Qualcomm

Empowering next-generation user experiences and services at scale with 6G

@QCOMResearch
September 3rd, 2025

Shaping the digital future

POWERING
the mobile revolution

REDEFINING
connected processing

ENABLING
intelligent computing everywhere

Best-in-class technology across industries

Unrivaled connectivity

High-performance, low-power computing

Leading edge AI

Mobile

Copilot+ PC

Spatial computing

AI wearables

Automotive

Edge networking

Industrial IoT

Edge computing and AI

AI-enhanced user interface is changing consumer behaviors

2025

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 using AI Agents

Changing consumer behaviors

Rise of AI agents

From app-based, user-initiated content consumption…

To persistent context-aware AI agents that observe, sense, and infer

Extension to new form factors

From smartphone only…

To an ecosystem of AI-enabled devices (watches, glasses, earbuds) working together for more natural interactions

Evolving usage patterns

From downlink-heavy traffic…

To sustained traffic growth, especially uplink, driven by AI agents continuously monitoring and sensing across IoT, robotics, AR glasses, …

Today
With smartphones…

2030+
Natural interactions via watch, glass, voice using AI Agents

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

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

"Tell me the history of this building."

AI agents are driving the need for network connectivity

CENTRAL CLOUD

NETWORK EDGE

ON DEVICE

10-20 ms latencies

100+ms latencies

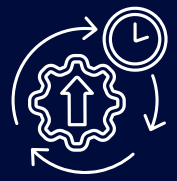
Tiered inferencing is enabling responsive low-latency network

Peta-OPS

Smartphone Today: ~45 TOPs ~7B parameters	**PC** Today: ~45 TOPs ~13B parameters
Glasses Today: ~0.5 TOPs ~1B parameters	**IoT** Today: ~0.1 TOPs <0.5B parameters

On-device AI is enabling context-aware intelligence

Opportunities for AI and wireless to reduce OPEX and enable new services



Real-time network efficiency optimization

TODAY

Early operator efforts to use AI-based predictive maintenance and troubleshooting

FUTURE OPPORTUNITY

Digital Twins enabling full-automation

Enable intent-based orchestration that adapt to user and application needs

Personalized and tiered service pricing

TODAY

Early monetization efforts are emerging (e.g., FWA)

FUTURE OPPORTUNITY

Offer premium experiences, e.g., XR

Enable context-aware pricing, e.g., special events, user intent, ...

New devices and services

TODAY

Network API exposure is in early stages for vertical services (e.g., Linux Foundation's CAMARA project)

FUTURE OPPORTUNITY

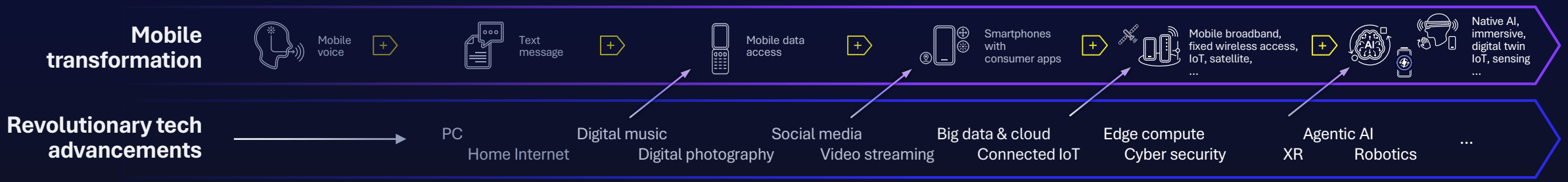
Inference and sensing as a service

New device subscriptions (e.g., glasses, drones, cars, robots, and others)

Mobile technology profoundly reshapes our world

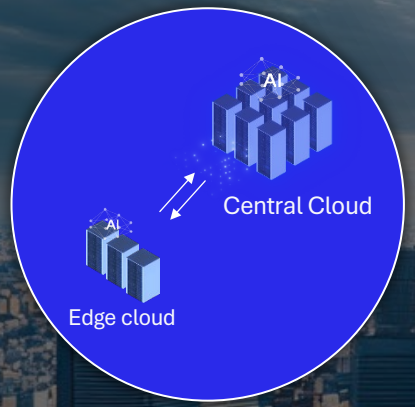
Decade-defining leaps: enabling aligned investments and leveraging significant technology advancements

1G	2G	3G	4G	5G	6G
1980s	1990s	2000s	2010s	2020s	2030s
Analog voice	Digital voice	Wireless Internet	Mobile broadband	Connected intelligent edge	**Next-gen wireless**



Global ecosystem aligned to launch 6G in 2030

6G will connect an expanded set of AI-powered devices and enable new services



Enabling tiered AI inferencing
on device, at network edge, and cloud

The smartphone remains the primary mobile hub for connectivity and compute

AI-powered consumer devices (glasses, watches, PCs) with cellular connectivity

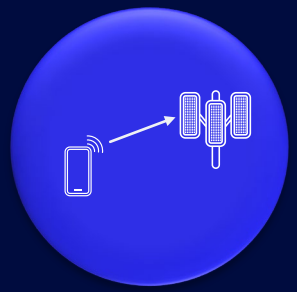
AI-powered IoT devices, robots, and cars with cellular connectivity

We are driving 6G foundational technology development

AI is unlocking new opportunities to bring performance improvements

Improving spectral efficiency in existing 5G FDD / TDD spectrum bands with baseband-only upgrade

TARGET:
~1.5x downlink & uplink capacity gains in FDD/TDD spectrum bands



Focusing on improving uplink coverage and capacity even at the cell edge

TARGET:
2-5x uplink edge data rate

Unlocking broadband in upper mid-band spectrum (e.g., 6-8 GHz)

TARGET:
~5x traffic load and ~3x downlink speed gains thru retrofitting existing cell sites with wideband 6G systems using 100-400 MHz channel sizes

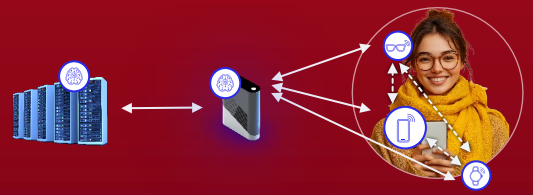
Optimizing 6G network deployment cost and device performance

TARGET:
~1/3 decoding complexity and ~50% less HARQ memory

WIDE RANGE OF 6G ENABLING TECHNOLOGIES

We are driving 6G technology to enable new user experiences and services at scale

Agentic AI and Extended reality experiences



Examples: Personal assistant, “see what I see”, avatar calling

TECHNOLOGY ENABLERS

Collaborative communications

Distributed compute

AI-enabled context-aware communications

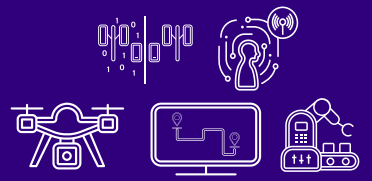
Examples: gaming and enhanced IoT services

TECHNOLOGY ENABLERS

AI-native protocol

UX-aware RAN

AI-enhanced network efficiency and services



Examples: context-aware pricing, drone sensing, device tracking

TECHNOLOGY ENABLERS

Digital twin network

Inferencing and sensing

6G INNOVATION

Agentic AI and extended reality experiences

Collaborative communications
Distributed compute

Agentic AI and extended reality experiences will fuel wireless growth

	PERSONAL AI ASSISTANT	SEE WHAT I SEE
		
DESCRIPTION	Real-time responses to user queries	Live video streaming of the user's surrounding
TRAFFIC REQUIREMENT	UL: 1-5 Mbps (image, video, audio) DL: 1-5 Mbps (AR overlays, voice) Latency: 100 ms	UL: 1-20 Mbps (video, audio) DL: 1-5 Mbps (AR feeds, overlays) Latency: 100+ ms

	AVATAR CALLING	PERSONALIZED EXPERIENCES
		
DESCRIPTION	Realistic and lively interactions	Digital Companions, Interactive gaming
TRAFFIC REQUIREMENT	UL: 1-10 Mbps (compressed avatar formats) DL: 1-100 Mbps (multi-party calls) Latency: 10 -30 ms	UL: 1-10 Mbps (video, audio, sensors) DL: 5-100 Mbps (2D/3D video) Latency: 10-30 ms

Data volume per application far exceeds the current average mobile user volume of 19 GB/month[2]

USER DATA VOLUME ESTIMATES

See what I see
50GB/month
10Mbps UL, 1Mbps DL,
20mins per day
90% uplink

Personal Assistant
44 GB/month
2.5Mbps UL and DL
40mins per day
50% uplink

Significant spectrum required to scale XR services

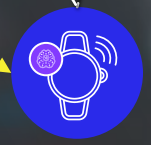
Channel Bandwidth	100MHz	~500MHz
Cell Capacity 45 Mbps DL 10 Mbps UL	~ 5 users/ cell [1]	>25 users/cell needed

Source: Qualcomm estimates:
1. Based on 3GPP TR 38.838 "Study on XR Enhancements for NR" for Dense Urban deployment, 80% indoor users projecting ~2-6 users/cell @45Mbps and 10ms latencies DL; ~4-9 users/cell @10Mbps and 30ms latencies UL
2. Ericsson Mobility Report, June 2025

Delivering agentic AI and extended reality 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

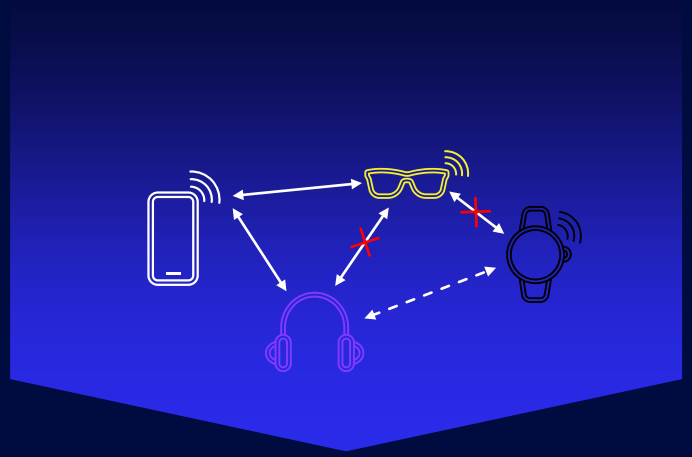
CLOUD
(CENTRAL & RAN EDGE)

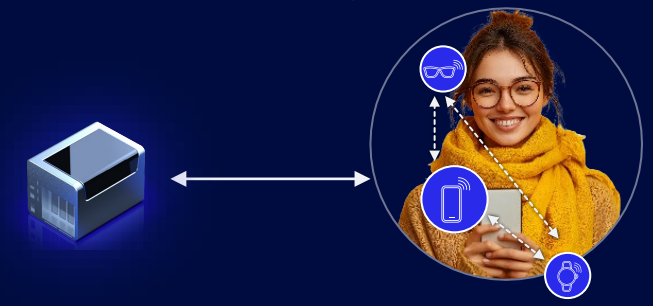


Collaborative communications
optimizes network connectivity for user devices like glasses, watches, and smartphones, ensuring the best possible performance, reliability, and user experience in all conditions

6G Collaborative communications can enhance user experience

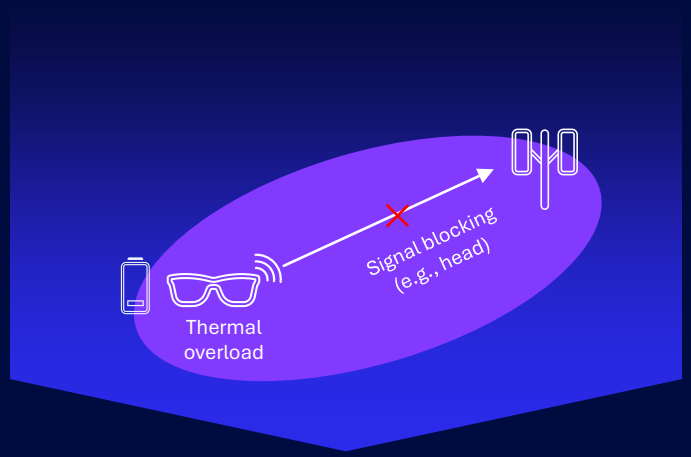
Seamless operations

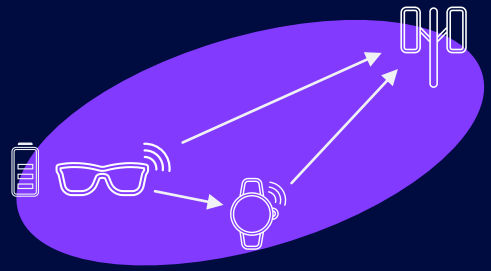




Leveraging standards-based features for seamless operations

Improved reliability and user satisfaction

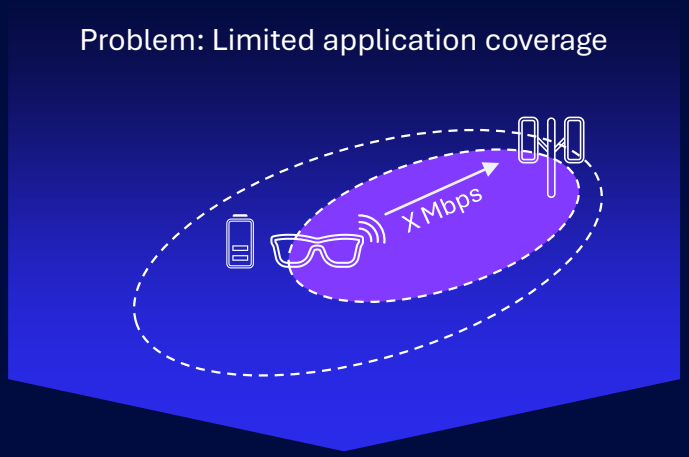


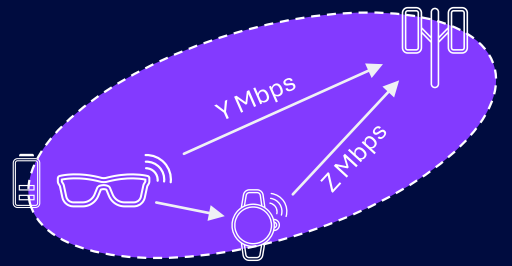


Path diversity mitigates blocking; Traffic splitting meet thermal requirements

Enhanced application coverage

Problem: Limited application coverage



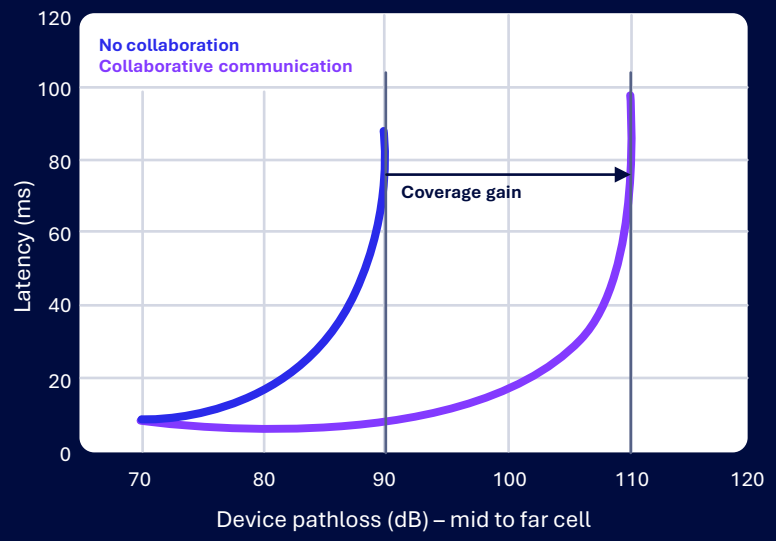


Traffic splitting can extend application coverage

Analysis show tangible user experience improvements

Improved coverage[1] with device body shadowing

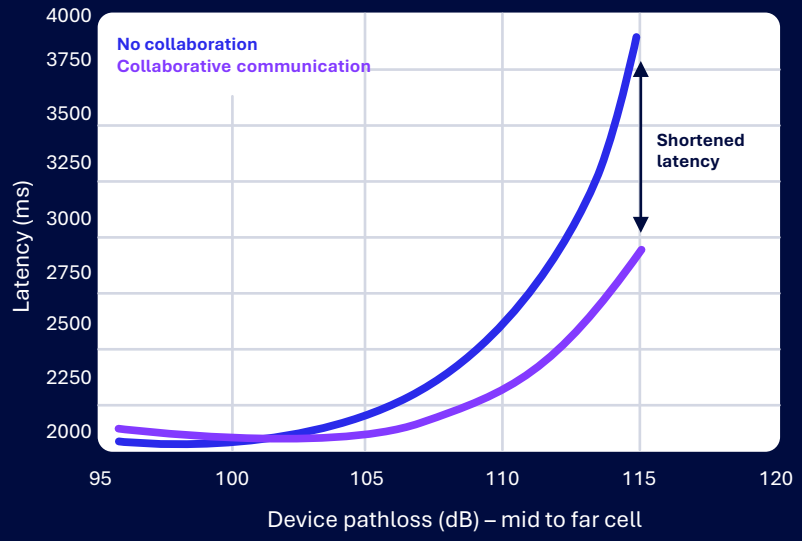
LATENCY VS. PATHLOSS (95TH PERCENTILE)



Augmented reality multimedia calling with glasses and watch

Improved Query-to-response (Q2R) latency[2]

MEAN Q2R LATENCY VS. PATHLOSS



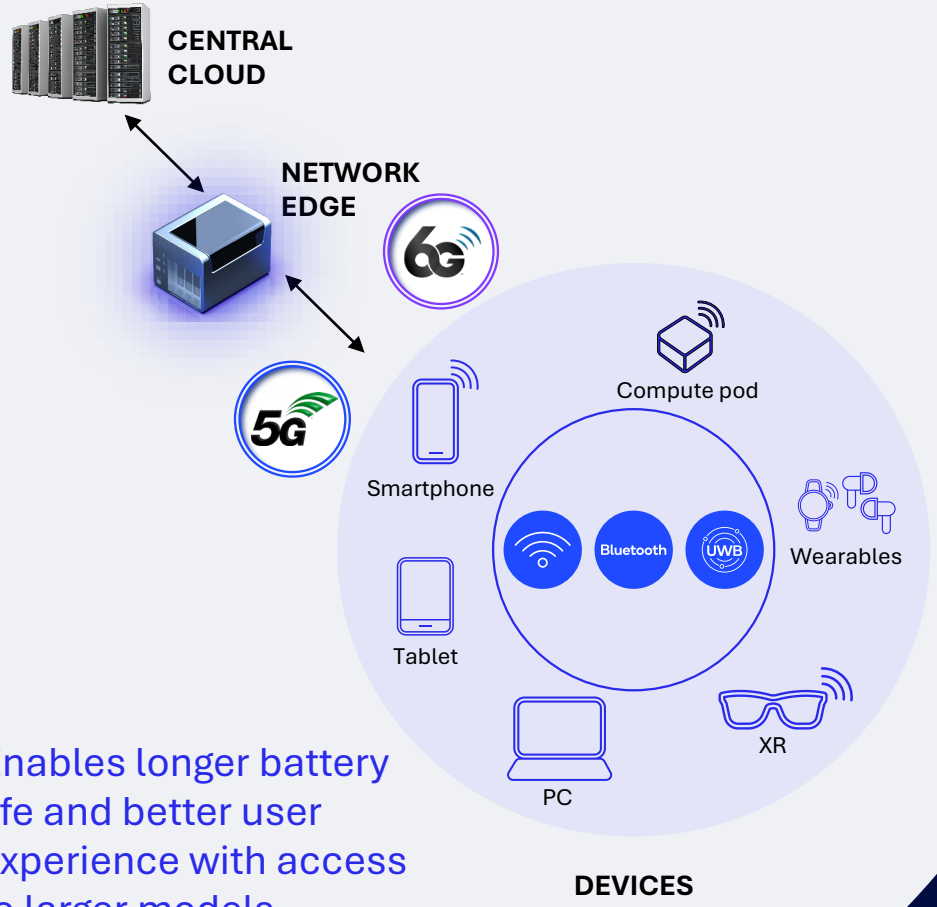
Multi-modal AI query with glasses and watch

1 2Mbps periodic traffic, 100ms packet delay bound. Uplink data routed via companion device due to body shadowing. 3GPP UMa with 100% outdoor UEs, 100MHz BW, Devices have 20dBm max Tx Power

2 Query is a ~150KB burst of audio

Distribute compute

Workloads are distributed across the network and devices



Enables longer battery life and better user experience with access to larger models

Rendering

Generating visuals

2D/3D Graphics, personalized content

Perception

Environment understanding and user tracking

Scene understanding, object recognition and tracking, 3D reconstruction

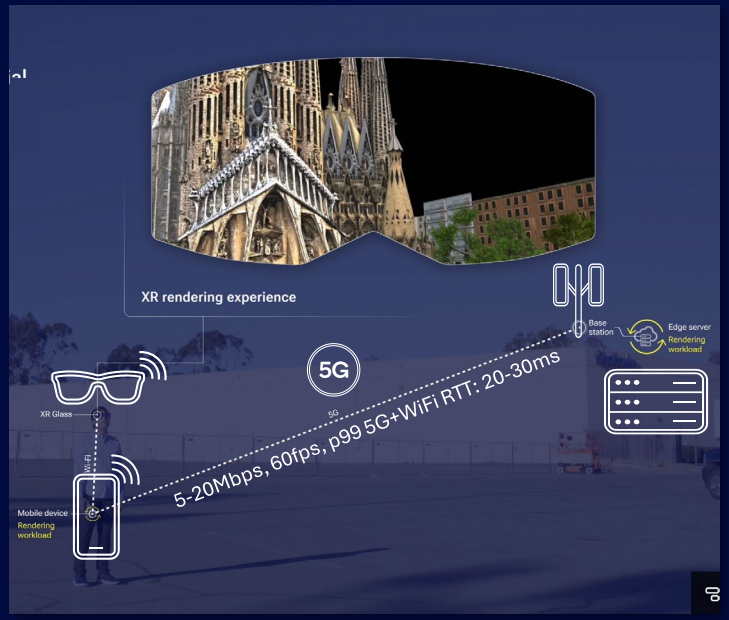
Generative AI

Enhancing user experiences

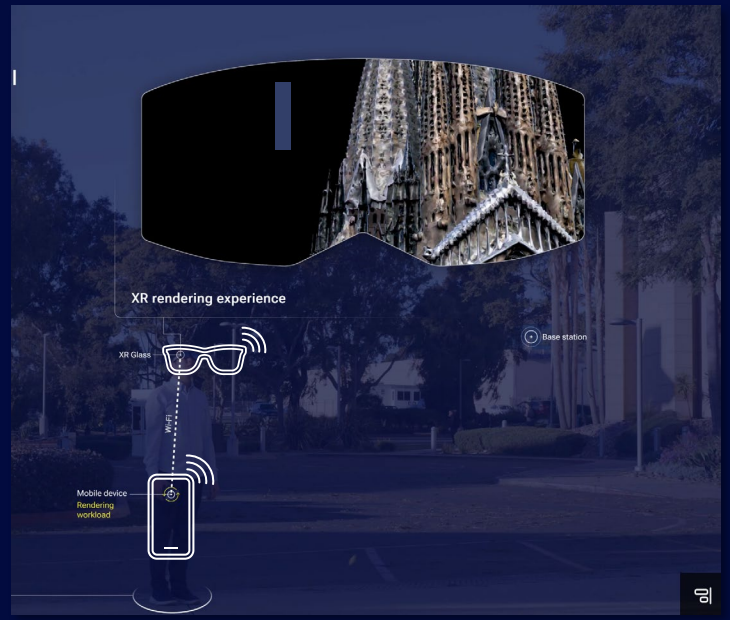
Digital Companions, video editing, 3D maps, language processing

Distributed compute

Distributed 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)

Joint XR trial on 5G Standalone network

T-Mobile | Ericsson | Qualcomm

On-device APIs enabled applications to seamlessly distribute rendering workloads

More information on the trial

Joint Press Release from MWC'25

6G Distributed compute can offer benefits for the wireless ecosystem

Mobile operators

New monetization opportunities with compute and AI as-a-service, with privacy and security

End users

Access to larger models and better device battery life and user experience

Example Network Functions

- Multi-user compute-communications scheduler
- Edge compute discovery and management
- Architecture and data management

Example Device Functions

- Application workload and QoS[1] requests
- User experience and KPI[2] requirements
- On-device compute capabilities

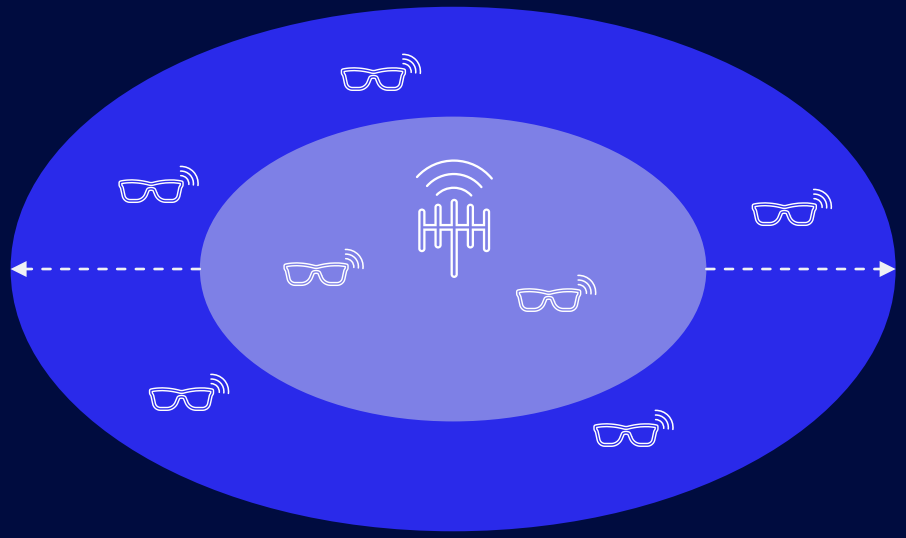
6G can orchestrate communication and compute workload requirements across devices

1 Quality of service; 2 Key performance indicator

Analysis show compelling coverage and capacity benefits

Rendering example

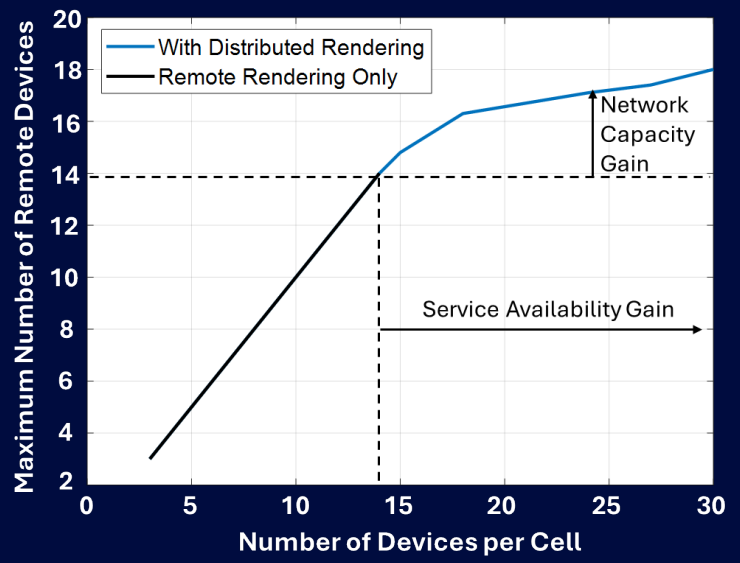
ACHIEVING ~2X APPLICATION COVERAGE[1] GAIN



With remote rendering, application coverage is limited to device with good SNR that meet rendering performance requirements

With distributed rendering, device can improve application coverage by switching between local and remote compute based on radio conditions

ACHIEVING ~30% SYSTEM CAPACITY[2] GAIN



With remote rendering, cell capacity is limited to devices that meet rendering performance requirements

With distributed rendering, network can support more remote rendering devices by switching devices between local and remote compute based on available resources

1 Assume 100MHz BW, loaded cell with device under test (DUT) supporting 25Mbps XR traffic with 25ms PDB and background devices with full buffer traffic;

2 Assume 100MHz BW, loaded cell with all devices supporting XR 25Mbps traffic with 25ms Packet delay bound; Collaborative application includes 2Mbps traffic to maintain state across users

6G INNOVATION

AI-enabled context-aware communications

AI-native protocol
UX-aware RAN

6G can leverage on-device AI to infer and share real-time context with the network

APP CONTEXT EXAMPLES

Gaming

AR call

Compute workloads

USER CONTEXT EXAMPLES

User inattentive vs. on-screen

Poor UX

User wireless conditions

DEVICE CONTEXT EXAMPLES

Battery levels

Compute availability

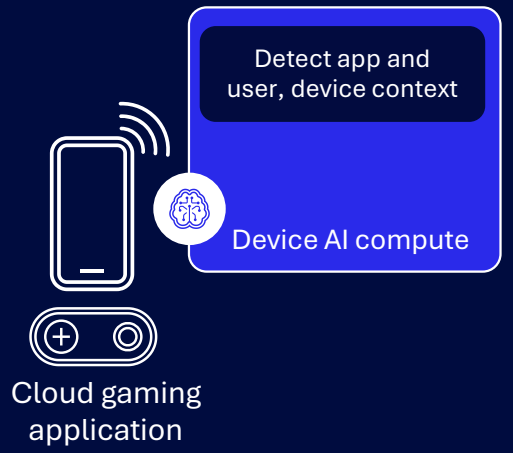
SAR, exposure

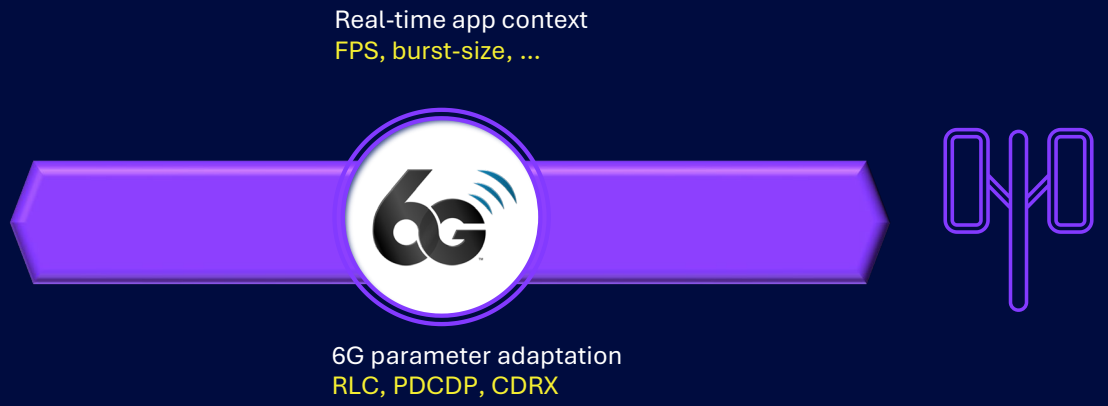
Enabling subscriber intent-based RAN optimization

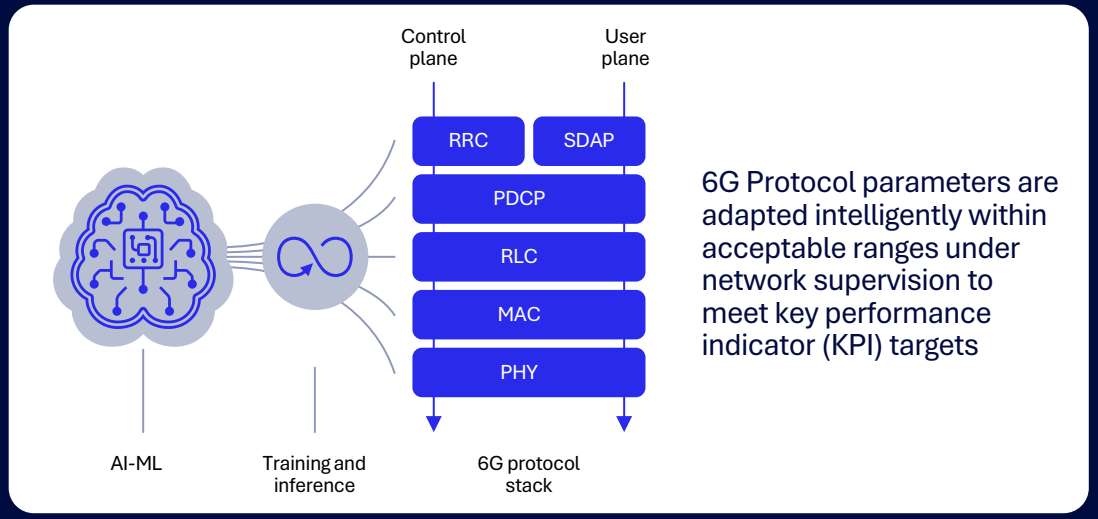
Device can leverage real-time context information in adaptation

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

Real-time application context from devices can enable AI-native protocols

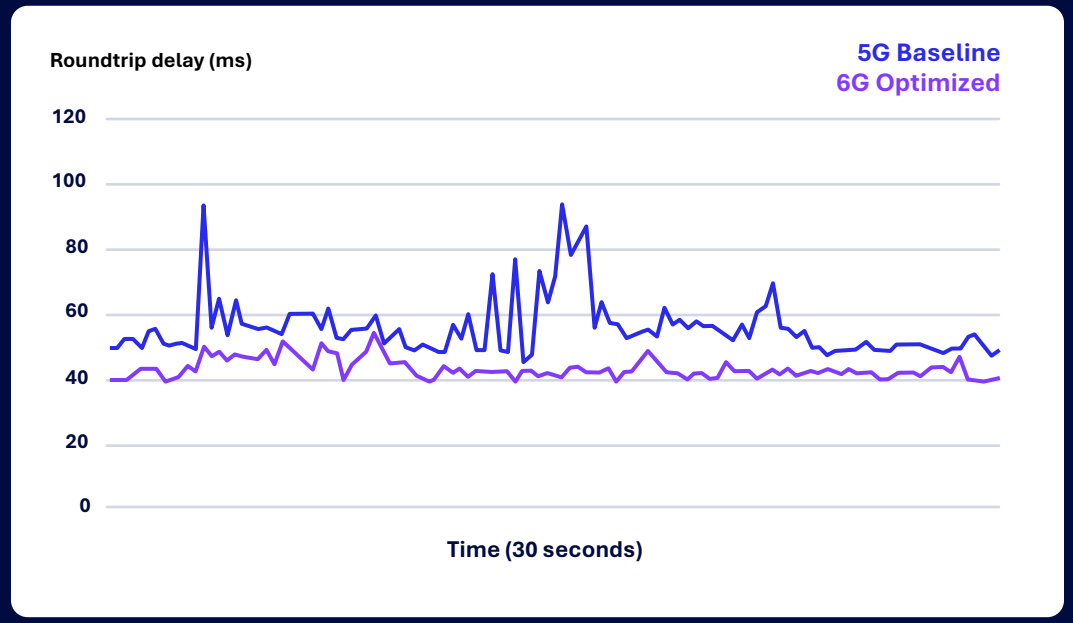


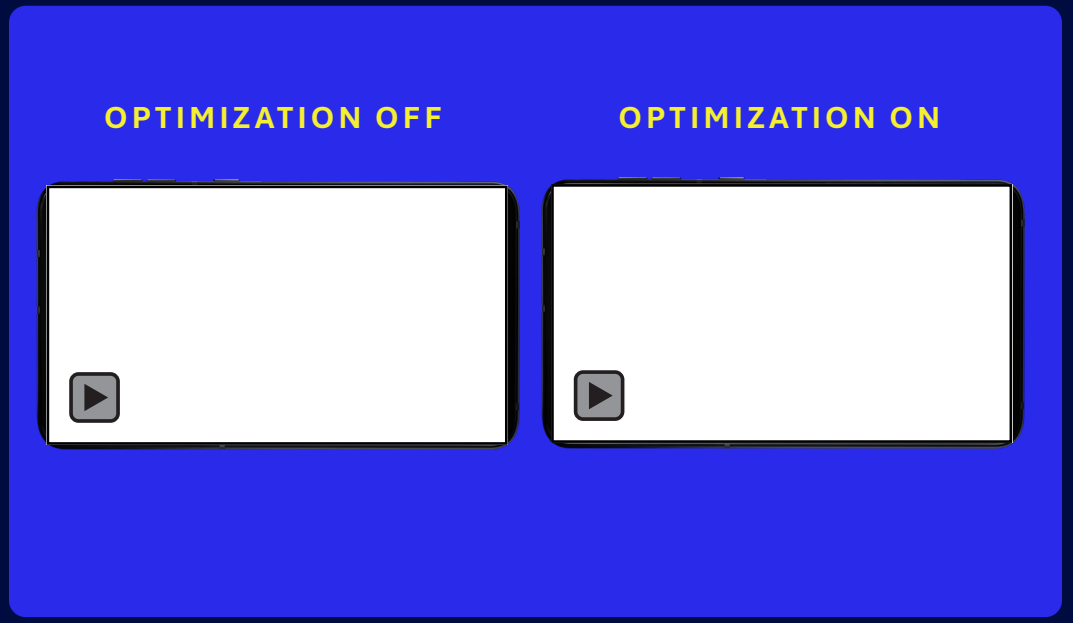




6G Protocol parameters are adapted intelligently within acceptable ranges under network supervision to meet key performance indicator (KPI) targets

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

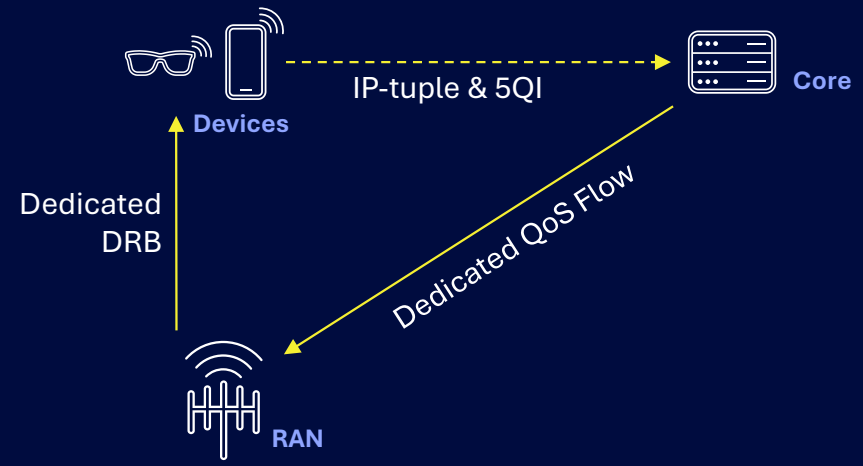
Live OTA System

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

On-device AI can enable a richer and more dynamic QoS

TODAY

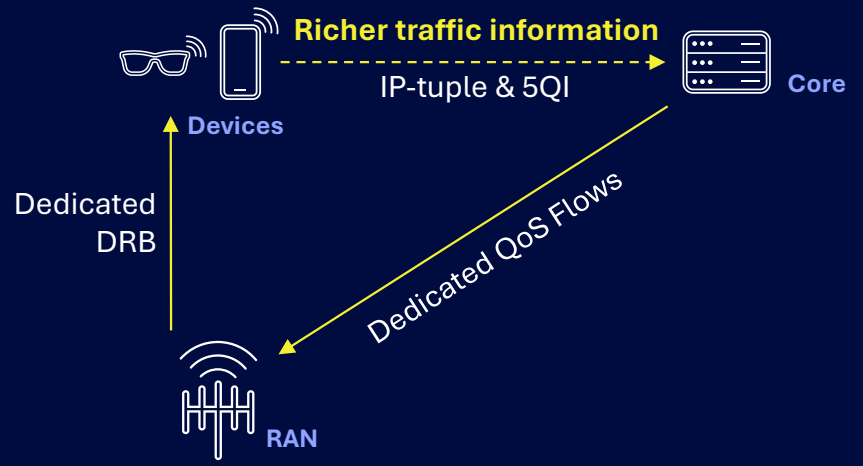
Device-initiated QoS



3GPP standards already support
IP-tuple and 5QI input from devices

EVOLUTION

Enabling richer and dynamic QoS



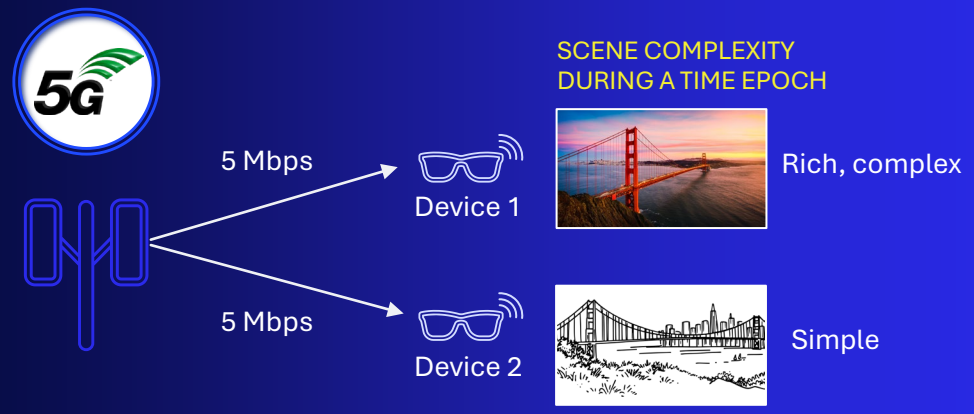
Richer traffic information

- Traffic class (e.g., app class, app name)
- Traffic pattern (e.g., burst duration, burst size)
- Traffic sub-flows within IP tuple (e.g., audio vs. animation)

DRB is Data Radio Bearer

On-device AI can enable UX-aware RAN

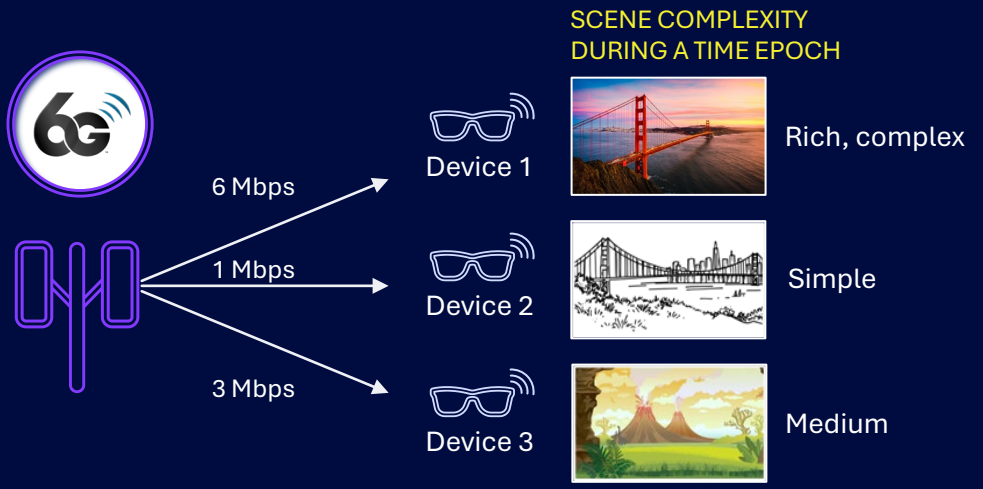
Devices provide real-time UX and content complexity inputs
Network can exploit ‘multi-user content diversity’ to improve resource allocation, coverage and capacity



5G resource allocation does not incorporate real-time UX

For example, a burst of complex content may result in user experience degradation

Inefficient resource allocation wastes capacity



6G resource allocation can incorporate real-time UX

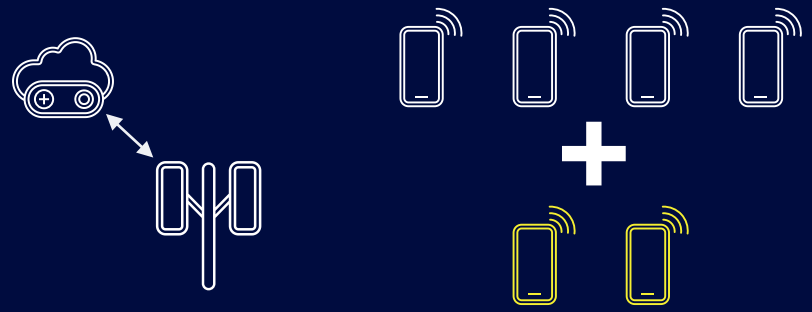
For example, a burst of complex content can get more resources to satisfy user experience

Efficient use of resources leads to capacity and coverage benefit

Analysis show real-time UX-aware RAN benefits

Comparing UX-aware RAN traffic scheduling with a baseline with proportional fair scheduler

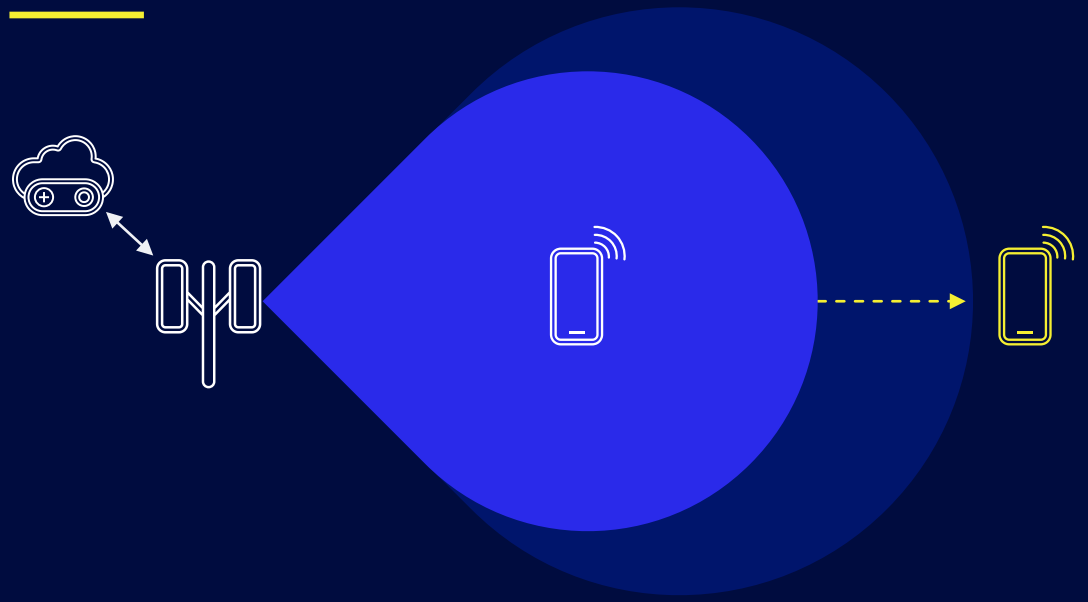
Improve network capacity[1] by 50%



Simulating urban macro network operating in midband with 100MHz bandwidth, utilizing cloud gaming traffic profile with <50Mbps throughput with 60fps framerate

Resulting in capacity improvement from 4 to 6 devices per cell

Improve application coverage by 30% and reduce 99th-percentile latency by 25%



Resulting in 30% more users with satisfactory user experience as well as 99th-percentile latency reduction of 25%

1 Capacity = number of devices per cell at which 90% of devices meet their target UX (35 dB PSNR)

6G INNOVATION

AI-enhanced network efficiency and services

Digital twin network
Inferencing and sensing services

6G can enable a real-time digital twin platform

Enable live network modelling and enabling new services

SMART CITY

Incorporate device RF and sensing data

Enable environment and perimeter safety and presence detection

AUTONOMOUS TRANSPORTATION

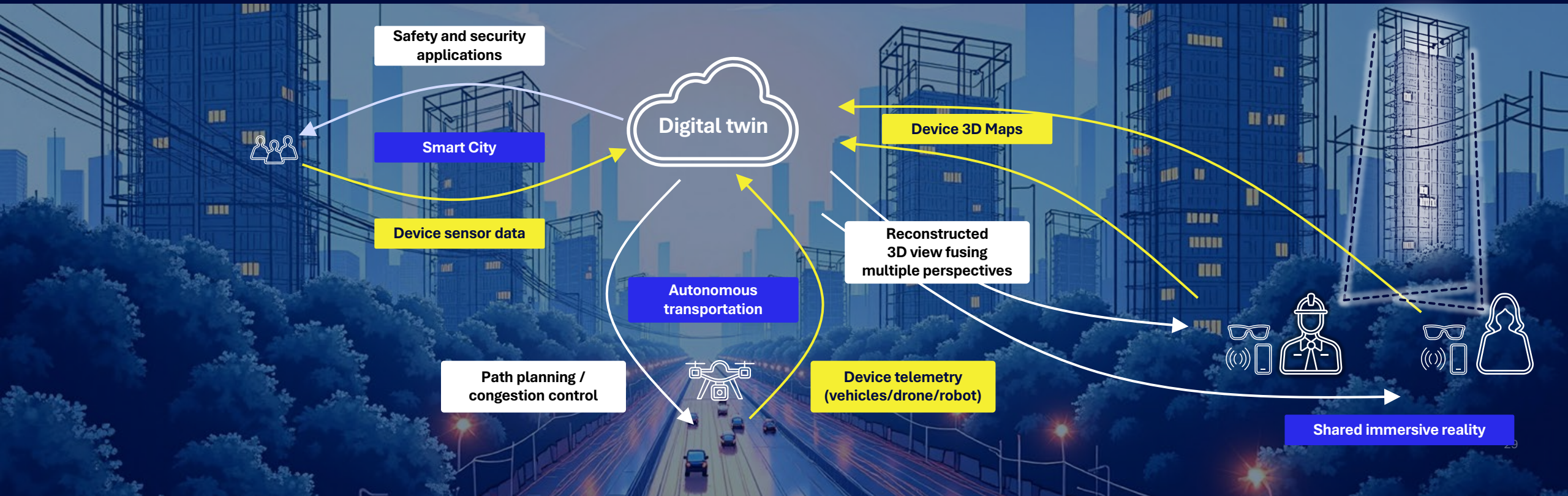
Incorporate vehicle/drone/robot telemetry

Enabling path planning, congestion control and alerts

IMMERSIVE REALITY

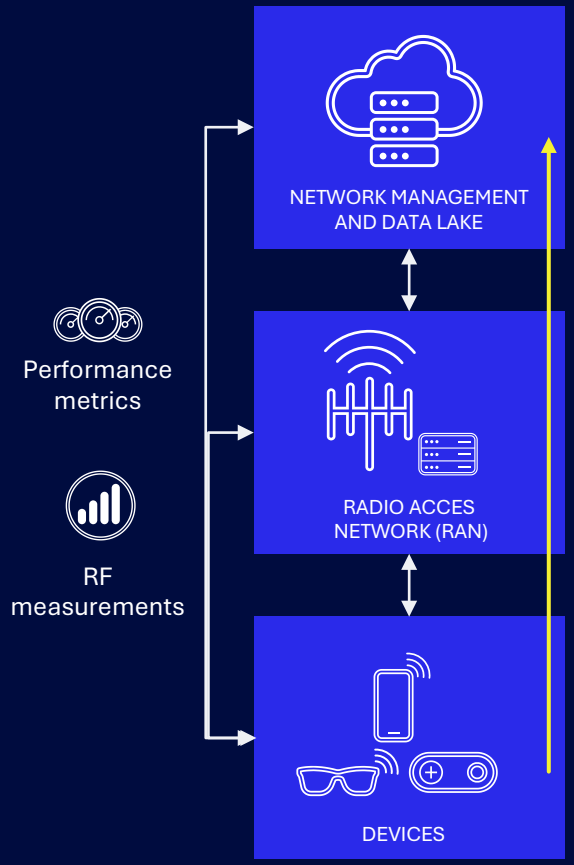
Incorporate 3D maps from devices

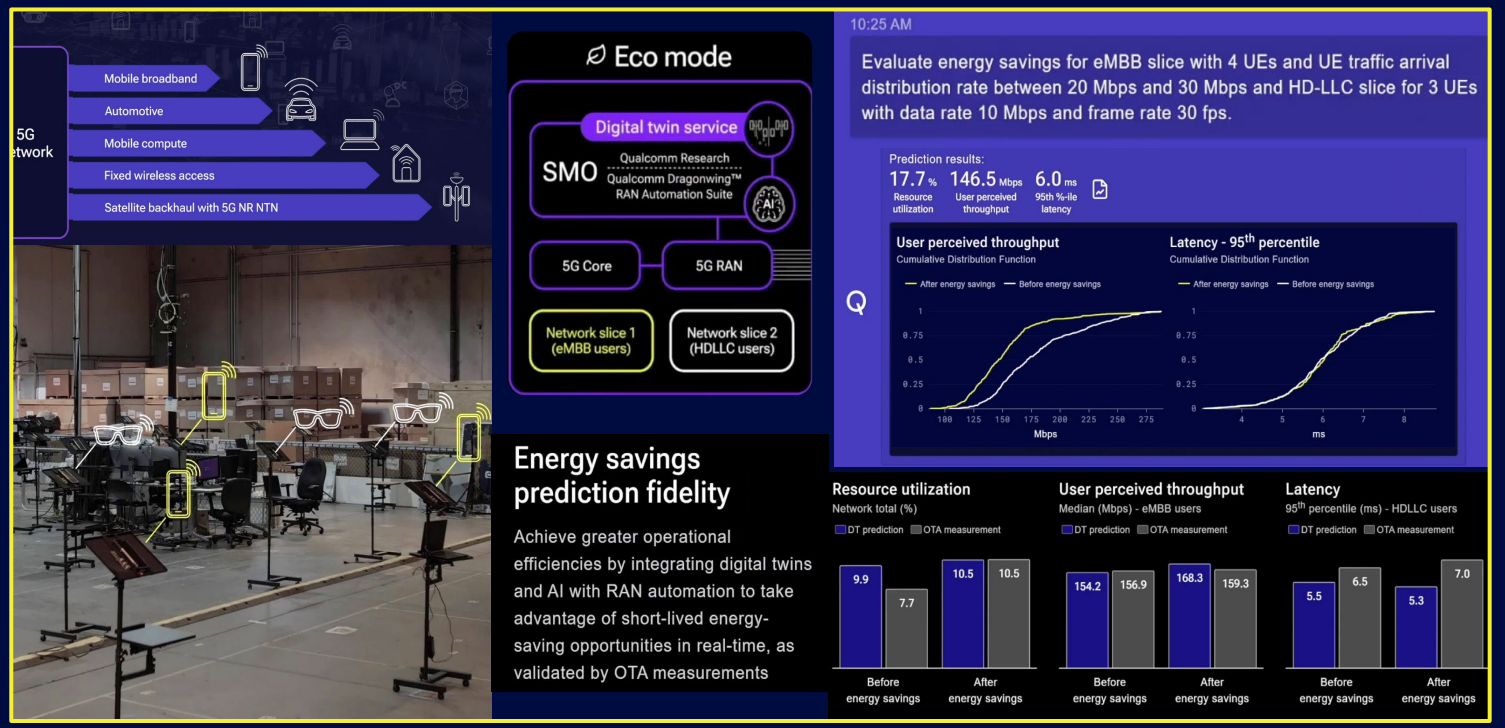
Reconstruction of 3D environment by fusing views across XR users



Example of 6G enabled digital twin-based network automation

Reducing Operating expenses
Enabling new monetization avenues such as context-aware experiences and user-service assurances





6G device feedback can help calibrate and improve accuracy of network digital twin

Example: Automating network energy savings using digital twins.
Shutting off carriers on gNodeB based on real-time usage.

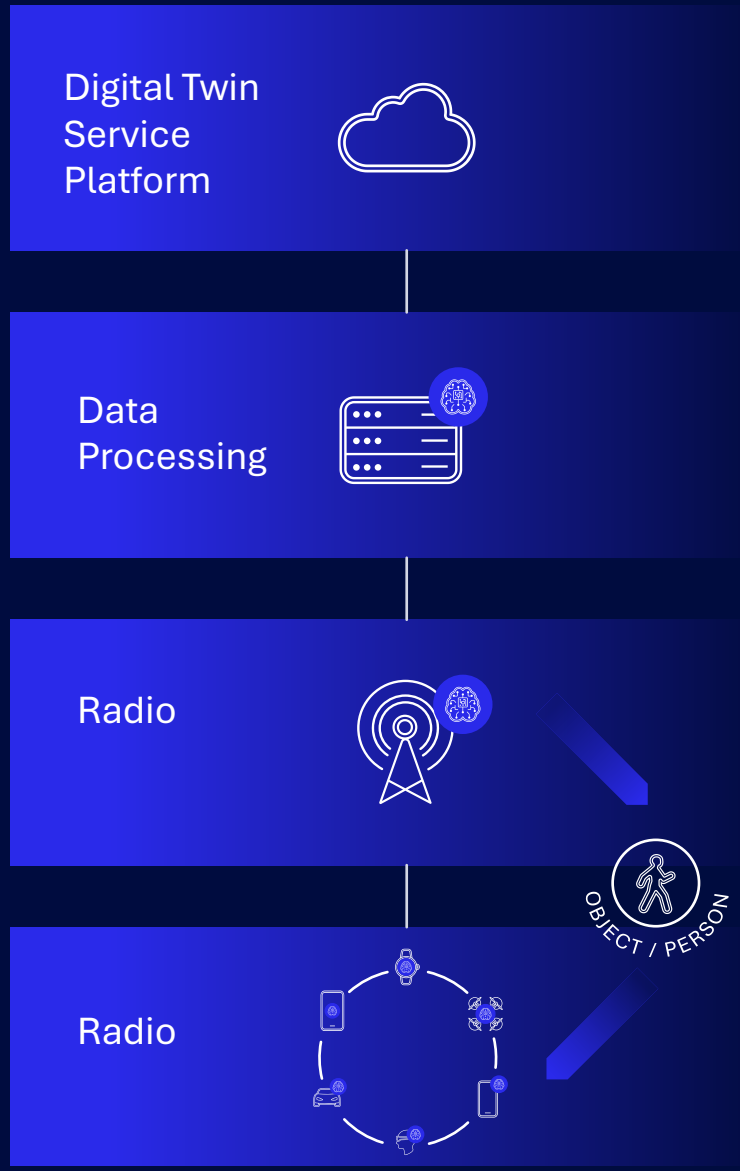
Integrated 6G wireless sensing services

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

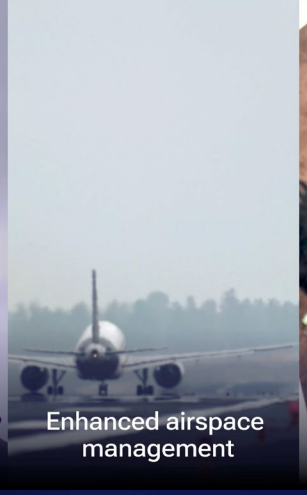
Qualcomm MWCB 2025

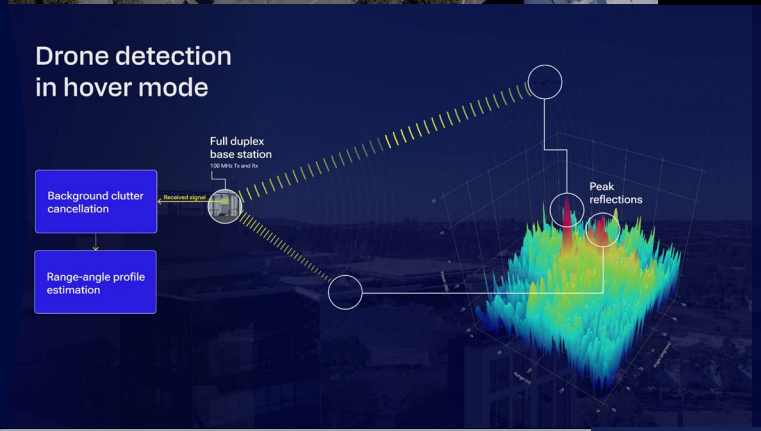
Enabling security and public safety applications via drone sensing

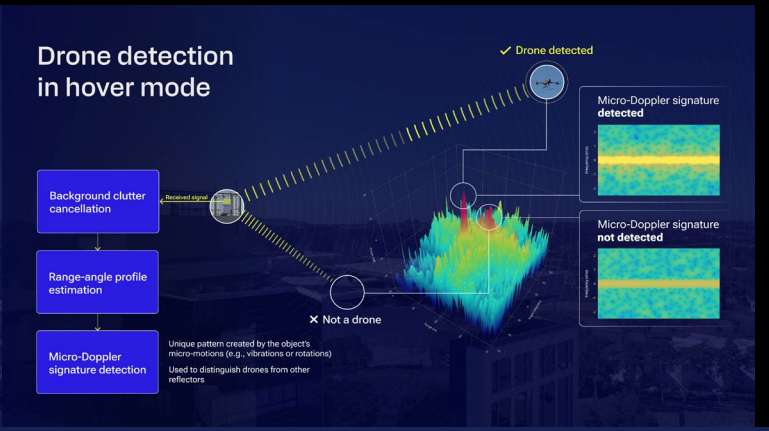
5G advanced Live over-the-air validation

- 3.5 GHz 5G Advanced testbed
- Detect hovering drones within 300 meters range of the base station
- Accurately estimate drone speed by analyzing Doppler signatures

6G larger bandwidth and MIMO arrays will further improve sensing robustness







Network inference and compute services

Enabling workload offloading across device types, with privacy and security

Enabling devices to access and run larger and personalized AI models

Reduce device power consumption

6G can orchestrate communication requirements and compute workloads across devices

Rendering
Generating visuals

Perception
Scene and user understanding

Generative AI
User experiences

1 Quality of service; 2 Key performance indicator

Empowering next-generation user experiences and services at scale with 6G

Advancements in wireless, edge AI, XR and low-power compute are enabling new digital experiences and interactions

6G is being designed to meet next-generation user experience and service demands in the era of advanced intelligence

We are driving cutting-edge technology innovations to enable new and enhanced user experiences and services

Thank you

Follow us on:

For more information, visit us at qualcomm.com & qualcomm.com/blog