

Innovating for the next generation of wireless connectivity

6G

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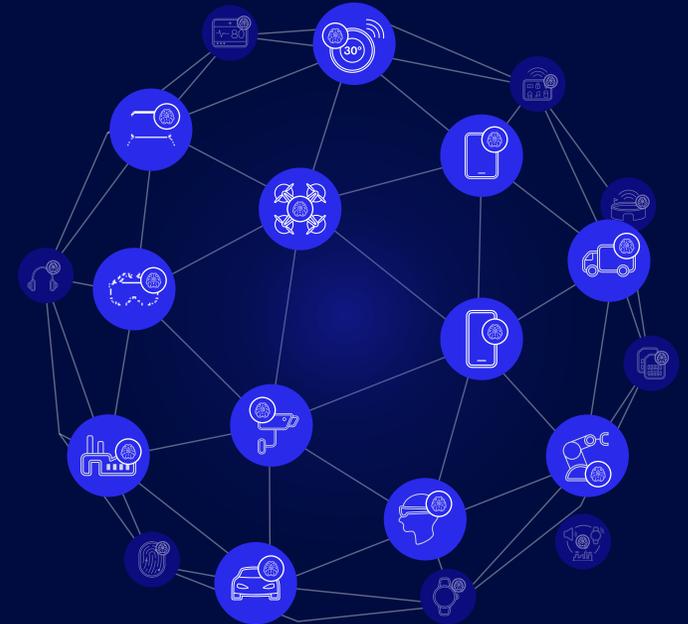
Shaping the digital future



Powering the mobile revolution



Redefining connected processing



Enabling intelligent computing everywhere

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

Central cloud

VERY LARGE MODELS

Ease of development
& deployment
Training

Aggregation
Absolute performance



Hybrid AI

Distribute loads across
cloud and devices

On-device

LARGE MODELS

Performance & efficiency
Privacy & security
Immediacy
Reliability
Personalization



Edge cloud

(on-prem or nearby)



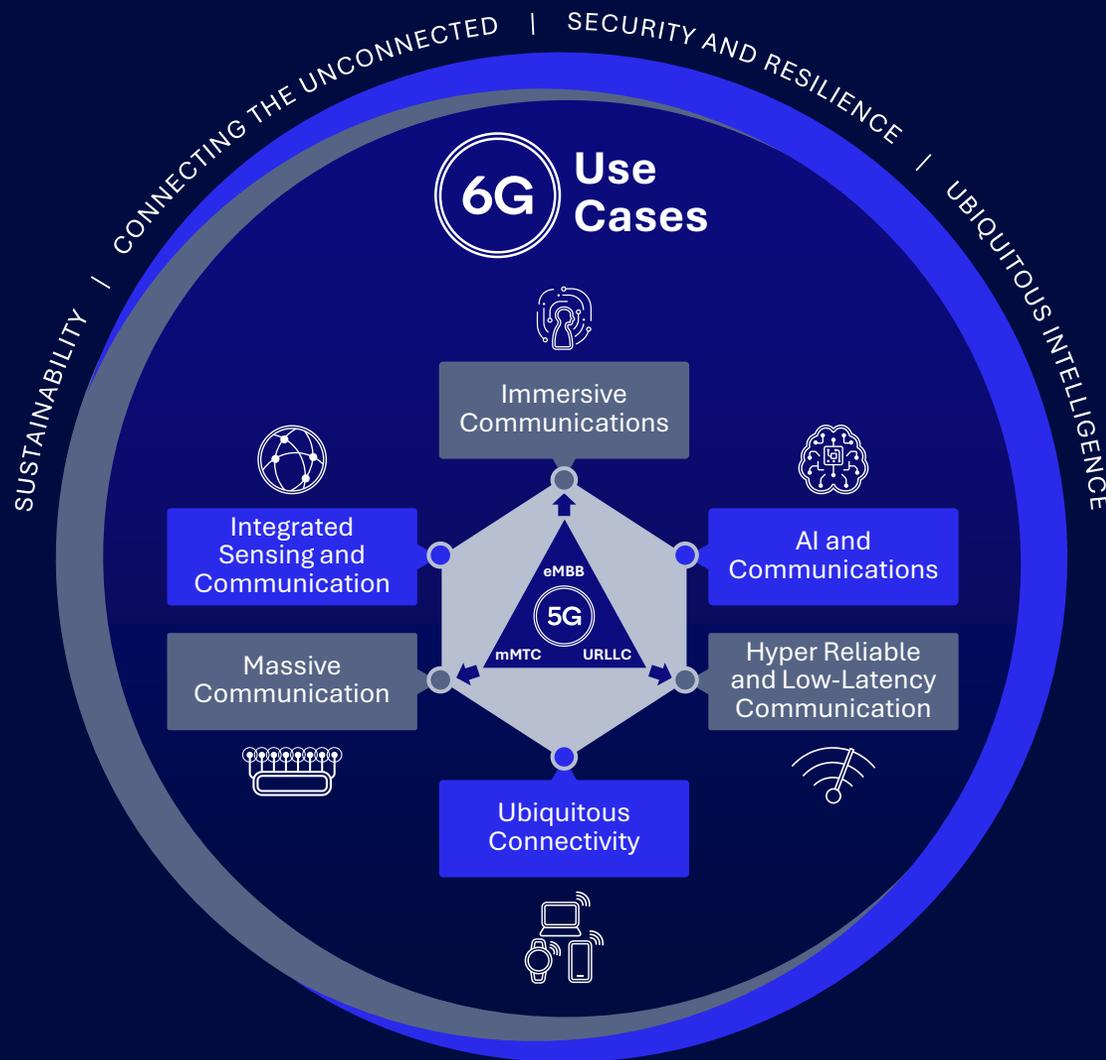
Value is created at the edge

Advanced wireless technologies enable the full economic potential of AI and connected compute



Connected compute unlocks new use cases for the merging physical, digital, and virtual worlds

6G vision from ITU-R — Usage scenarios and capabilities



Enhanced Capabilities

Security resilience	
Reliability	5G $1-10^{-5}$ 6G $\uparrow 1-10^{-5} - 1-10^{-7}$
Latency	5G 1 6G $\downarrow 0.1 - 1$ ms
Mobility	5G 500 6G $\uparrow 500 - 1,000$ km/h
Connection density	5G 10^6 6G $\uparrow 10^6 - 10^8$ devices/km ²
Area traffic capacity	
Spectrum efficiency	
User experience data rate	
Peak data rate	

6G Capabilities

New Capabilities

- Coverage
- Sensing-related capabilities
- AI-related capabilities
- Sustainability
- Interoperability
- Positioning (1-10 cm)

BACK TO THE WIRELESS FUNDAMENTALS

What do we expect from the next era of wireless connectivity?

Technology exploration for next-generation wireless system design

FOUNDATIONAL EVOLUTION

Continued enhancements to core wireless system design

OPERATIONAL OPTIMIZATION

New tools to maximize wireless system efficiency

EMERGING SERVICES

Scalable, next-generation user experiences



Applying AI to solve difficult wireless challenges

- Deep wireless domain knowledge is required to optimally use AI capabilities

Wireless challenges

Hard-to-model problems



Computational infeasibility of optimal solution



Efficient modem parameter optimization



Dealing with non-linearity



AI-enhanced wireless communications



AI strengths



Determining appropriate representations for hard-to-model problems



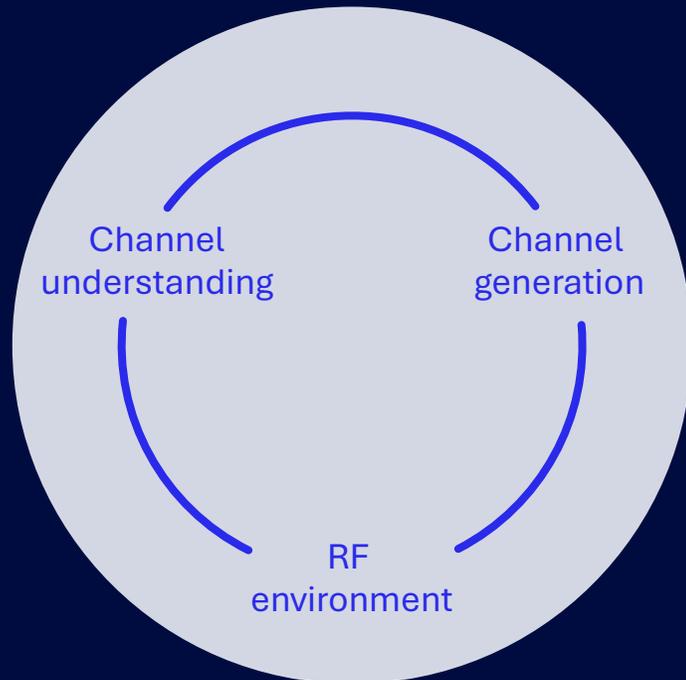
Finding near-ideal and computationally realizable solutions



Modeling non-linear functions

Using AI/ML to solve hard-to-model wireless problems

Example: AI/ML can improve channel modeling



Channel Generation

Synthetic channel generation, e.g., GAN¹

$$p(x_{1:T}) = \prod_{t=1}^T p(x_t | x_{1:t-1})$$

Channel Prediction

Fading channel prediction, RSRP prediction²

$$p(x_{t+n} | x_{1:t})$$

Channel Modeling

Channel Inference

Inferring channel on other antennas, beams, frequencies, or locations²

Recover full x_t based on partial observation:

$$\tilde{x}_t: p(x_t | \tilde{x}_{1:t})$$

Channel Compression

Channel State Feedback^{2,3}

Compress x_{t+1} based on prior

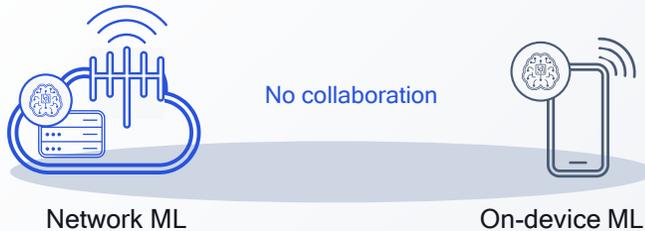
$$p(x_{t+1} | x_{1:t})$$

Evolving towards an AI-native wireless system

Multiple wireless AI/ML training and inference scenarios

Overlay AI/ML

INDEPENDENTLY AT THE DEVICE OR NETWORK



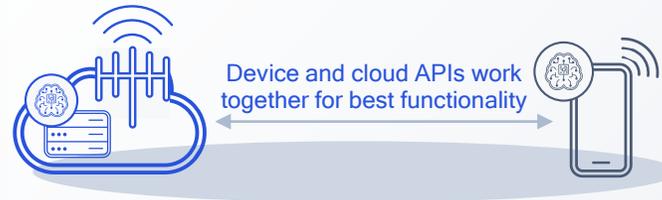
ML operates independently at the device and network as an optimization of existing functions

Proprietary ML procedures including model development and management

Proprietary and standardized data collection used as input to training

Cross-node AI/ML

COORDINATED BETWEEN DEVICE AND NETWORK



ML operates in a coordinated manner between the device and network

Proprietary and standardized ML procedures including model development and management

Further data collection used as input to training as well as monitoring

Native AI/ML

AT ALL DEVICE AND NETWORK LAYERS



ML operates autonomously between the device and network across **all protocols and layers**

Integrated ML procedures **across to train performance and adapt to different environments**

Data fusion for integrated dynamic ML lifecycle management

5G

5G
ADVANCED

6G



ADAPTIVE INTELLIGENCE

Multi-vendor wireless AI interoperability

Training flexibility

Collaborating with Nokia Bell Labs, we demonstrated the flexibility of sequential learning, which can facilitate network decoder-first or device encoder-first training.

Robust gain

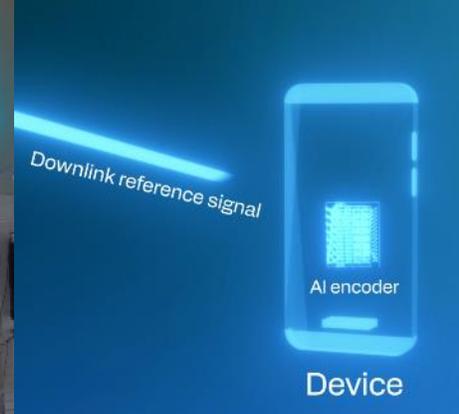
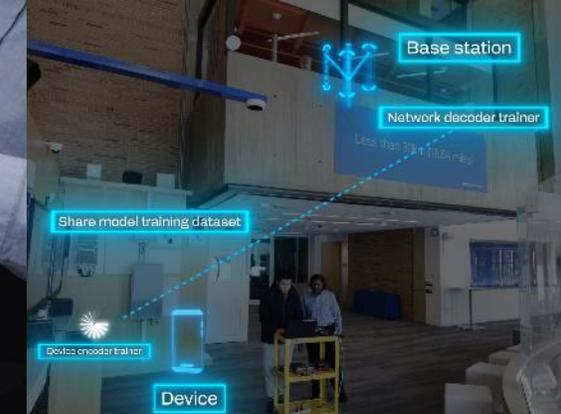
Cross-node AI-enhanced channel state feedback can provide substantial improvements over model-based approaches with 3GPP Type I CSI feedback.

Scalable adaptation

Maintaining hyper-local models can offer the greatest benefits, but using a common model trained with data from various locations can be the most efficient approach.



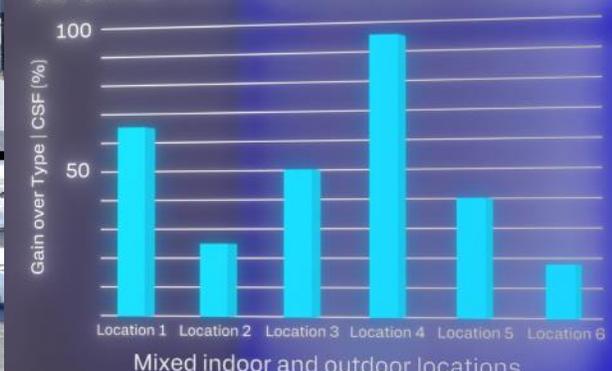
[Watch the demo video](#)



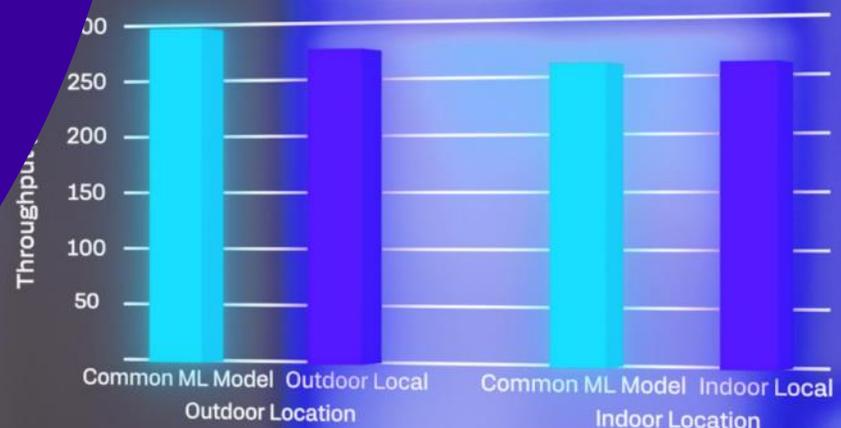
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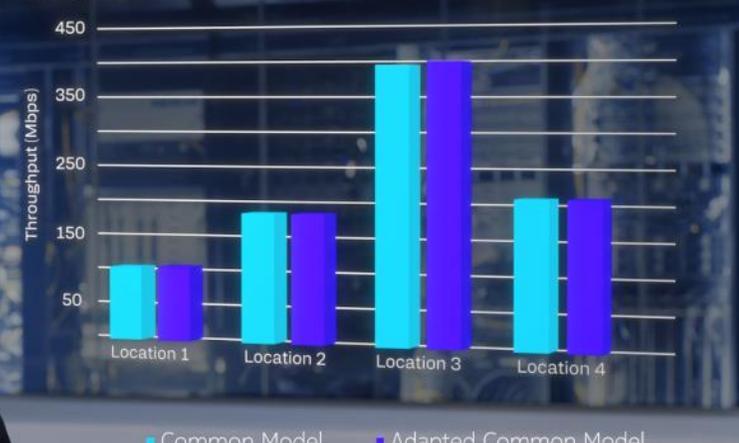
AI-enhanced CSF vs. 3GPP Type I CSF



Common Model vs. Hyper-local Model

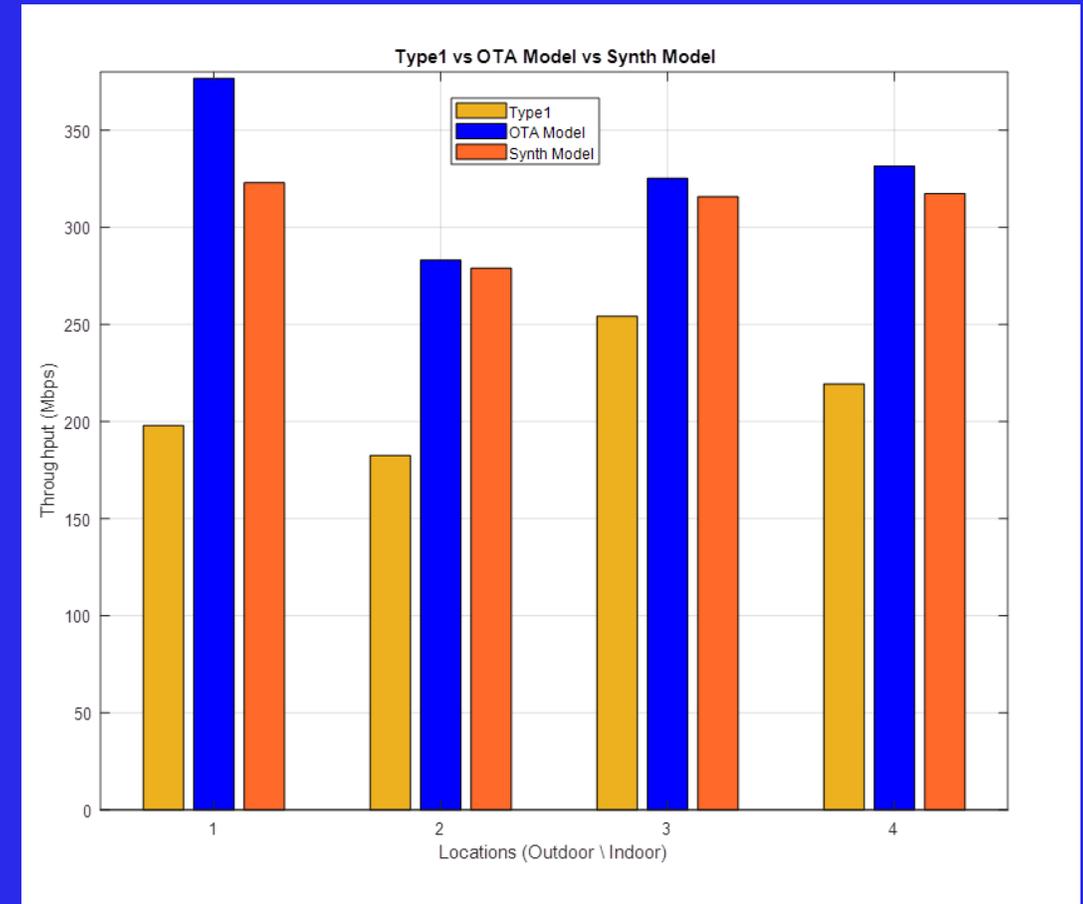


Cross-node CSF: Common Model vs. Adapted Common Model



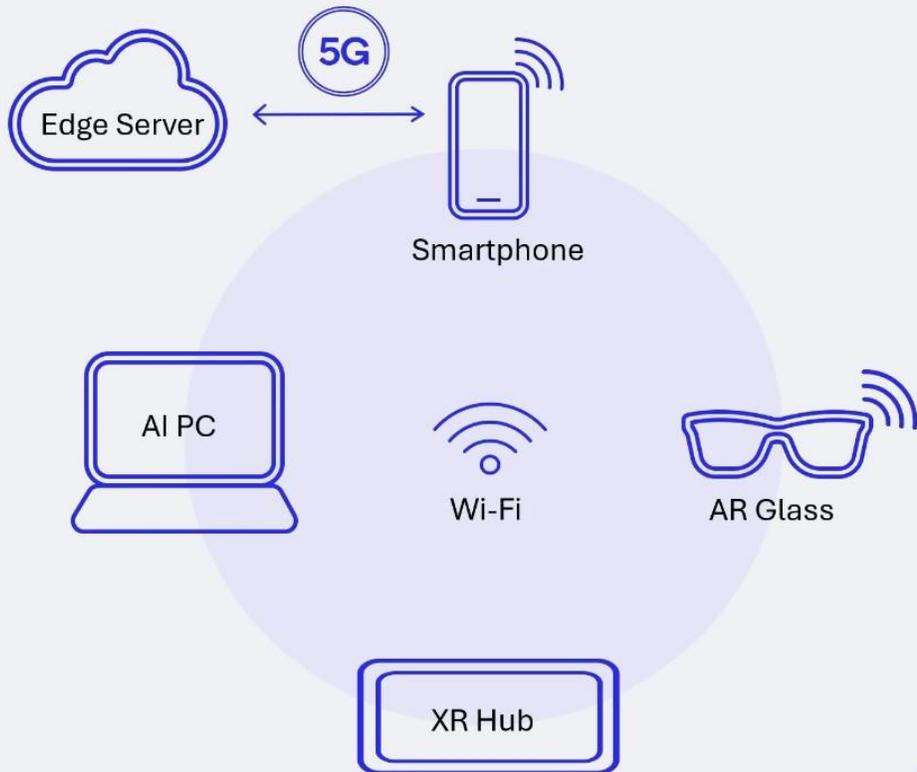
Synthetized-based ML models versus OTA local and common based models

- **OTA results**, in a multi-vendor lab testbed, OTA trials confirmed between 35 and 90% DL throughput gain versus 3GPP Type-1 feedback
- **Synthetic models**, trained on simulator-generated cluster delay line (CDL) channels covering mixed LoS/NLoS indoor and outdoor cases, performed within [2–15%] of OTA-trained AI models indoors and matched performance outdoors



comparison of the downlink throughput between the Type 1, ML-based model with common training and synthetized-based ML model CSF, at 4 different locations.

Using on-device intelligence to distribute spatial compute workloads



Rendering

Generating visuals

- 3D Graphics

Perception

Environment understanding and user tracking

- Scene understanding
- Object rec and tracking
- 3D Reconstruction

Gen AI

User experience

- LLMs

Qualcomm

MWCB 2025



IMMERSIVE COMMUNICATION

Improving experiences with distributed spatial compute

Higher quality experience

Distributed spatial compute enables superior and uninterrupted XR user experience.

Extended XR coverage

Distributed spatial compute extends the service area, allowing the system to serve a larger number of users.

Reduced power consumption

Distributed spatial compute improves devices battery life and extends usage time.



[Watch the demo video](#)

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Spatial Compute Workloads

Rendering

Generating visuals

- 3D Graphics

Perception

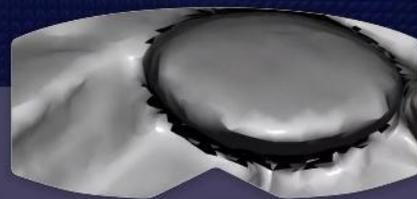
Environment understanding and user tracking

- Scene Understanding
- Object Rec and Tracking
- 3D Reconstruction

GenAI

User Experience

- LLMs



3D reconstruction (3DR)



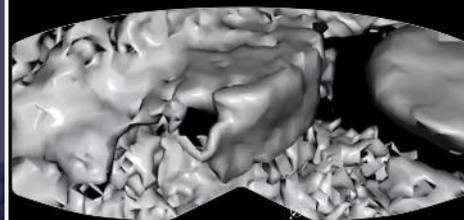
XR rendering experience



Distributed Spatial Compute



3DR on mobile device



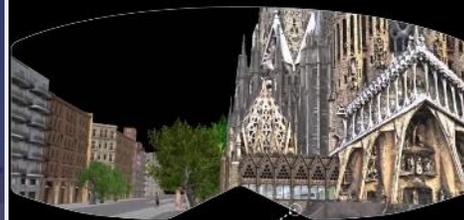
3DR with distributed spatial compute

Improves 3DR with more powerful ML models



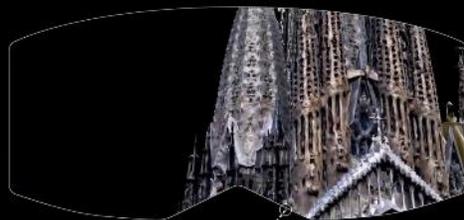
Rendering with distributed spatial compute in good 5G coverage

High fidelity experience

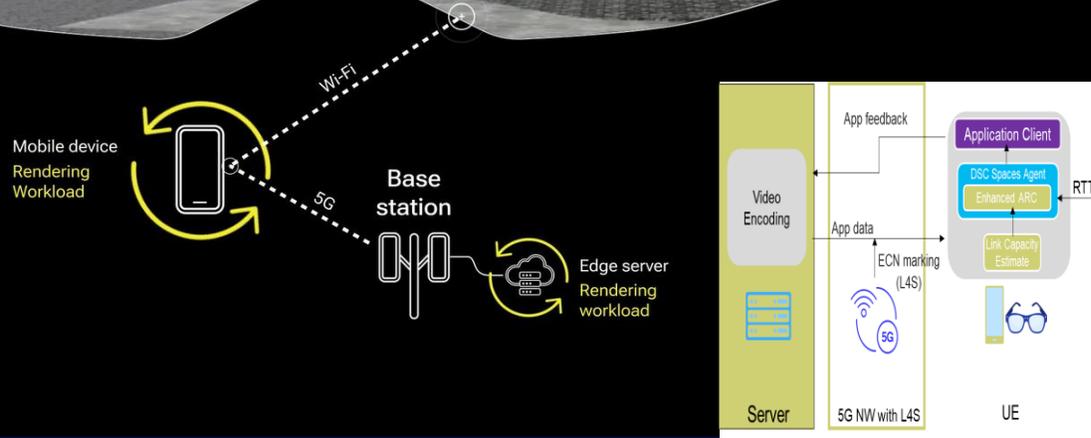


Rendering with distributed spatial compute in poor 5G coverage

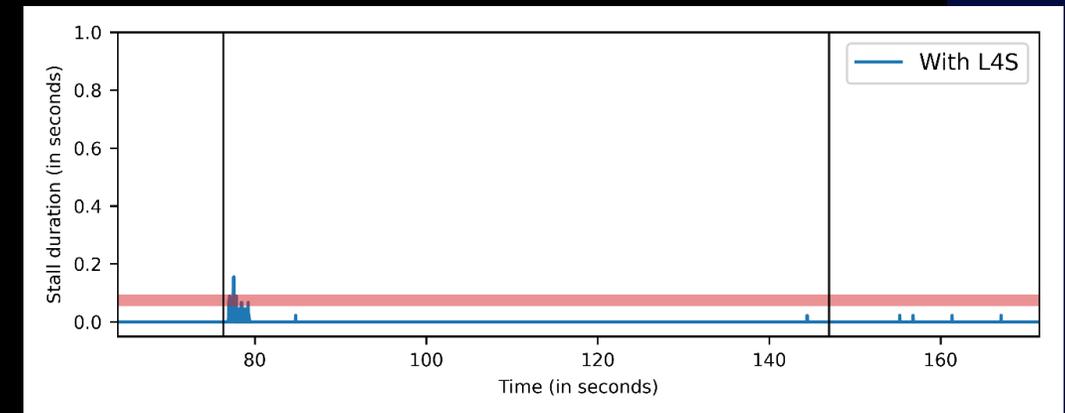
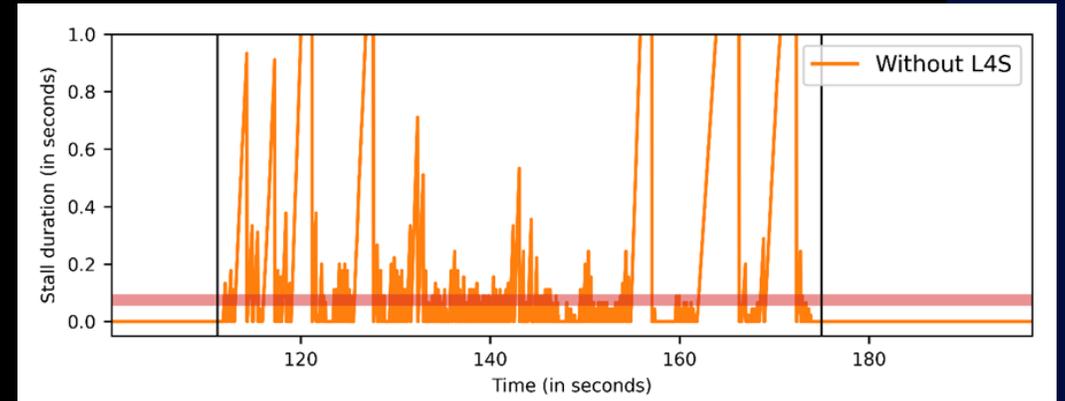
Ubiquitous experience



Rendering with L4S in a loaded network



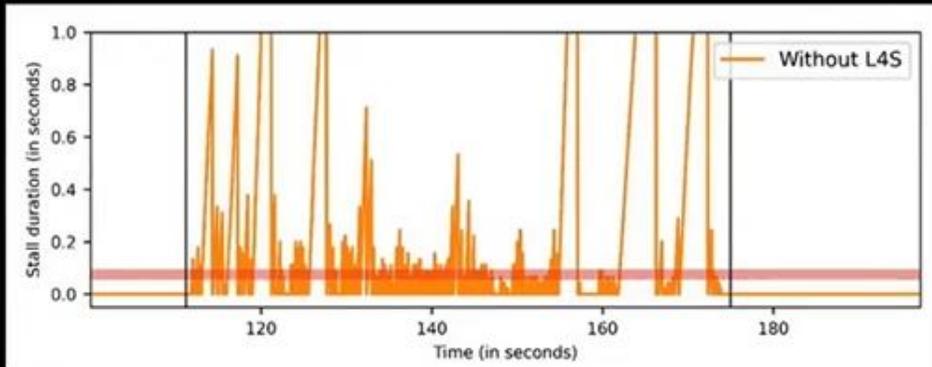
Comparison in number of duplicated frames without and with L4S



the number of
ence

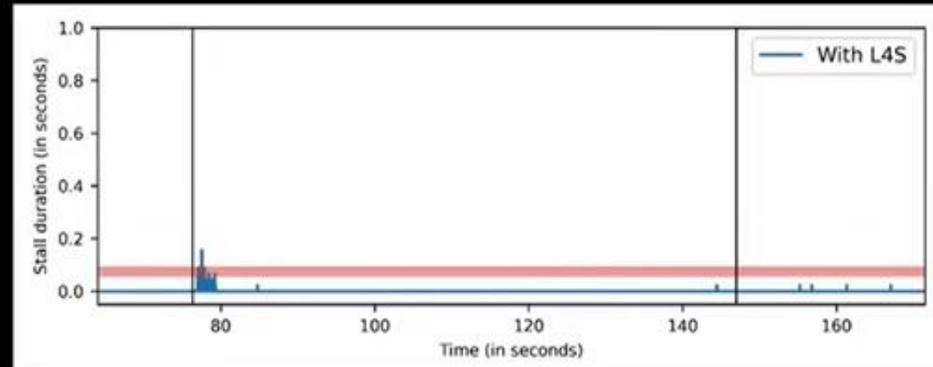
Rendering without L4S in a loaded network

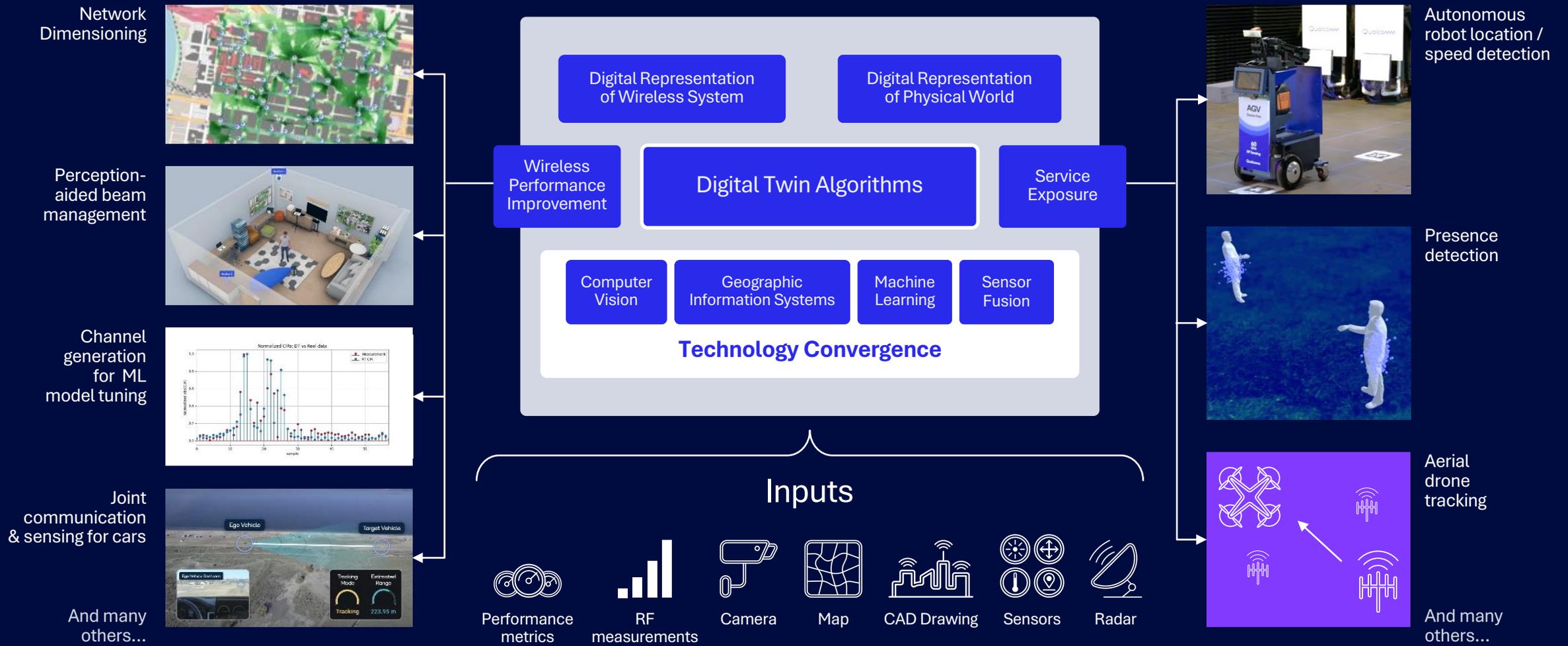
Degraded rendering experience



Rendering with L4S in a loaded network

Improved rendering experience





Digital twin networks: Virtual representations of physical networks

Monitoring and performance optimization of its real-world counterpart



AUGMENTED PERCEPTION

Sensing-enhanced Communication

Accurate modeling

Wireless sensing enables the identification of material properties, allowing the digital twin to mirror the physical world with high precision.

Real-time update

Combining wireless sensing with real-time ray tracing for channel modeling ensures that the radio digital twin stays up to date with the latest environmental changes.

Energy savings

Scalable, high-fidelity radio digital twin can be used to optimize beam searches and selection, leading to a significant reduction in device power consumption.



[Watch the demo video](#)

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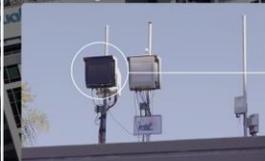
ISAC over-the-air testbed
San Diego, CA



Sensing-enabled devices



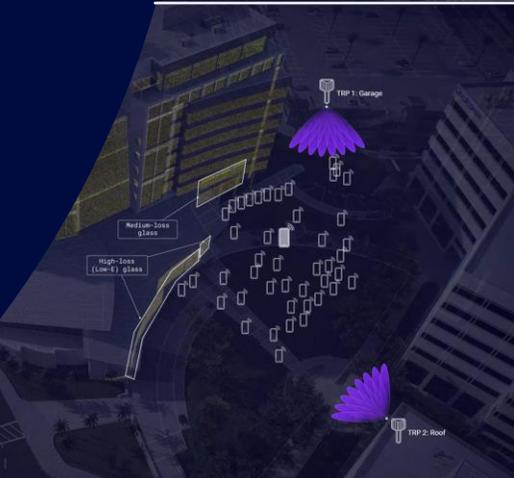
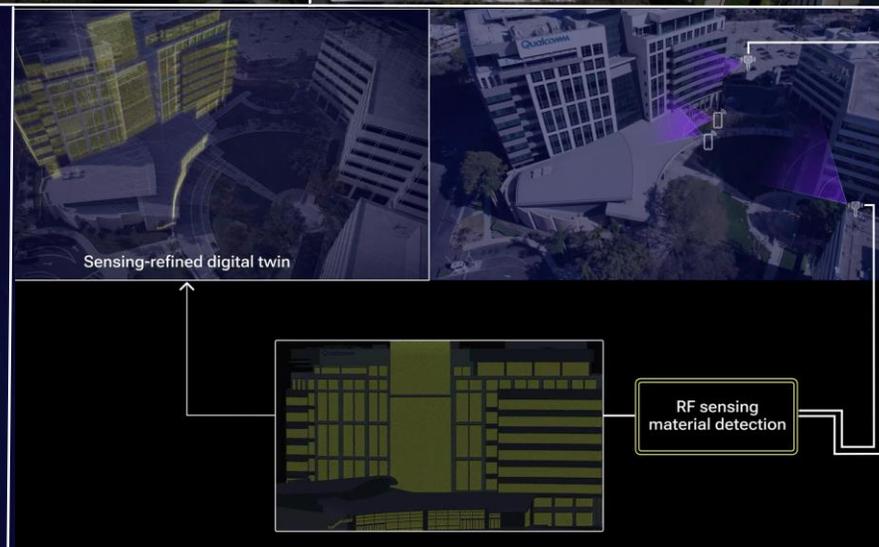
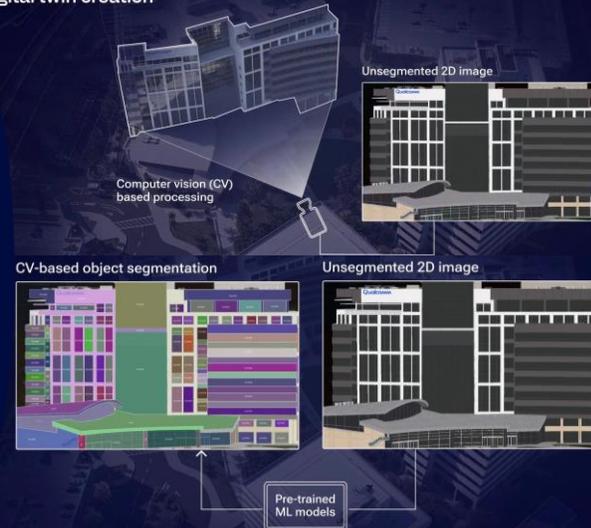
TRP 1: Garage



TRP 2: Roof



Digital twin creation



Leading wireless technology innovation



Qualcomm

Wireless Research Directions & Priorities



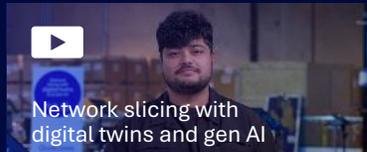
Bluetooth



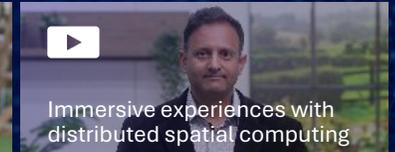
FOUNDATIONAL EVOLUTION



OPERATIONAL OPTIMIZATION



EMERGING SERVICES



Thank you

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