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Cellular Evolution in the AI Era: The Road to 6G

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Agenda

6G vision

6G + AI

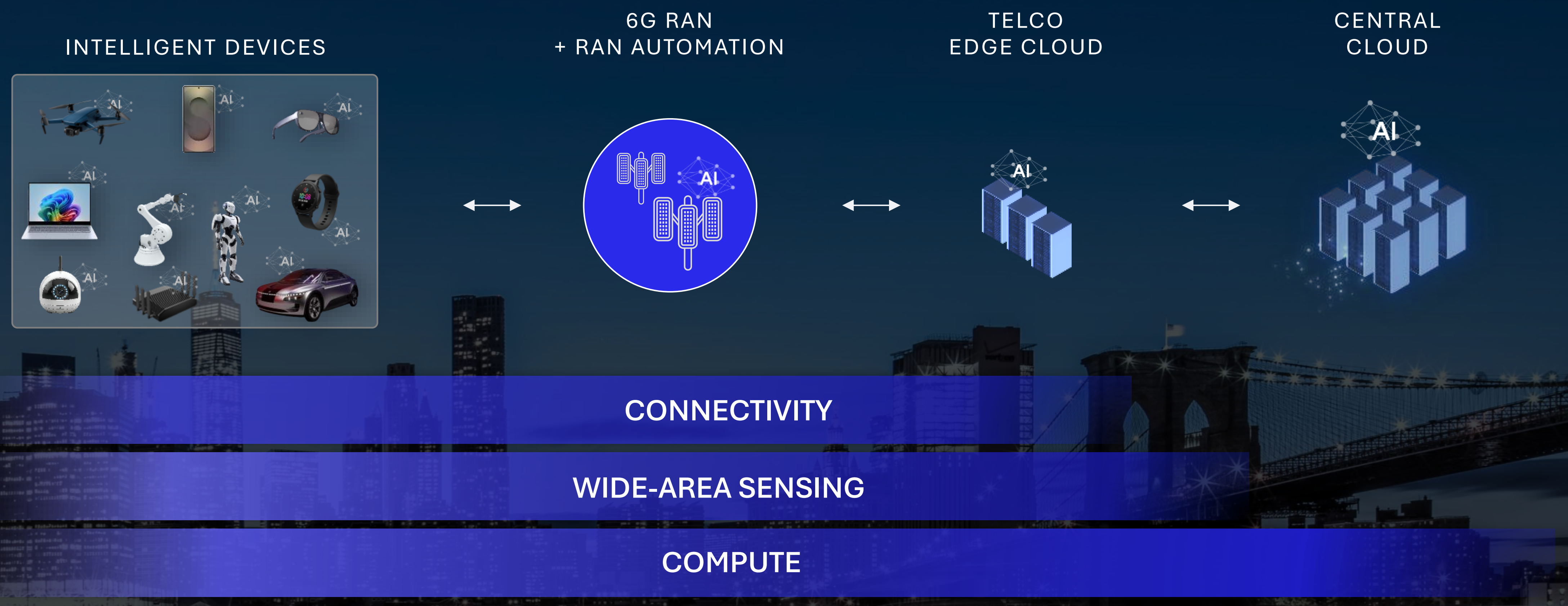
- AI user experiences
- AI for 6G connectivity

6G network sensing

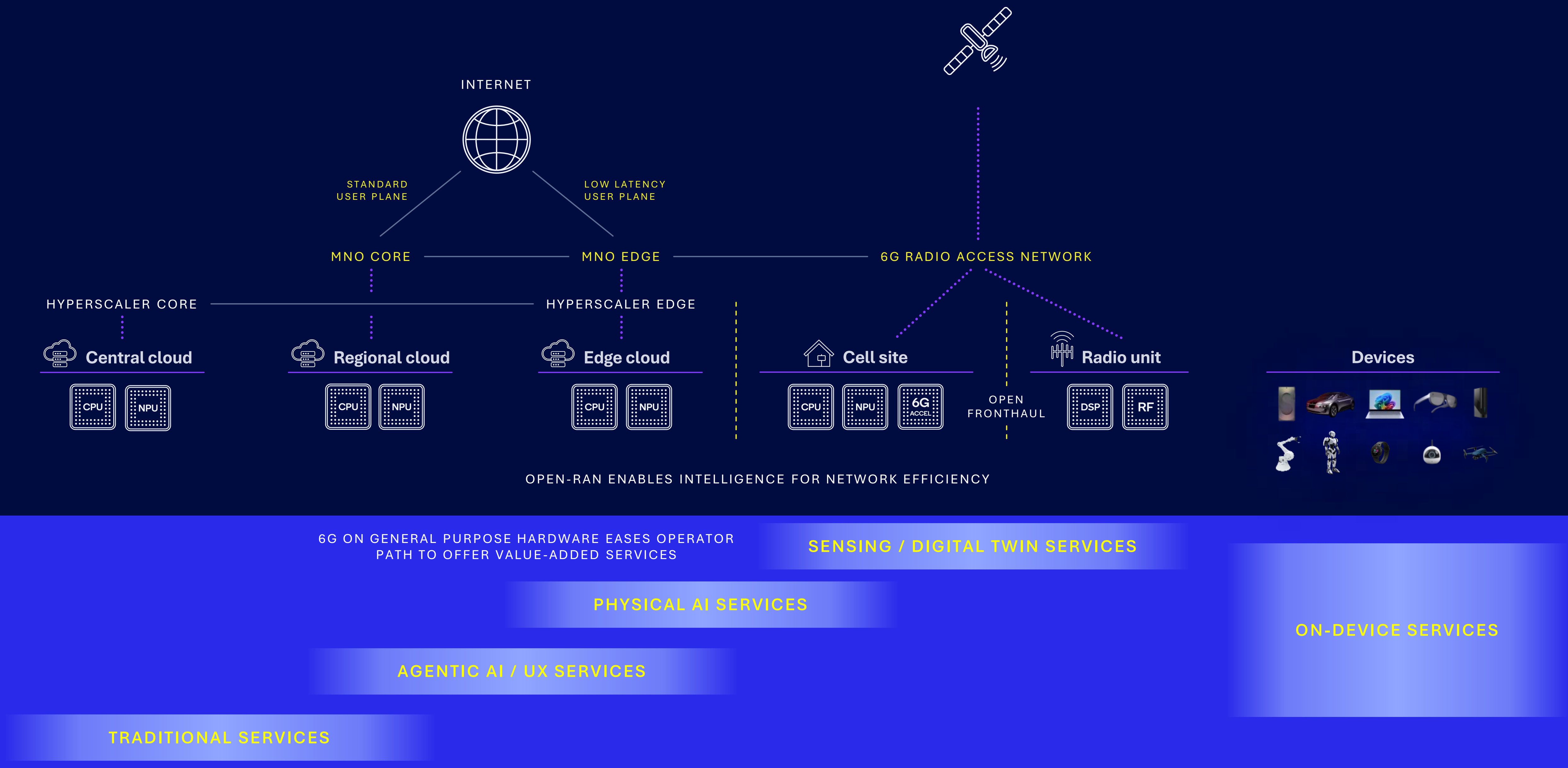
6G performance

6G timeline

6G Pillars: Connectivity, Wide-area Sensing, Compute



AI-driven transformation of the 6G network architecture and system



6G + AI user experiences

AI is the new UI - Changing consumer behaviors

2026

App-based and user-initiated content consumption

"Show my schedule and tell me about my next patient."

"Order a ride for two people to go to the mall and remind me what to buy!"

"Tell me the history of this building."

2030 AND BEYOND

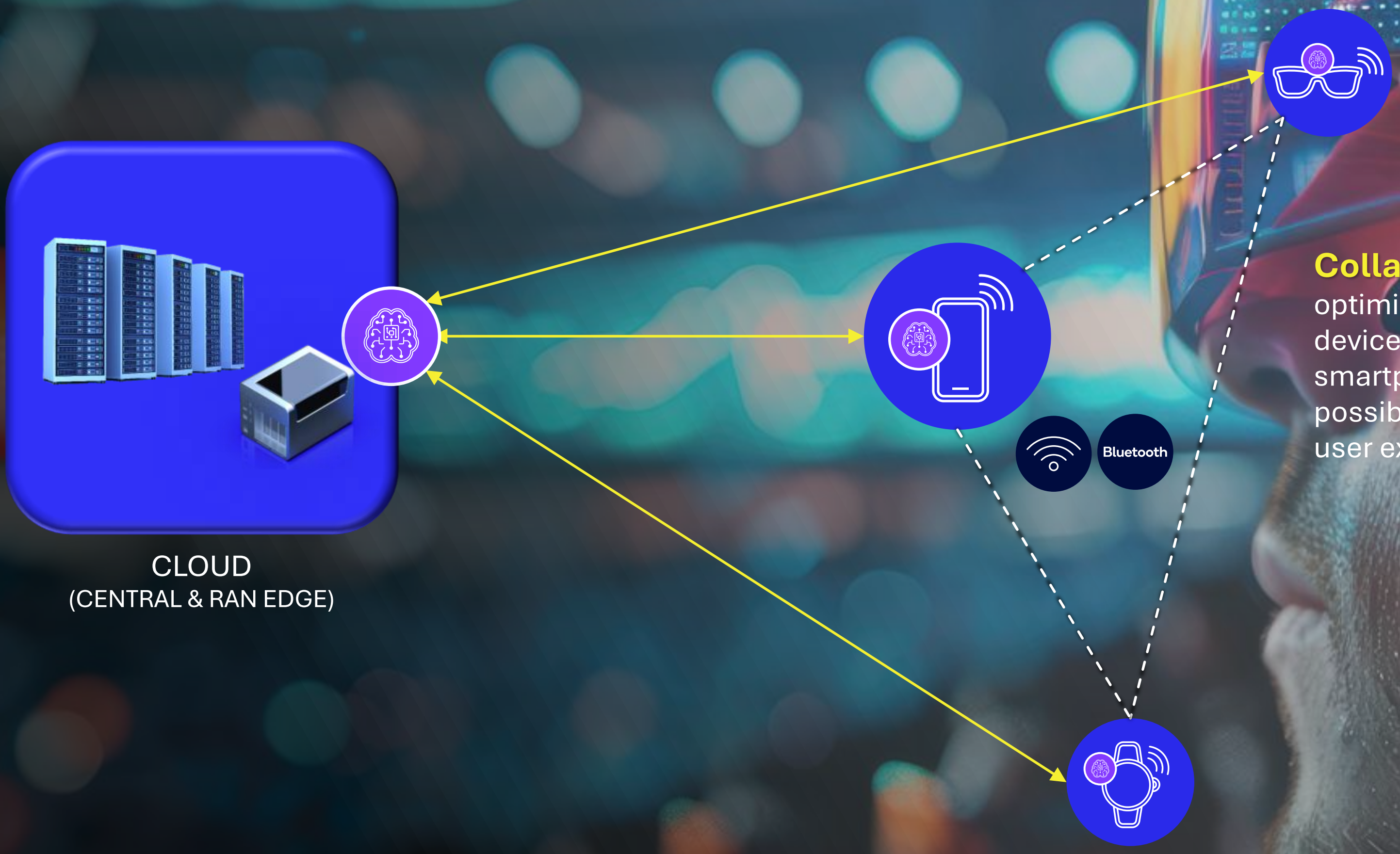
Natural user interface with voice, glass, watch

Persistent and context aware AI Agents

Increasing Uplink Traffic

Delivering consumer AI and XR at scale with distributed compute and collaborative communications

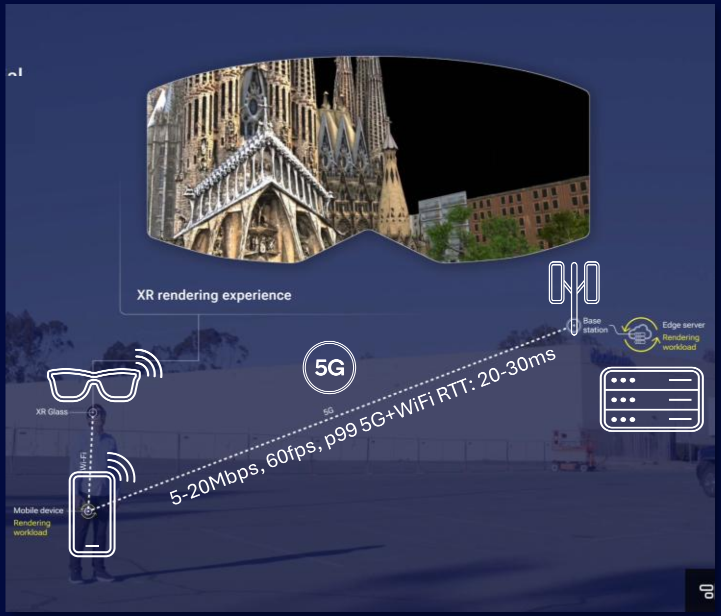
Distributed compute
across devices and network for multimedia and multi-modal AI to meet power, thermal, latency and user experience requirements



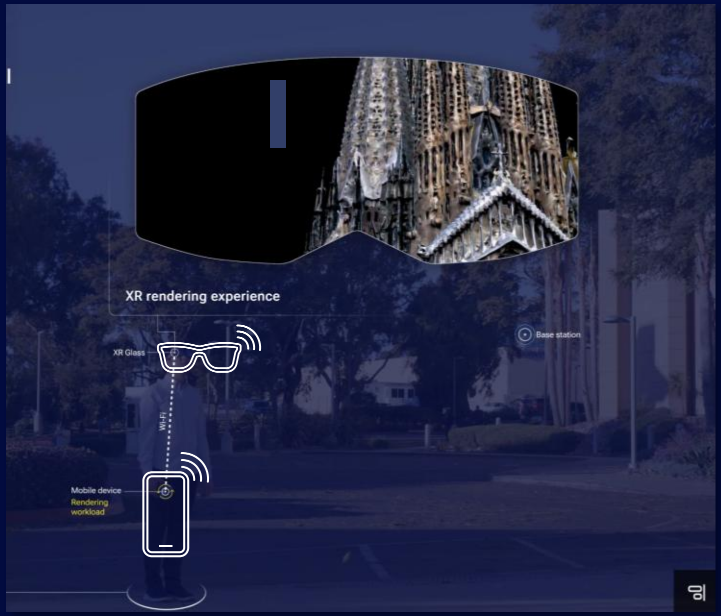
Collaborative communications
optimizes network connectivity for user devices like glasses, watches, and smartphones, ensuring the best possible performance, reliability, and user experience in all conditions

Distributed compute Trials in TMO 5G network (2025)

AR Rendering example



In good RF/network scenarios, compute is offloaded to cloud (remote rendering)



In poor RF/network scenarios, compute is done on device (on-device rendering)

~2X APPLICATION COVERAGE[1] GAIN

~30% SYSTEM CAPACITY[2] GAIN

IMPROVED BATTERY LIFE

Applications

SPORT EVENTS

"Track player 9 and show player stats"

SHOPPING

"How would this dress look on me in blue color"

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6G

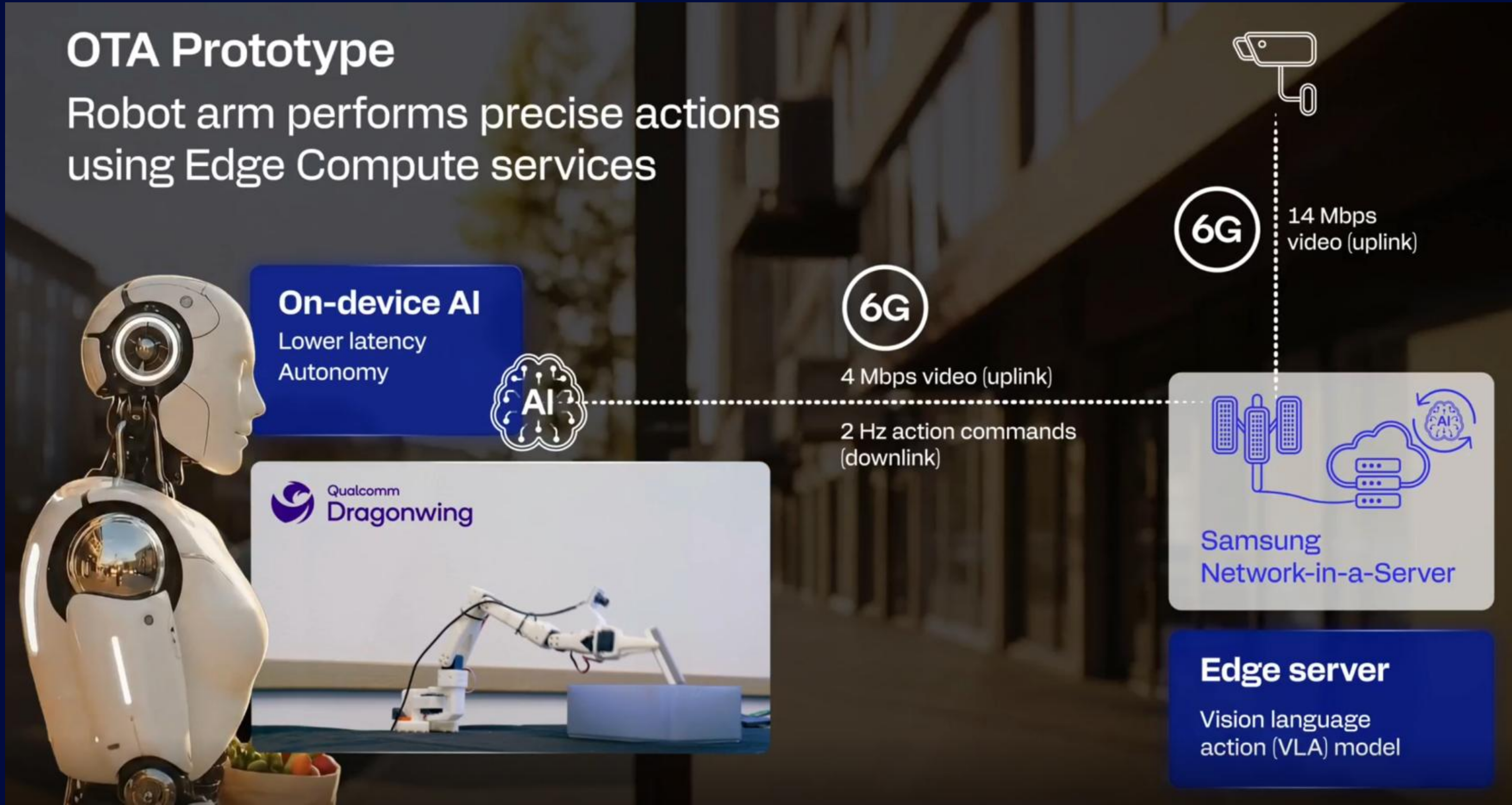
Physical AI Example

A robotic system seamlessly combining on-device AI with edge-hosted VLA models over cellular to perform precise, real-time actions

6G compute-as-a-service supports advanced physical AI applications with larger models, assured QoS, and lower device power consumption

6G Enables Compute and Inference as a Service

Smart connectivity with hybrid AI across device, edge and cloud



AI for 6G connectivity

Context Aware Communication

On-device intelligence for inferring real-time context and enabling adaptive and optimized 6G communication

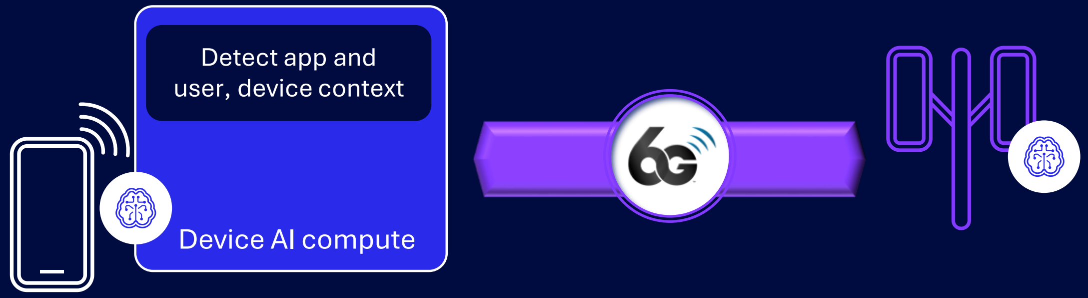
TRAFFIC CONTEXT EXAMPLES

Traffic class : Gaming

Traffic class : OTT call

USER CONTEXT EXAMPLES

User experience : Poor video quality



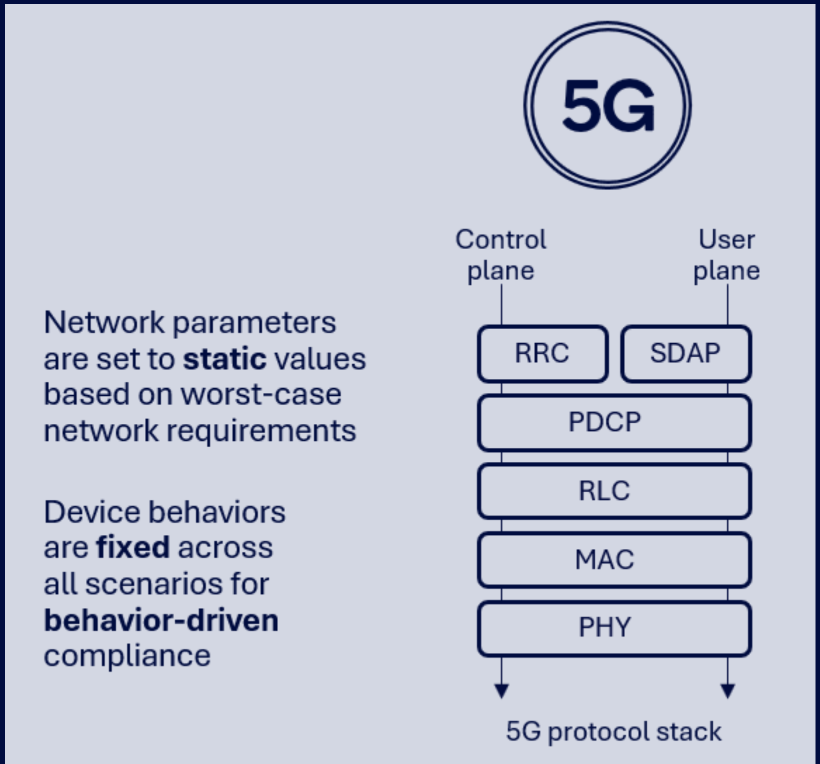
Device can leverage real-time context information for local adaptation of parameters

Device and network collaborate to ensure system is responsive to subscriber intent, user experience, device, and wireless conditions

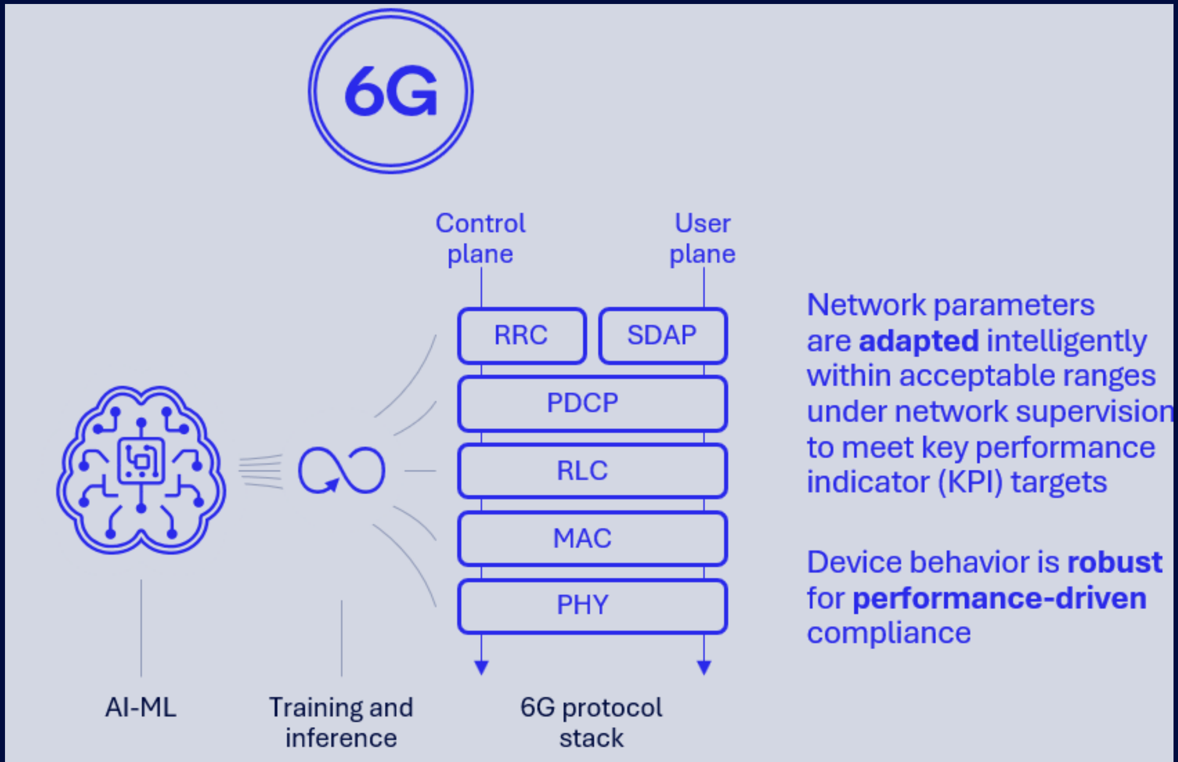
Context Aware Communications: AI-Native Protocols

On-Device AI obtains real-time context information and adapts 6G parameters (e.g., RLC, PDCP)

5G today

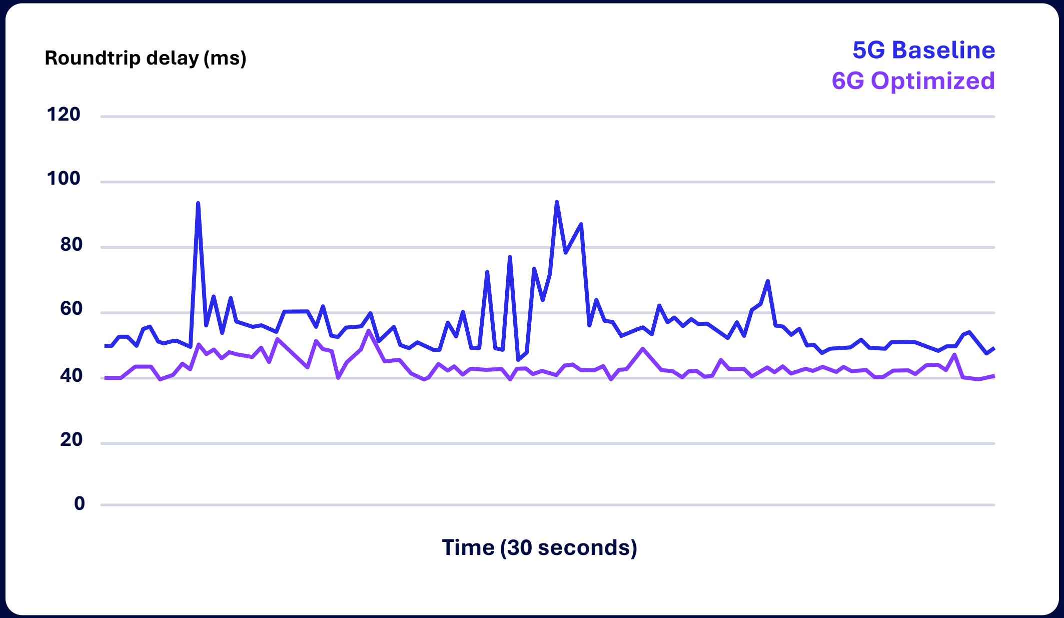


6G AI-Native Protocol



Context Aware Communications: AI-Native Protocols

Over-the-air performance results show significant user experience improvement



Cloud Gaming Application

Dynamically adapted RLC, PDCP parameters reduced latency spikes and improved user experience

Live OTA System

100 MHz BW, 60 FPS, 30 Mbps DL, STEAM-based cloud application, bursty adjacent cell interference

6G network sensing

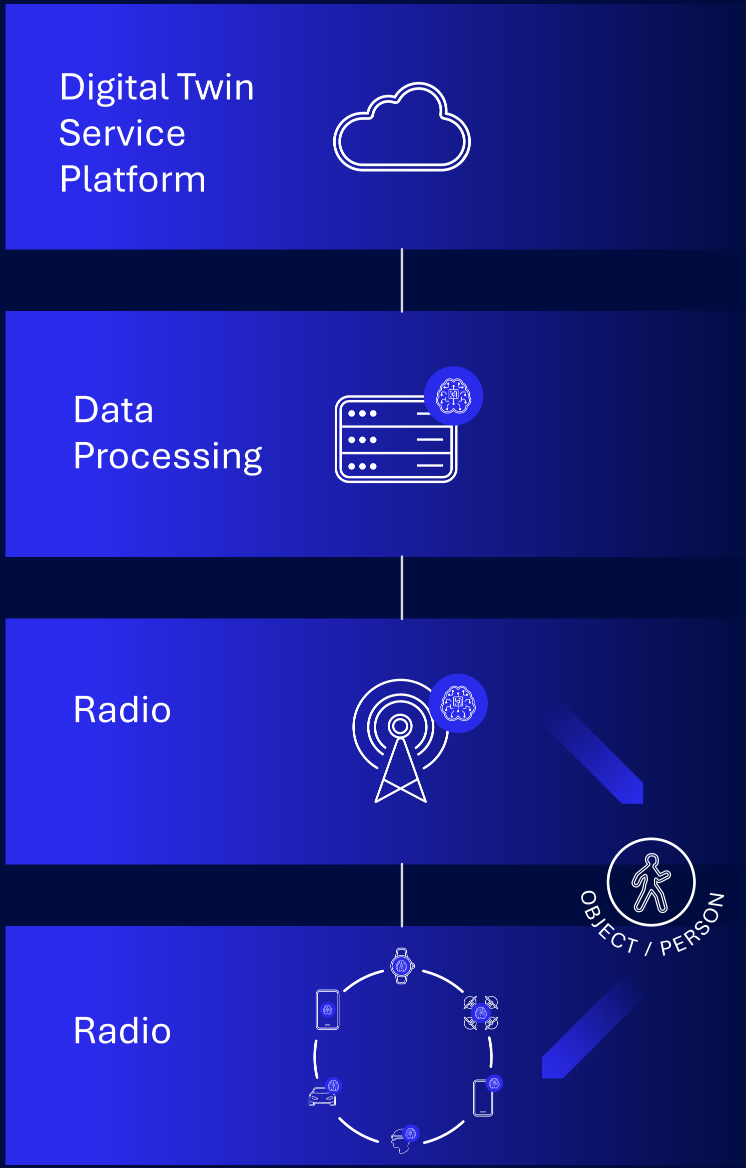
Integrated 6G wireless sensing services

Leverage existing network deployments

Utilize 6G larger bandwidth and MIMO arrays to gain insights into real-time environment

Incorporate 6G device feedback

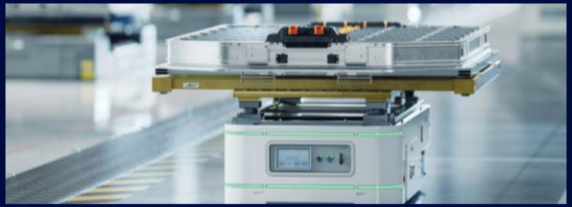
Include other sensor inputs (e.g., vision)



Digital Twin Enabling diverse uses


Drone detection and tracking


Obstacle monitoring on roads/railways


Automated guided vehicles (AGVs) detection & tracking


Intruder Monitoring

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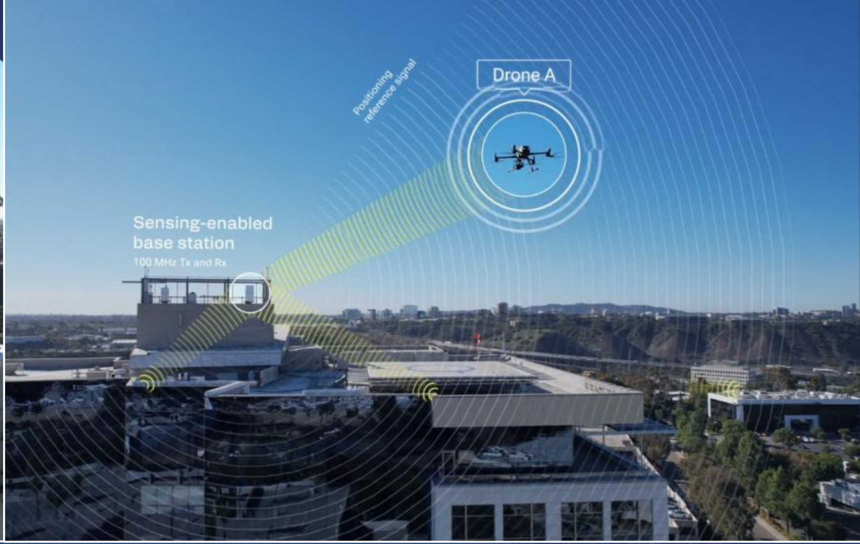
Wide-area aerial sensing

OTA demonstration of aerial object detection using sub-6 GHz spectrum

Classification of detected drones using machine learning

Monostatic sensing



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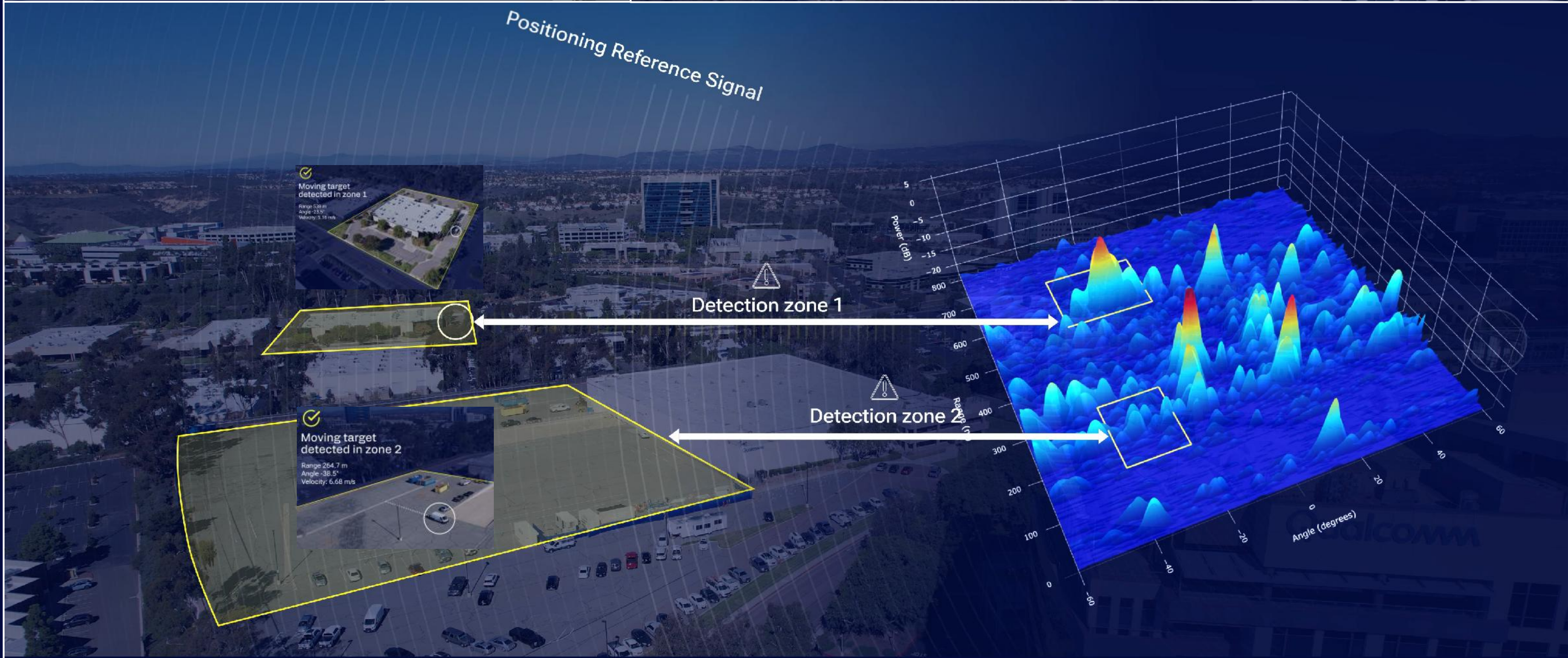
Wide-area ground sensing

OTA demonstration of ground object detection using sub-6 GHz spectrum

Monitor two separate zones for moving vehicle

Monostatic sensing

MWC-B 2026



Received signal ⇨ Background clutter cancellation ⇨ Range-velocity profile estimation — Identify velocity of potential moving targets ⇨ Range-angle profile estimation — Detect targets at identified velocity within region of interest

6G performance

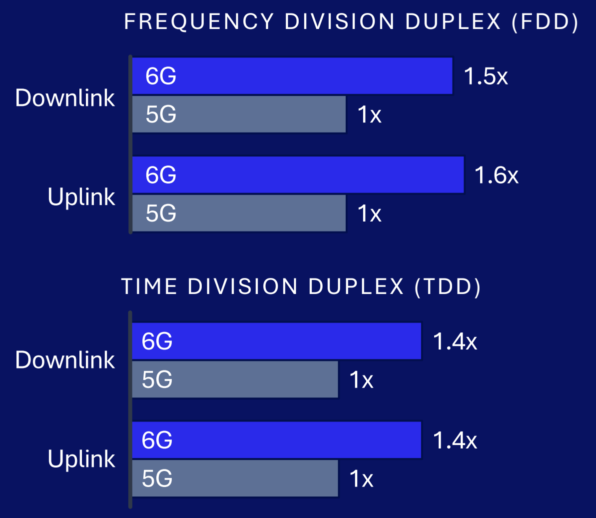
The 6G wideband advantage for new spectrum bands

	KPI	Multi-CC CA e.g., 200 MHz x 2	Single CC e.g., 400 MHz
DEVICE BENEFITS	Power savings with fast bandwidth adaptation	Slow Scell activation (adding CCs) and / or higher UE power w/ activated multi-CC	Fast BWP-based adaptation for low latency UE and network power savings
	Power-efficient uplink transmission	Larger MPR for uplink CA transmission	Improved MPR across wideband single CC Enables wideband low-PAPR waveform
	Lower complexity device hardware	Excessive hardware cost with multi-CC scheduling & configuration	Single CC scheduling simplifies scheduling / configuration and UE modem control
NETWORK BENEFITS	Network efficiency and overhead	Excessive overhead of SSB, broadcast signal, DL control, guard-band per CC	Fast BWP-based adaptation for low latency UE and network power saving
	Network capacity and trunking efficiency	Worse trunking efficiency than wideband CC with typical commercial schedulers	Pooling all aggregated resources as one entity under a single scheduler
	Network RU / RF hardware complexity	More RF challenges to support multi-CCs with a single RF chain Higher cost to have multiple RF chains	Single RF chain to support single wideband contiguous carrier
NEW SERVICE	Wideband sensing and positioning precision	Positioning / sensing accuracy limited by CC BW	High-precision positioning & RF sensing (sub-meter accuracy)

Single 6G **wideband** carrier delivers significant benefits over carrier aggregation

New 6G PHY brings higher spectral efficiency to new and existing bands

50%+ gain in spectral efficiency from a network baseband-only upgrade



EXEMPLARY FEATURES	5G NR	CAPACITY GAP IN DL*	CAPACITY GAP IN UL*	COMPARISONS
Guard-band reduction	8~10% for small BW	Up to 6% in FDD	Up to 6% in FDD	Target up to 98+%
Coding / Modulation, MIMO, Interleaver	QAM + LDPC	20-50% **	10%+	Prob. shaping, SIC-friendly-MIMO mapping Frequency domain interleaver, etc.
Data channel	Slot-level HARQ/DMRS	15-20%	10-15%	Low-overhead DMRS Glue-RS for multi-slot channel estimation DMRS based CQI feedback
UL-MIMO (Advanced receiver diversity + Beamforming)	Open-loop and non-coherent	N/A	10-15%+	Network assisted (UL RSRP-based) Tx antenna selection Facilitate coherent UL MIMO
Low PAPR waveform	Single layer DFT-s	N/A	10-15%+	DFT-s MIMO Low-PAPR DFT-s enhancements
Other data, control channel designs and other changes …				
MU-MIMO ***	eType-2 CSF	20+%	up to 20%	Explicit CSI for DL SB precoding for UL

* Comparison baseline is 5G-Advanced

** Performance gain varies in FDD / TDD and with Doppler

6G timeline

TIMELINE TO 6G

2025 | 2026 | 2027 | 2028 | 2029 | 2030

3GPP
A GLOBAL INITIATIVE

6G Release 20 RAN Study

6G Release 21 Work Item

1st 6G SPECIFICATIONS

6G

MWC 26

MWC 27

MWC 28

LA 28

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Advancing the state of the art in wireless communications

VALIDATING 6G AIR INTERFACE TECHNOLOGIES

EXPLORING NEW 6G SERVICES AND USER EXPERIENCES

Leading to commercial 6G launches

AI IS THE NEW UI

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NEXT-GENERATION DEVICES AND NETWORKS

6G Commercial Launch

Qualcomm Technologies is developing a **6G modem-RF device** solution targeting commercial launch in **2H '29**

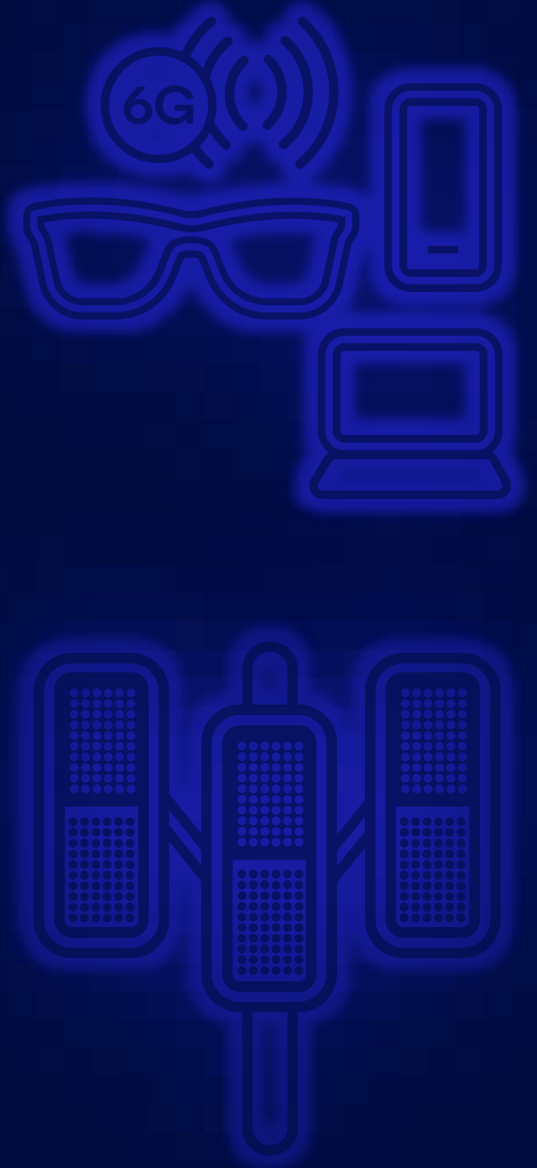
Qualcomm Technologies is also planning to enable the next-generation RU and DU

RU

The future: Power-efficient, AI-driven, 6G-grade, Giga-MIMO with wide area sensing capabilities

DU

Edge-first power-efficient design harnessing datacenter-grade Qualcomm Oryon™ CPUs and Qualcomm® Hexagon™ NPU technology



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