backhaul

~1.5–2 years between releases

Rel 17
Continued expansion and enhancements

- Enhanced DL/UL MIMO, multiple transmission points
- NR-Light Reduced Capability (RedCap) for low-complexity IoT
- More capable, flexible IAB
- Unlicensed spectrum across all use-cases
- 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
- Non-terrestrial network (i.e., satellites)
- Rel-15 deployment learning, eMBB enhancements, XR, others

5G Advanced

Rel 18
New wave of 5G innovations in the decade-long 5G evolution

- Further eMBB enhancements
- Full-duplex MIMO
- Extended Reality (XR)
- Smart repeaters for coverage expansion
- Automotive and NR V2X enhancements
- Non-terrestrial network enhancements
- 5G NR-Light expansion for IoT and more
- AI/ML data-driven designs
- Broadcast enhancements
- Sidelink in unlicensed spectrum

Rel 19
Realizing the full potential of 5G and bridging to 6G

- Continued MIMO, mobility
- Advanced topology
- Wireless AI
- Device and network energy savings
- Ambient IoT
- XR evolution
- Enhanced NTN
- Duplex evolution
- Higher midband spectrum
- Integrated sensing and communications
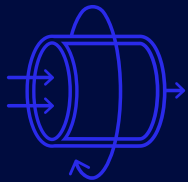
Rel 20

Rel 21+

6G

Qualcomm

Key technology inventions in 5G Advanced Release 18
Leading the innovation pipeline for 5G Advanced and beyond

Enhanced Uplink

To optimize device-to-network transmission performance

Enhancements to uplink MIMO, device coverage, mobility, CA power aggregation, and Tx switching

Broadband Evolution

To improve mobile and fixed broadband experiences

Enhancements in MIMO performance, device mobility, DSS, CA enhancements, precise positioning, multi-SIM

IoT Advancement and Expansion

To support new devices and enhanced smart device efficiencies

Improved XR, drone comm., RedCap efficiency, narrowband & sidelink positioning, small data Tx, low-power wakeup receiver

Efficient System Design

To capture energy-saving and flexible deployment opportunities

Network energy saving, network-controlled repeater, full duplex, NR-U sidelink, sidelink relay, mobile IAB, improved NTN, broadcast/multicast
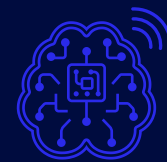
Wireless AI Foundation

To lay the groundwork for intelligently connected networks and devices

Evaluation of ML-based system design and use cases, e.g., channel feedback, beam management, positioning, mobility optimization

Retail & Payments

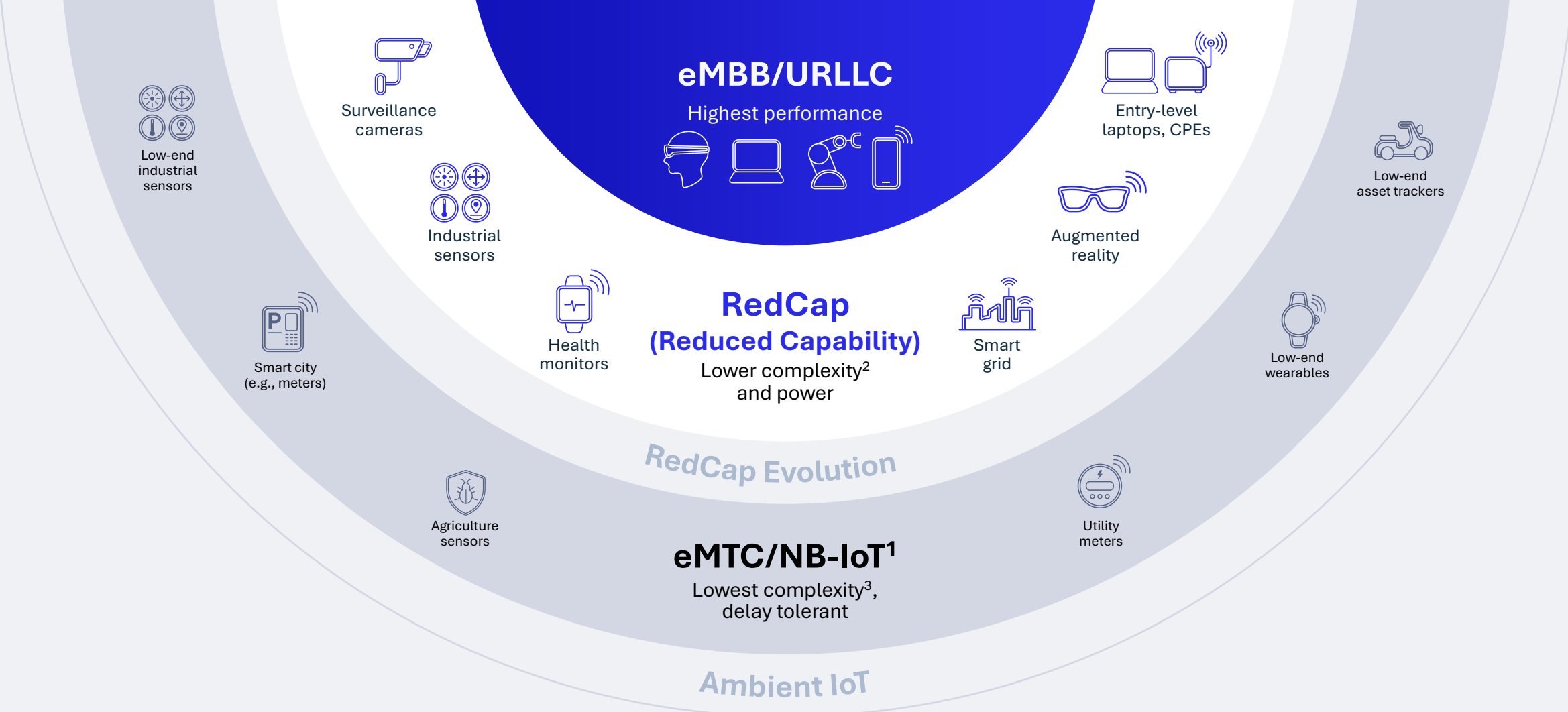Energy & Utilities

Building & Enterprise

Location & Tracking

Industrial & Automation

Driving digital transformation across different segments

eMBB/URLLC
Highest performance

Surveillance cameras

Entry-level laptops, CPEs

Low-end industrial sensors

Industrial sensors

Augmented reality

Low-end asset trackers

RedCap
(Reduced Capability)
Lower complexity[2] and power

Health monitors

Smart grid

Smart city (e.g., meters)

Low-end wearables

RedCap Evolution

Agriculture sensors

Utility meters

eMTC/NB-IoT[1]
Lowest complexity[3], delay tolerant

Ambient IoT

5G NR | A unified, scalable air interface allowing coexistence of a wide range of 5G device classes

Bridging the 5G IoT capability and complexity gap with RedCap

Expanding the 5G universe to connect more tiers of devices and services

	LATENCY	THROUGHPUT	DENSITY	COMPLEXITY	BATTERY LIFE
Mission-critical IoT (with TSN, URLLC, and precise positioning)	Low	High	Low	High	Reference
Reduced Capability (RedCap)					
5G massive IoT (i.e., eMTC, NB-IoT)	High	Low	High	Low	Long

High-performance

Low-complexity

5G RedCap will fuel device ecosystem expansion in diverse 5G deployments

Mass Tier Broadband

- Fixed Wireless Access CPEs
- Connected PCs
- Mobile Routers & tablets

Industrial IoT

- Industrial sensors
- IoT gateway
- Surveillance cameras

Consumers IoT

- High-end wearables
- Health monitors
- XR Glass-to-Cloud

5G Standalone realizes the full potential of 5G for the Industrial IoT

Support the broadest range of devices and use cases, including eMBB, low-complexity IoT, XR, and mission critical apps

Standalone private networks

Build independent private networks with multiple options for security credentials and optional public network fallback to meet custom needs

Use mmWave, sub-7 GHz, unlicensed bands with NR-U, or multiple bands with 5G SA carrier aggregation

RedCap devices

Densify wireless IoT connectivity with reduced capacity 5G RedCap devices for longer battery life and greater cost-effectiveness

Time sensitive networking

Cut the wires between industrial nodes with deterministic 5G TSN latency for more efficient and responsive industrial operations

5G Standalone

Network slicing

Secure mission-critical data flows from heavy best-effort traffic with end-to-end resource reservations for network slices

Edge Compute and URLLC

Host delay-sensitive application servers on edge compute resources collocated with 5G vRAN for the lowest latency and the highest data integrity

Precise positioning

Leverage 5G communication infrastructure for centimeter-level positioning indoors and outdoors

5GC: 5G core; eMBB: Enhanced mobile broadband; MEC: Multi-access edge compute; SA: Standalone; TSN: Time sensitive networking; URLLC: Ultra-reliable low latency communications; vRAN: Virtualized radio access network; XR: Extended reality

5G private networks bring benefits to industry and enterprise

Public network fallback

Private network[1]
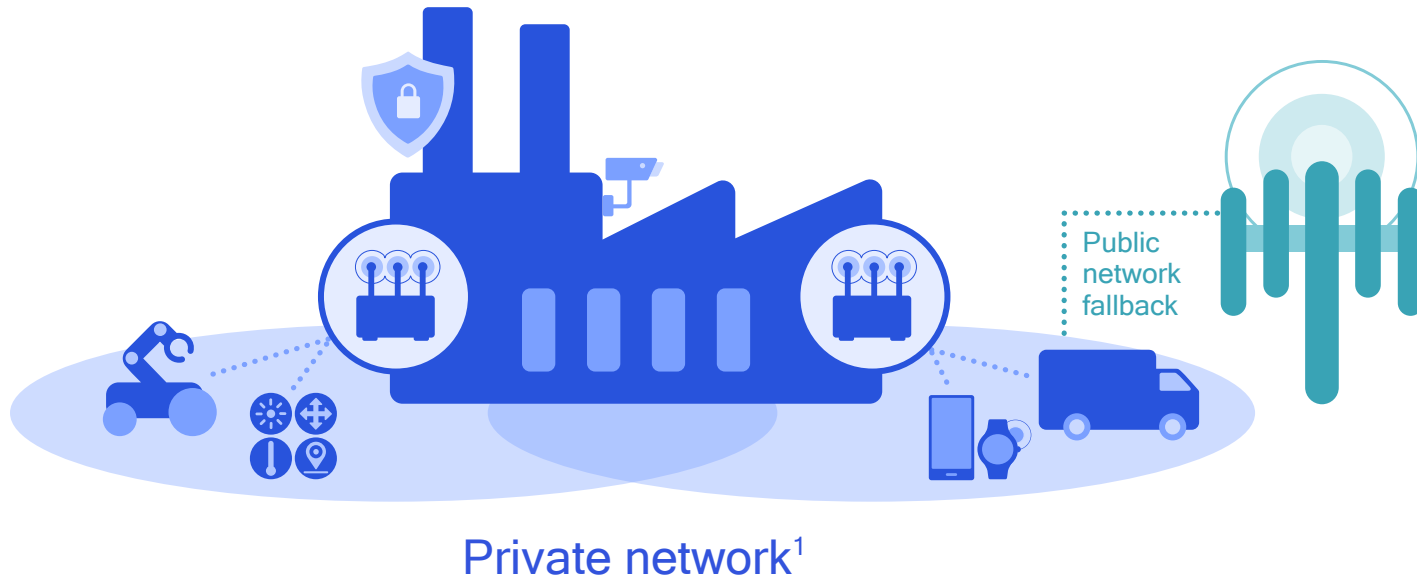
Dedicated
Local network, dedicated resources, independently managed

Secure
Cellular grade security, sensitive data stays on-premises

Optimized
Tailored performance for local applications, e.g., low latency, QoS[2]

5G

Coverage, capacity, and mobility
Outdoor/indoor, high data speeds, seamless handovers, public network fallback

Reliability and precise timing
Industrial grade reliability, latency and synchronization (eURLLC[3] and TSN[4])

Interoperability
Global standard, vast ecosystem, future proof with rich 5G roadmap

1. Also referred to as non-public network (NPN); 2. Quality of service; 3. Enhanced ultra-reliable low-latency communication; 4 Time sensitive network

Police officer

EMT on duty

Locating personnel in emergencies

Medical emergency detected

Precise indoor location shared

13

Navigating automated guided vehicles (AGVs)
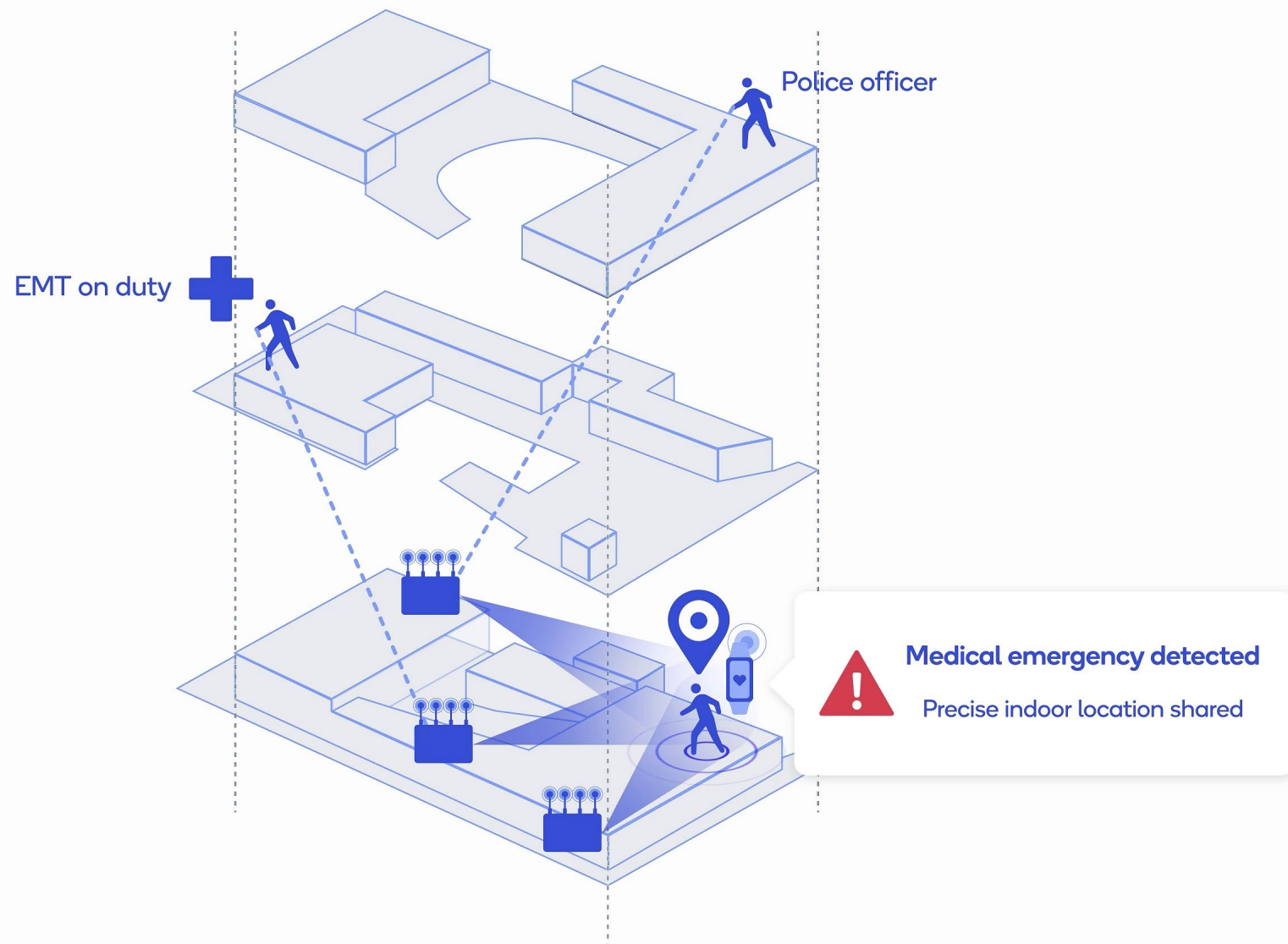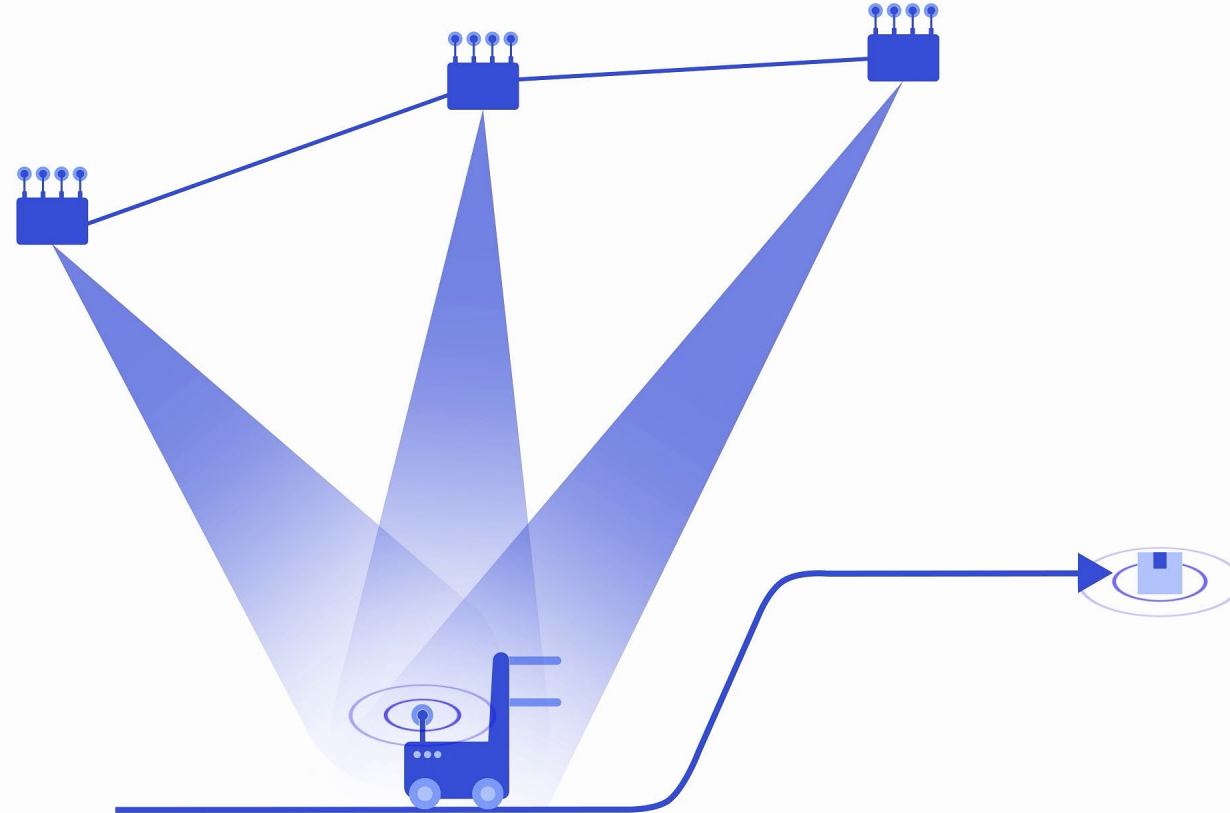
Indoor precise positioning has many industrial applications
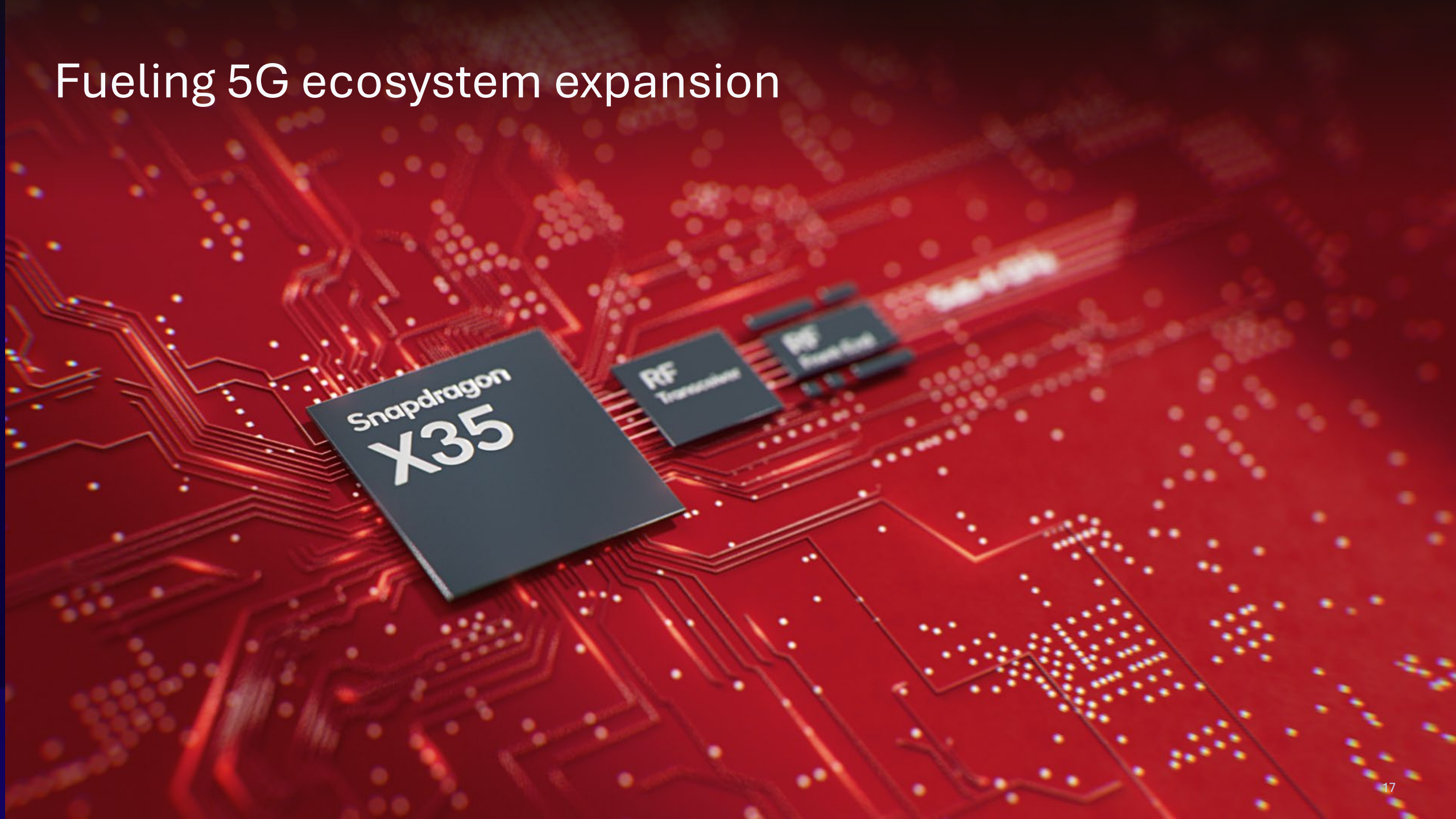
Tracking assets and routing packages

Fueling 5G ecosystem expansion
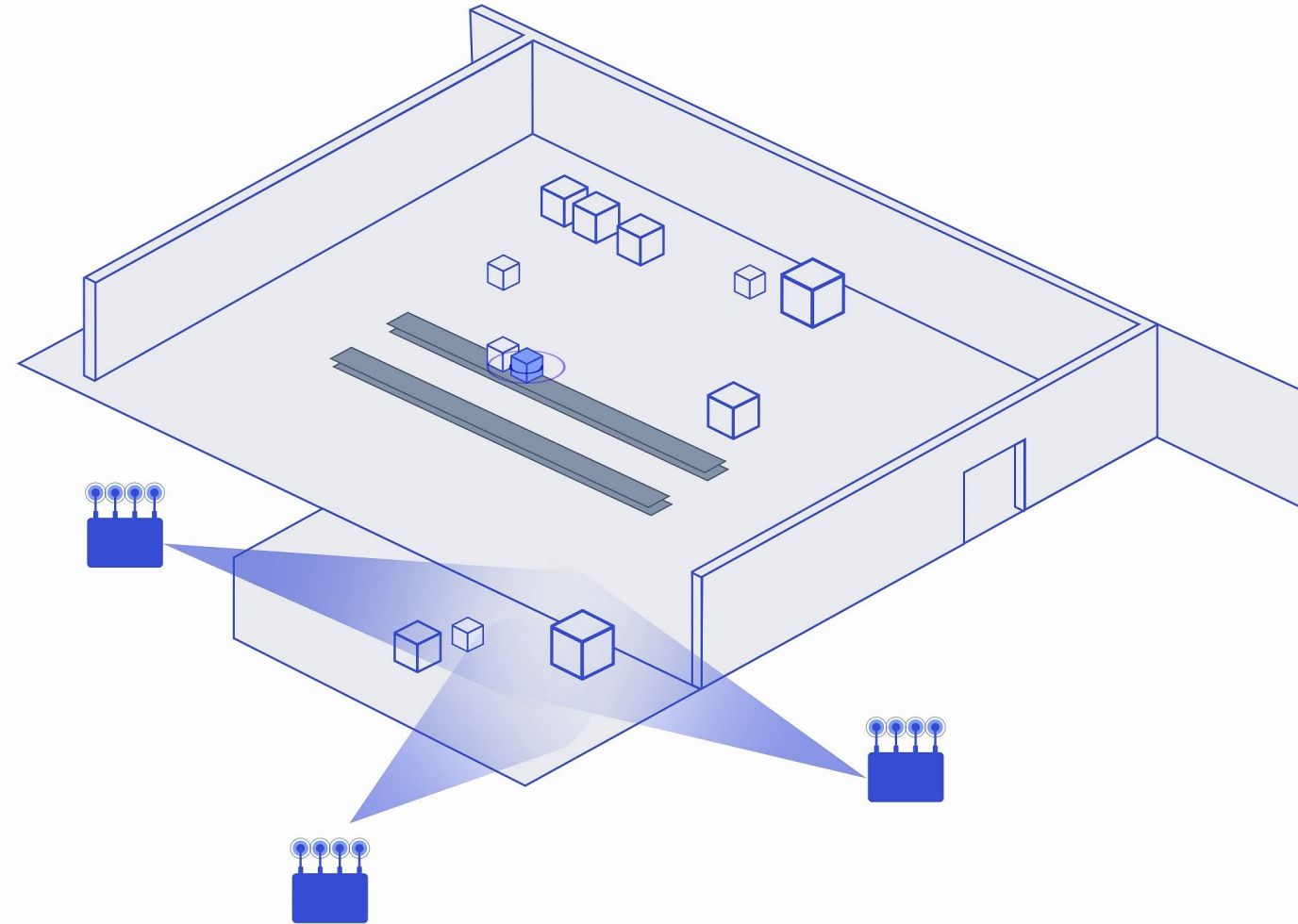
Snapdragon
X35 5G modem-RF

Qualcomm
aware platform

Innovative IoT platform to digitally transform industries

Combines our industry-leading silicon, expansive ecosystem and API-first, developer-friendly tools

Supports enterprises and developers to build scalable, cost-effective, and secure IoT solutions

Can be integrated with enterprise software and reseller platforms
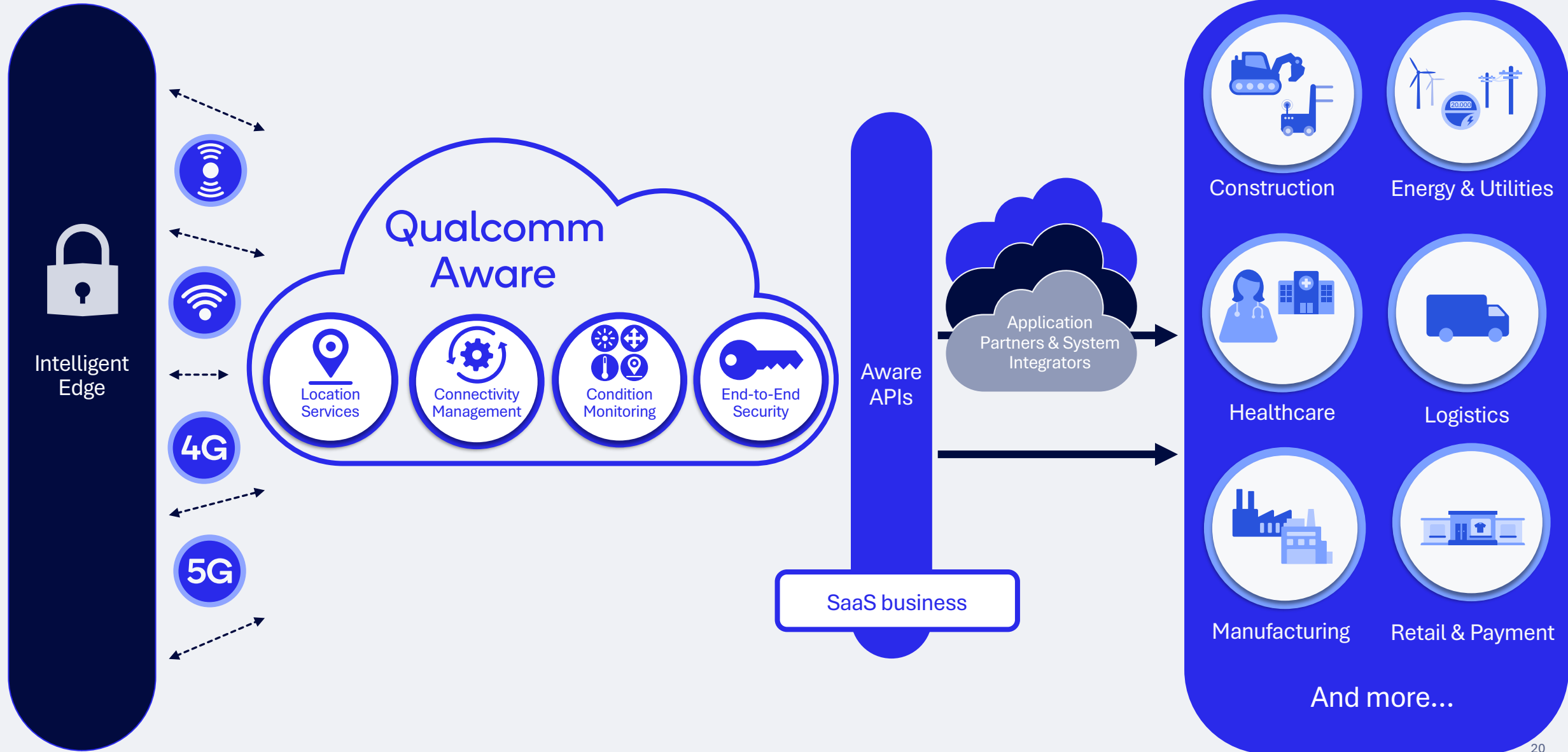
Opens new SaaS-based revenue opportunities

Supporting partners

ABInBev

ARROW

BASF
We create chemistry

Capgemini

cognizant

FERRERO

gridspertise
accelerating your electric future

ikotek

KYOCERA

L&T Technology Services

MAERSK

Microsoft

Mondelēz International

NAVER Cloud

QUECTEL

RBC

roambee

salesforce

SODAQ
WORLD-FRIENDLY™ IOT

TE connectivity

TECH mahindra

Telit

Thundercomm

tive

tomtom

Trimble

VUSION
ses imagotag

ZURICH

Foxconn Industrial Internet

Qualcomm Aware™ Platform: The Industrial Intelligence Solution

Qualcomm

Qualcomm and Aramco Digital Announce World's First Processors with Native Support for 5G in 450MHz Spectrum

Sep 11, 2024   RIYADH

At the Global AI Summit (GAIN), Qualcomm Technologies, Inc. and Aramco Digital announced the world's first processors with native support for 5G in 450MHz spectrum —designed to revolutionize 5G connectivity and coverage in a single processor. Qualcomm Technologies' advanced IoT processors, Qualcomm® QCS8550 and QCS6490, provide ubiquitous and resilient coverage that will be necessary to connect millions of intelligent edge devices. Qualcomm Technologies provides comprehensive 5G modem-to-RF solutions consisting of the modem, RF transceiver, TX power amplifier, RX low-noise amplifiers, filters, duplexers and switches, helping optimize the performance and accelerate the development of 450 MHz enabled IoT devices including industrial handhelds and ruggedized smartphones.

Local network analytics
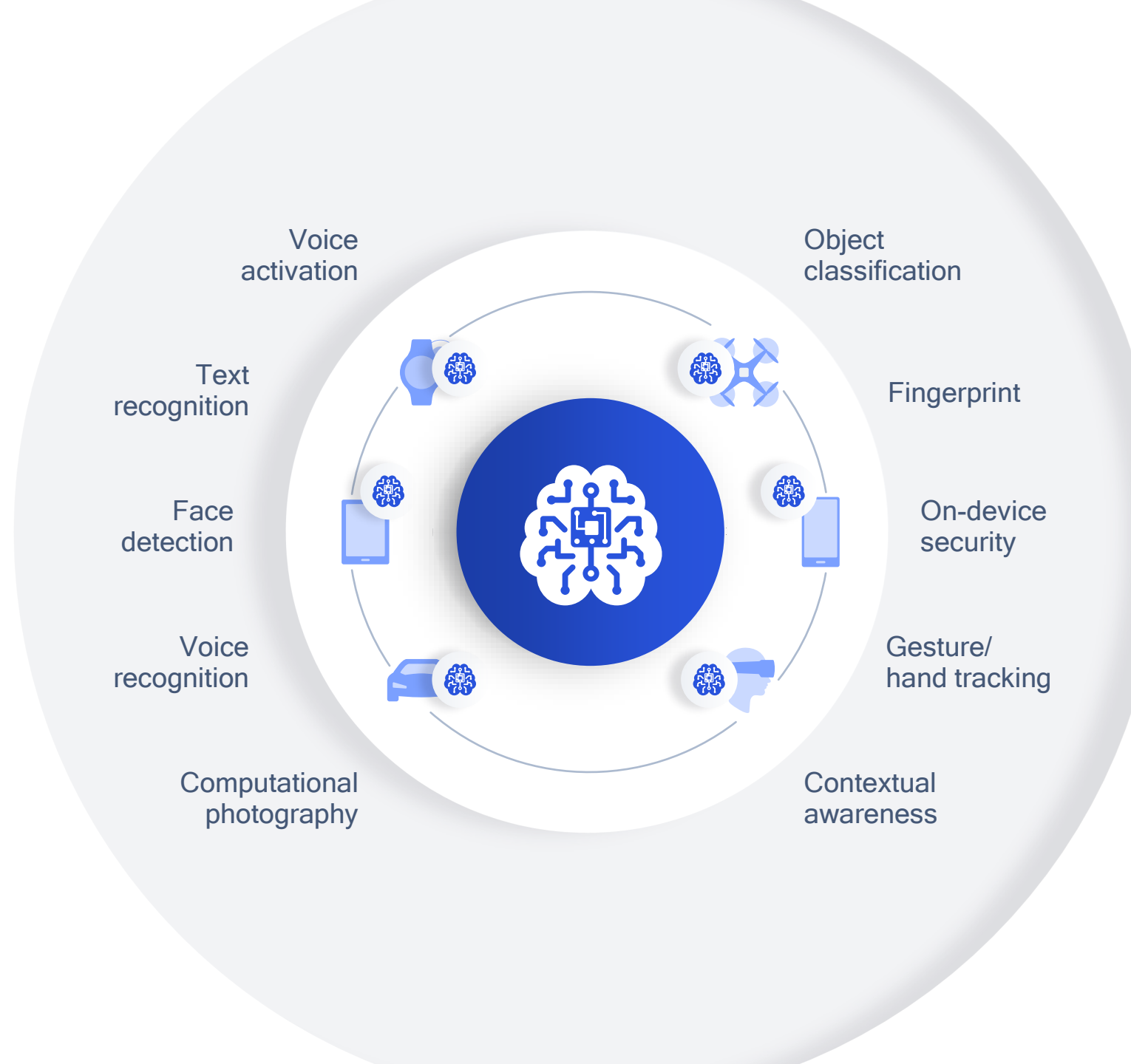
Low-latency interactive content

Boundless XR

On-demand computing

Industrial automation and control

Enterprise data

Edge cloud
+
on-device AI

Voice activation

Object classification

Text recognition

Fingerprint

Face detection

On-device security

Voice recognition

Gesture/ hand tracking

Computational photography

Contextual awareness

Snapdragon
X80 5G Modem-RF

**Qualcomm®
5G AI Suite
Gen 3**

AI-enhanced 5G Advanced user experience

Multi-antenna management to improve user experience

Contextually-aware QoS and latency improvements

60%[*] faster CPE service acquisition (mmWave)

10%[*] lower power in connected mode (mmWave)

Location accuracy improvement by **30%**[*]

Best-cell selection time reduced by **20%**[*]

30%[*] faster link acquisition

Snapdragon 8 Gen 3

Titan of on-device intelligence

Generative AI powerhouse

up to **10B** parameters on device

up to **20** tokens per sec for 7B LLMs

AI

Qualcomm® Hexagon™ NPU

98% faster
40% more efficient

Stable Diffusion and ControlNet
<1 sec fastest in the world

77GB/s, 4.8GHz LPDDR5x memory bandwidth

Qualcomm AI Stack

Pytorch ExecuTorch and optimized models

First to support **multi-modal gen AI models**

On-device personalization with Qualcomm sensing hub

World's 1st to support speculative decoding

4nm process node

Qualcomm® Kryo™ CPU

3.3GHz CPU max frequency

30% performance
20% efficiency

Security
Truepic with C2PA
Strongbox protection
Dual Always-Sensing ISPs

Gaming

25% performance
25% efficiency

240 FPS

Unreal Engine 5 with Lumen lighting system

Global illumination Next-gen lighting effects

Camera

Photo expansion

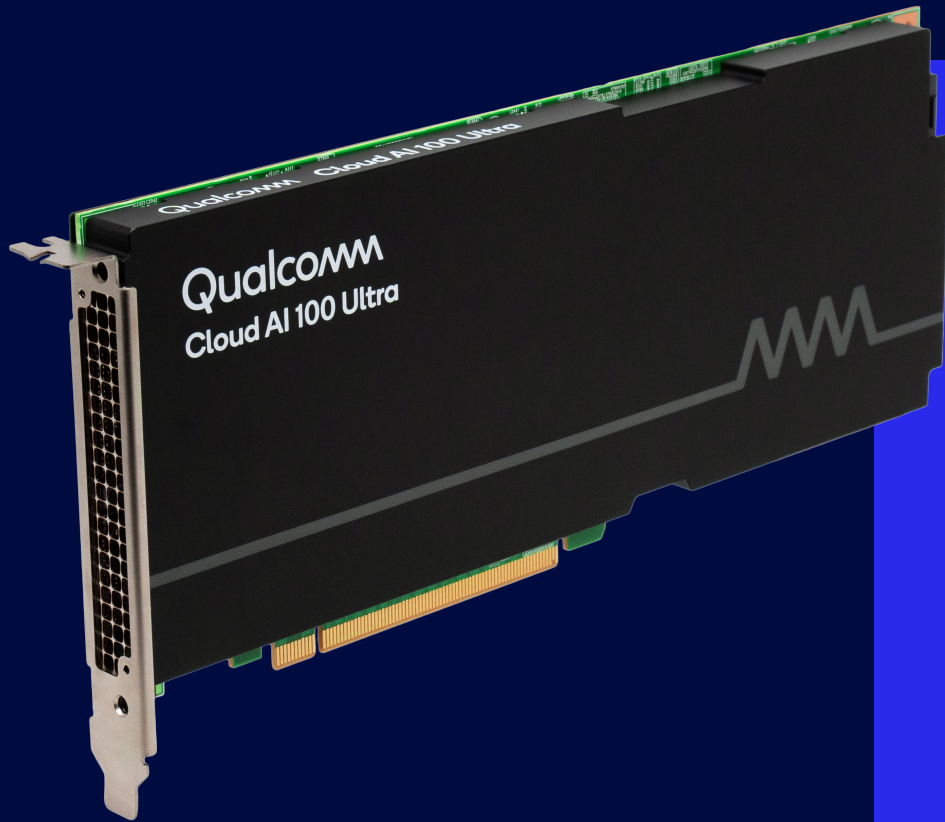**Night vision** for video capture

Video object eraser

Dolby HDR photo capture

Sound

24bit, 96KHz Lossless

Qualcomm XPAN

Vision for gen AI-augmented and autonomous networks

NETWORK DIGITAL TWIN

OPERATOR NETWORK

Has there been any documentation of cell malfunctions today or in previous days?

To my knowledge, there are no reports of malfunctions for the designated cell.

Have there been any severe weather conditions in the vicinity or any tower construction near the cell?

There have been no reports of extreme weather and no recent construction activity near the cell.

Please suggest actions that can be done to rectify situation

Based on similar scenarios I suggest an azimuth tilt of 3-8 degrees to the right and 1-3 up.

| Intelligent monitoring and management | On-the-fly modeling | Proactive alerts | Programming AI-assistants | 'Level-3' autonomous networks |

Sign up for the **What's Next in Wireless Tech** newsletter!

Thank you

Follow us on: in X ⊡ ▶ f
For more information, visit us at qualcomm.com & qualcomm.com/blog