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MWC Shanghai
5G Network Forum

Qualcomm

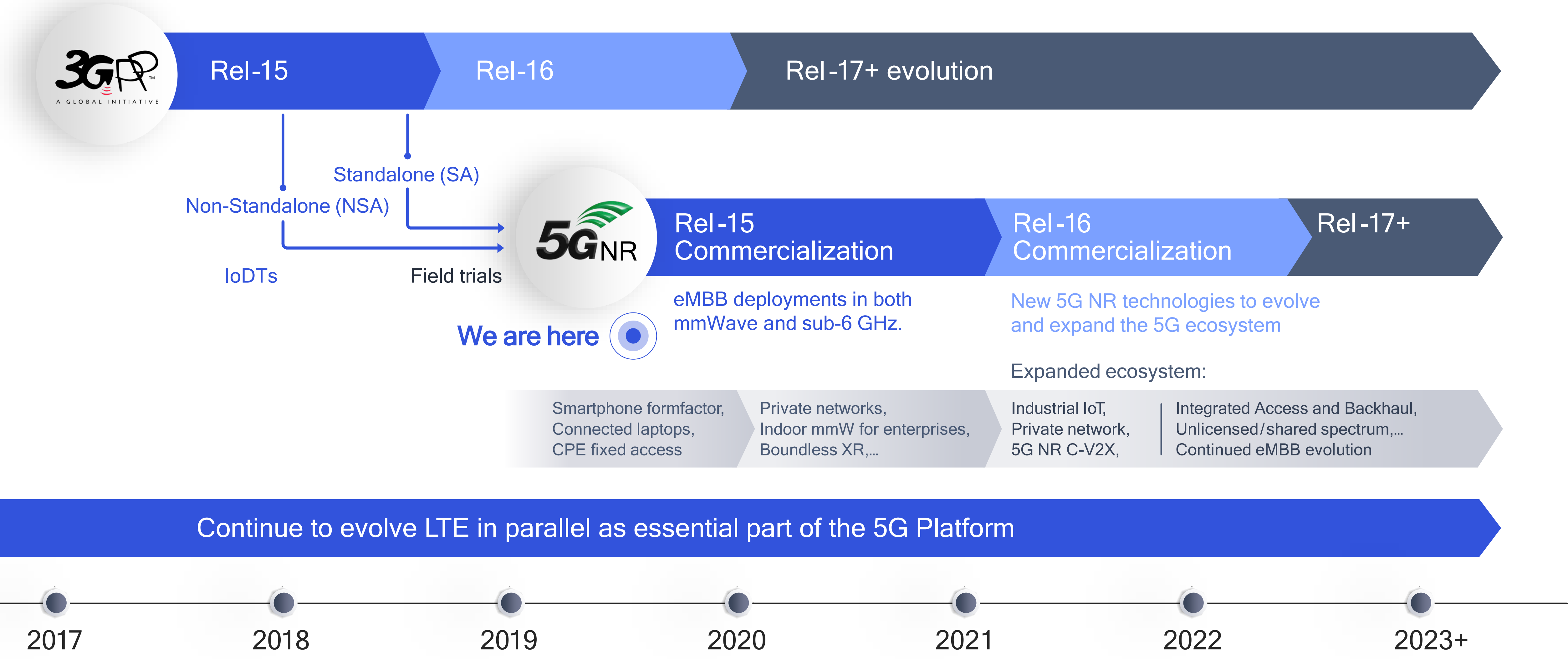
A deep dive into 5G NR mmWave's commercialization in 2019 and beyond

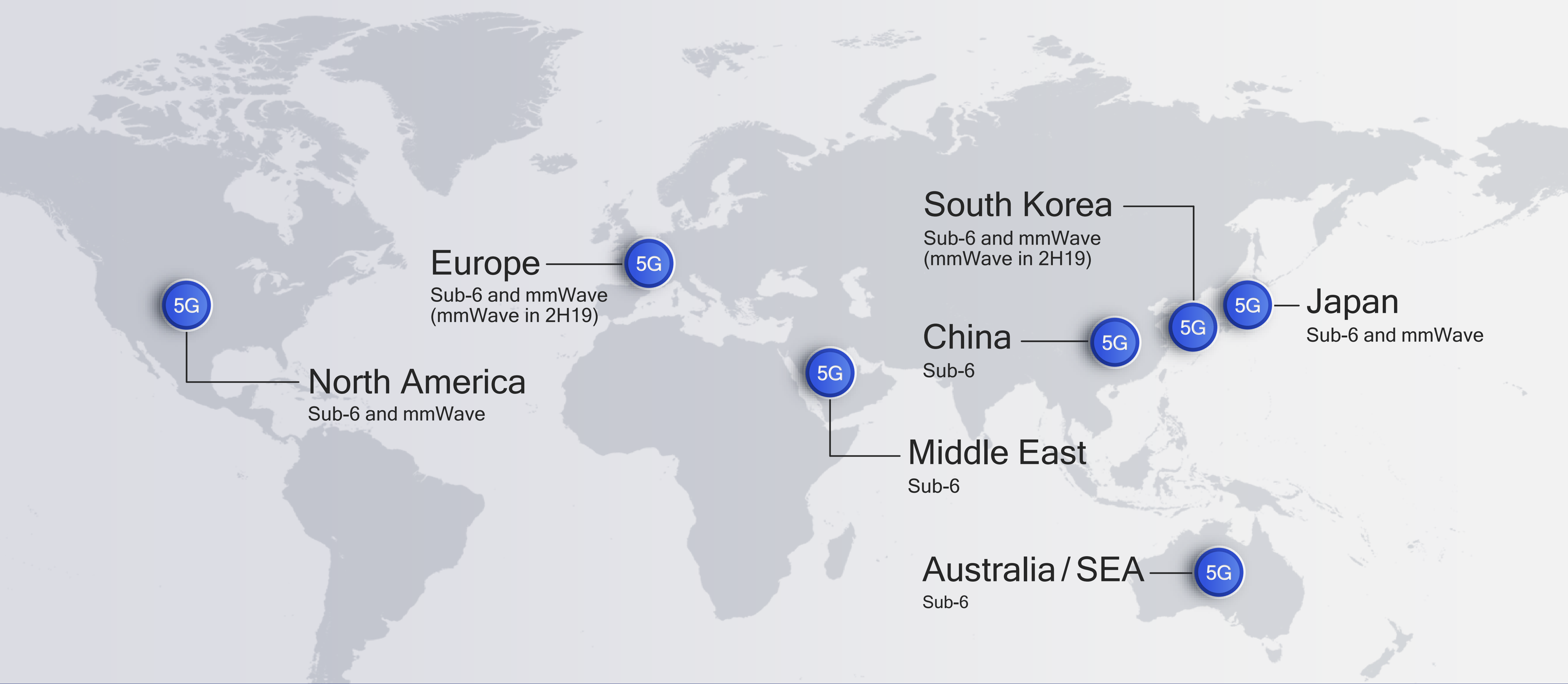
Junli Wu

Director, Engineering
Qualcomm Wireless Communication Technologies


A unifying connectivity fabric for future innovations
Like electricity, you will just expect it everywhere
5G
Multi-gigabit speed
Scalable to extreme simplicity
Ultra-low latency
Virtually unlimited capacity
Extreme reliability
On-device intelligence

Driving the 5G roadmap and ecosystem expansion





2019 is the year of 5G

Deployments happening in regions across the globe

5G

5G NR mmWave will support new and enhanced mobile experiences

- Fiber-like data speeds
- Low latency for real-time interactivity
- Massive capacity for unlimited data plan
- Lower cost per bit

We are overcoming the mobile mmWave challenge

Proving the skeptics wrong about mmWave can never be used for mobile

Limited coverage and too costly

Significant path loss means coverage limited to just a few hundred feet, thus requiring too many small cells

Significant coverage with co-siting

Analog beamforming w/ narrow beam width to overcome path loss. Comprehensive system simulations reusing existing sites.

Works only line-of-sight (LOS)[1]

Blockage from hand, body, walls, foliage, rain etc. severely limits signal propagation

Operating in LOS and NLOS[1]

Pioneered advanced beamforming, beam tracking leveraging path diversity and reflections.

Only viable for fixed use

As proven commercial mmWave deployments are for wireless backhauls and satellites

Supporting robust mobility

Robustness and handoff with adaptive beam steering and switching to overcome blockage from hand, head, body, foliage.

Requiring large formfactor

mmWave is intrinsically more power hungry due to wider bandwidth with thermal challenges in small formfactor

Commercializing smartphone

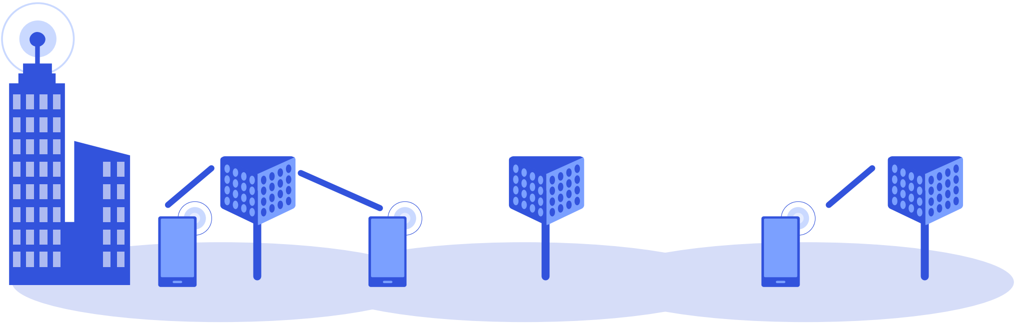
Announced modem, RF, and antenna products to meet formfactor and thermal constraints, plus device innovations.

1 LOS: Line of sight, NLOS: Non-line-of-sight

5G NR mmWave is bringing new waves of opportunities

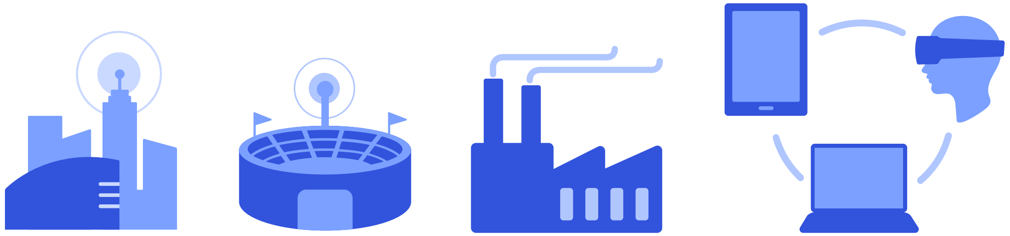
For outdoor deployments…

- Significantly elevate today's mobile experiences – initially focusing on smartphones
- Deployments predominantly driven by mobile operators – initially focusing on dense urban



For indoor deployments…

- Complementing existing wireless services provided by Wi-Fi – also expanding to new device types
- Bringing superior speeds and virtually unlimited capacity for enhanced experiences

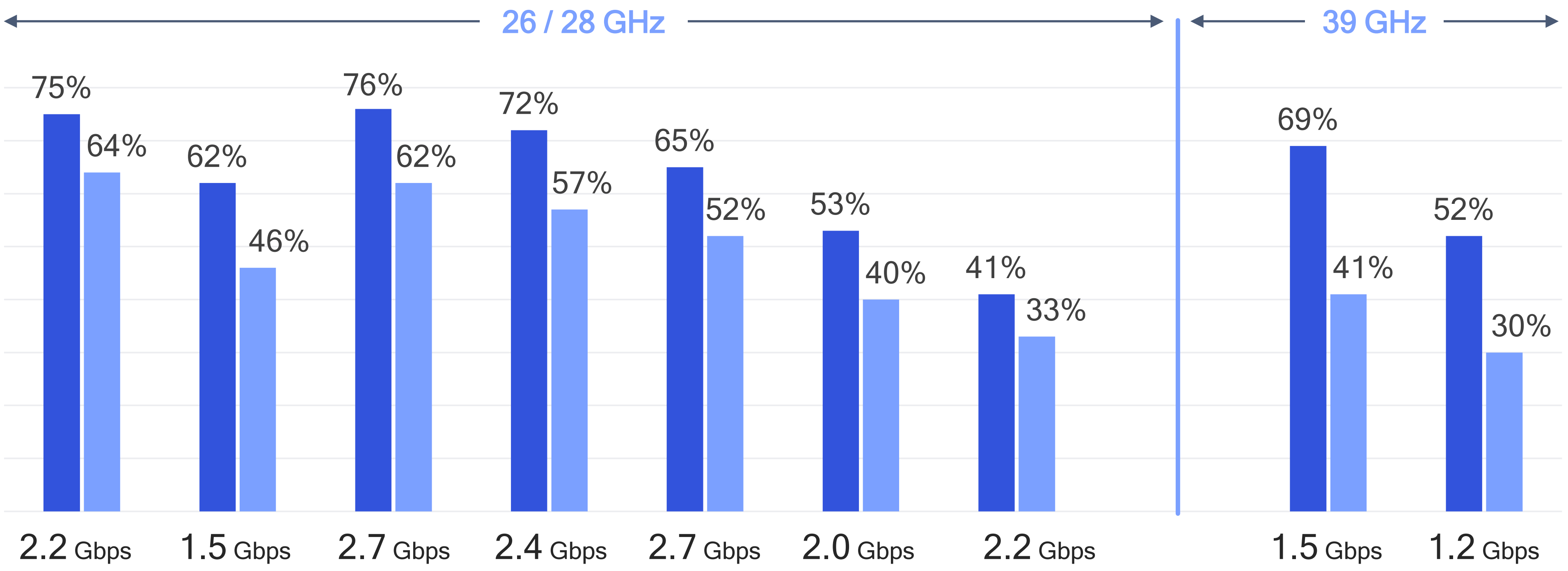


Creating value for the mobile ecosystem

Operators, service providers, venue owners, infra vendors, device OEMs, …

Downlink
Uplink
Coverage %

Co-siting with LTE



Median Downlink Burst Rate (Gbps)

Site density (per km²)		US City 1	US City 2	Korean City 1	Hong Kong	Japan City 1	Russia City 1	Europe City 1	US City 1	US City 2
	Total	48	36	41	39	28	26	28	48	36
	Macro	0	8	33	39	28	26	7	0	8
	Small	48	28	8	0	0	0	21	48	28

Simulations assumptions: Based on MAPL (maximum allowable path loss) analysis with ray tracer propagation model and city/area specific models; minimum 0.4 bps/Hz and 0.2 bps/Hz for downlink data and control, out-to-out coverage only; Using 800 MHz DL bandwidth and 100 MHz uplink bandwidth with 7:1 DL:UL TDD

Significant 5G NR mmWave outdoor coverage via co-siting

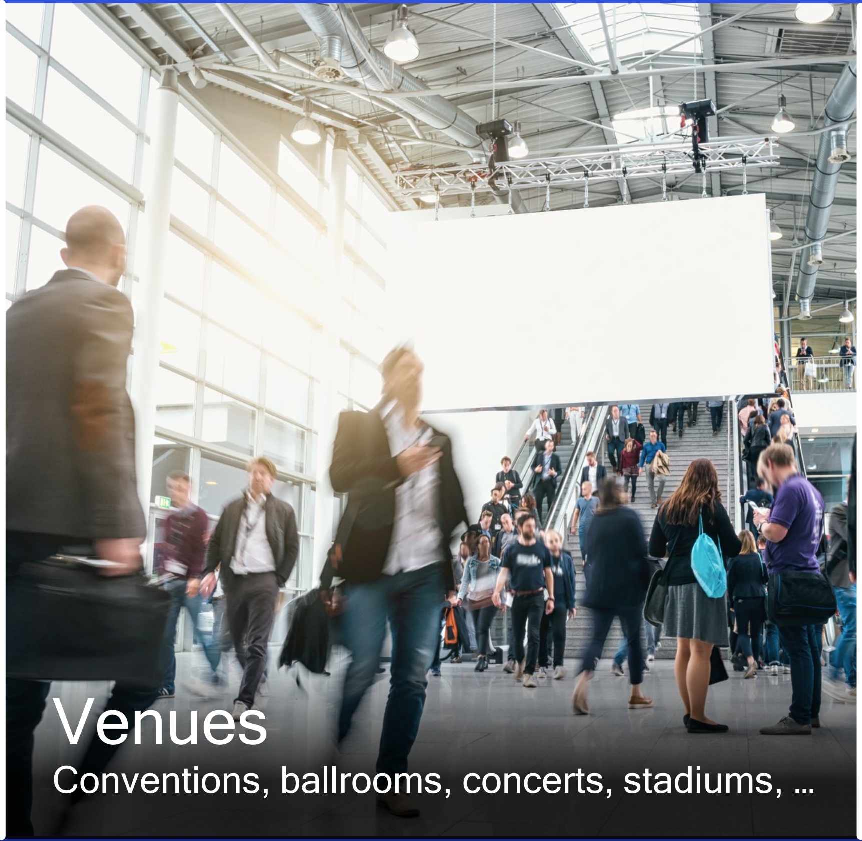
Simulations based on over-the-air testing and channel measurements

Extending 5G NR mmWave to indoor deployments

For new and enhanced experiences complementing existing Wi-Fi services

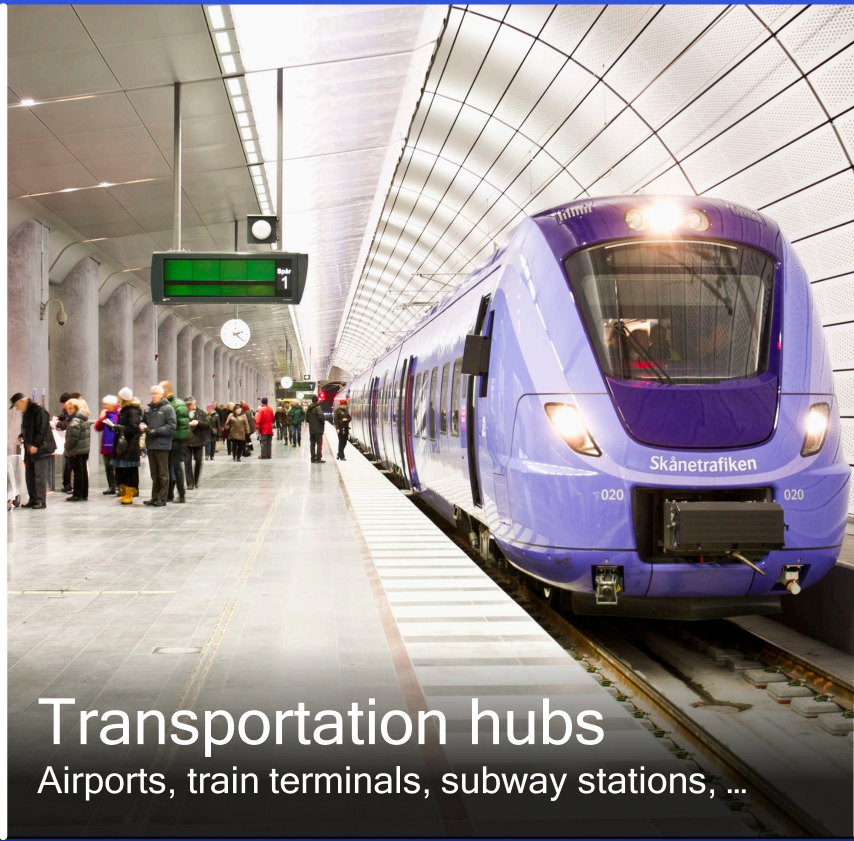
Enterprises

Offices, meeting rooms, auditoriums, …



Venues

Conventions, ballrooms, concerts, stadiums, …



Transportation hubs

Airports, train terminals, subway stations, …

- Bringing multi-Gigabit speed, low latency, and virtually unlimited capacity
- Supporting devices beyond smartphones – tablets, XR, always-connected laptops
- Leveraging existing Wi-Fi or cellular infrastructure by co-siting small cells

5G NR mmWave boosts performance in Enterprise networks

Downlink/uplink coverage comparable to Wi-Fi with 1:1 or partial co-site

Realize multi-Gigabit burst rate with wider bandwidths (e.g., 800 MHz)

Complement indoor Wi-Fi deployments

Existing Wi-Fi access point locations – co-sited with 5G NR mmWave antenna locations

Complete coverage at 28 GHz[1] at Qualcomm headquarters

- ~98% Downlink coverage with 1:1 co-siting
- ~99% Uplink coverage with 1:1 co-siting
- 5 Gbps downlink median burst rate[3]

Coverage simulation based on MAPL (maximum allowable path loss) analysis with ray tracer propagation model and measured material and propagation loss; minimum 0.4/0.1 bps/Hz for downlink/uplink data and control; 2 Maximum Allowable Path Loss; DL: 115 dB, UL 117 dB 3 Using 800 MHz DL bandwidth and 100 MHz uplink bandwidth with 7:1 DL:UL TDD

5G NR mmWave for convention centers

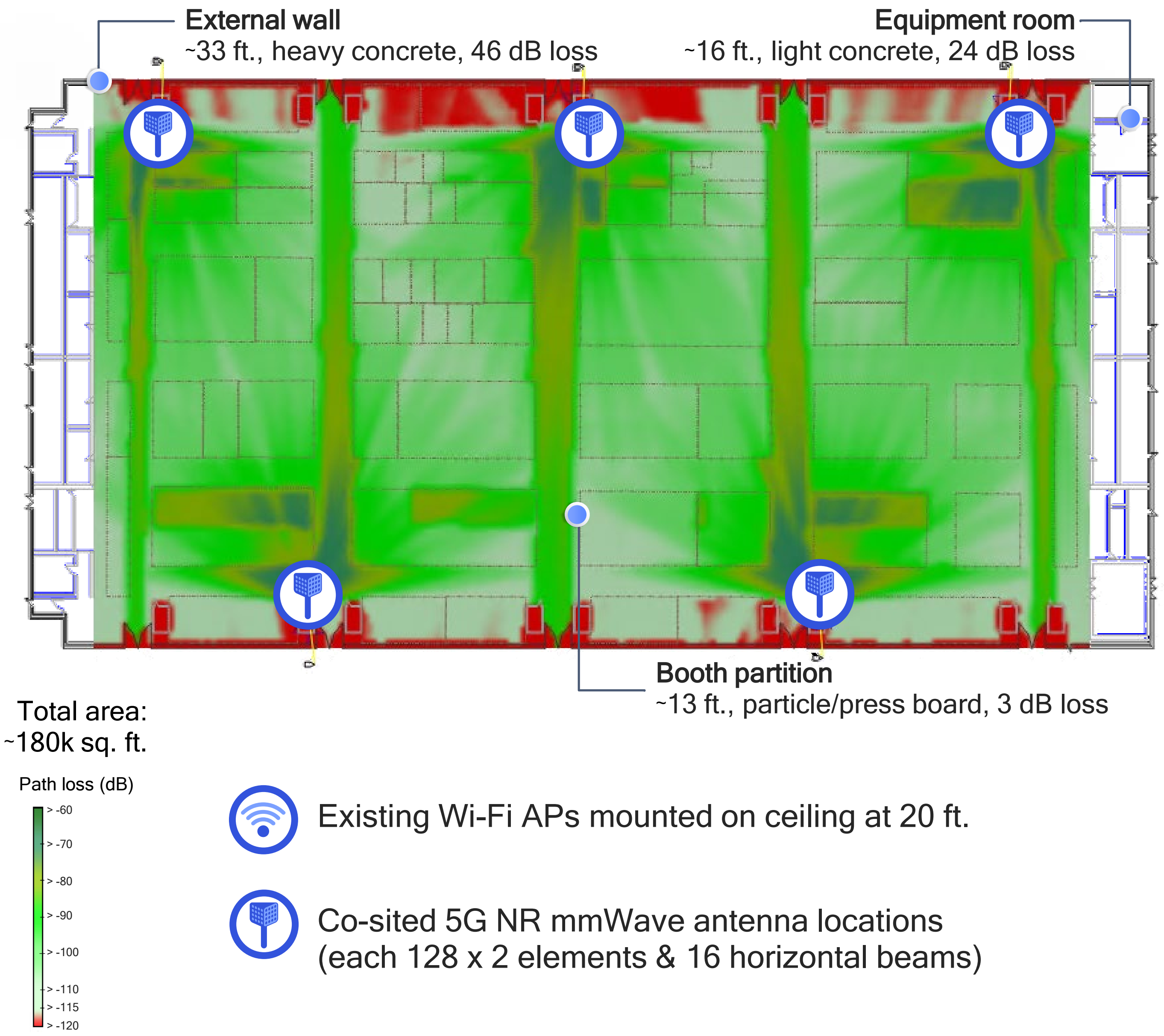
Co-siting 5G NR mmWave gNodeB antennas with existing Wi-Fi access points

Achieving significant coverage at 28 GHz[1]

- Downlink coverage of ~**87%** with 115 dB MAPL[2]
- Uplink coverage of ~**92%** with 117 dB MAPL

Realizing multi-gigabit user experience[3]

- Downlink median burst rate of **1.5 Gbps**



1 Coverage simulation based on MAPL (maximum allowable path loss) analysis with ray tracer propagation model and measured material and propagation loss; minimum 0.4/0.1 bps/Hz for downlink/uplink data and control; 2 Maximum Allowable Path Loss; 3 Using 400 MHz DL bandwidth and 100 MHz uplink bandwidth with 7:1 DL:UL TDD

5G NR mmWave for underground subway stations

Co-siting 5G NR mmWave gNodeB antennas with existing LTE DAS or Wi-Fi access points

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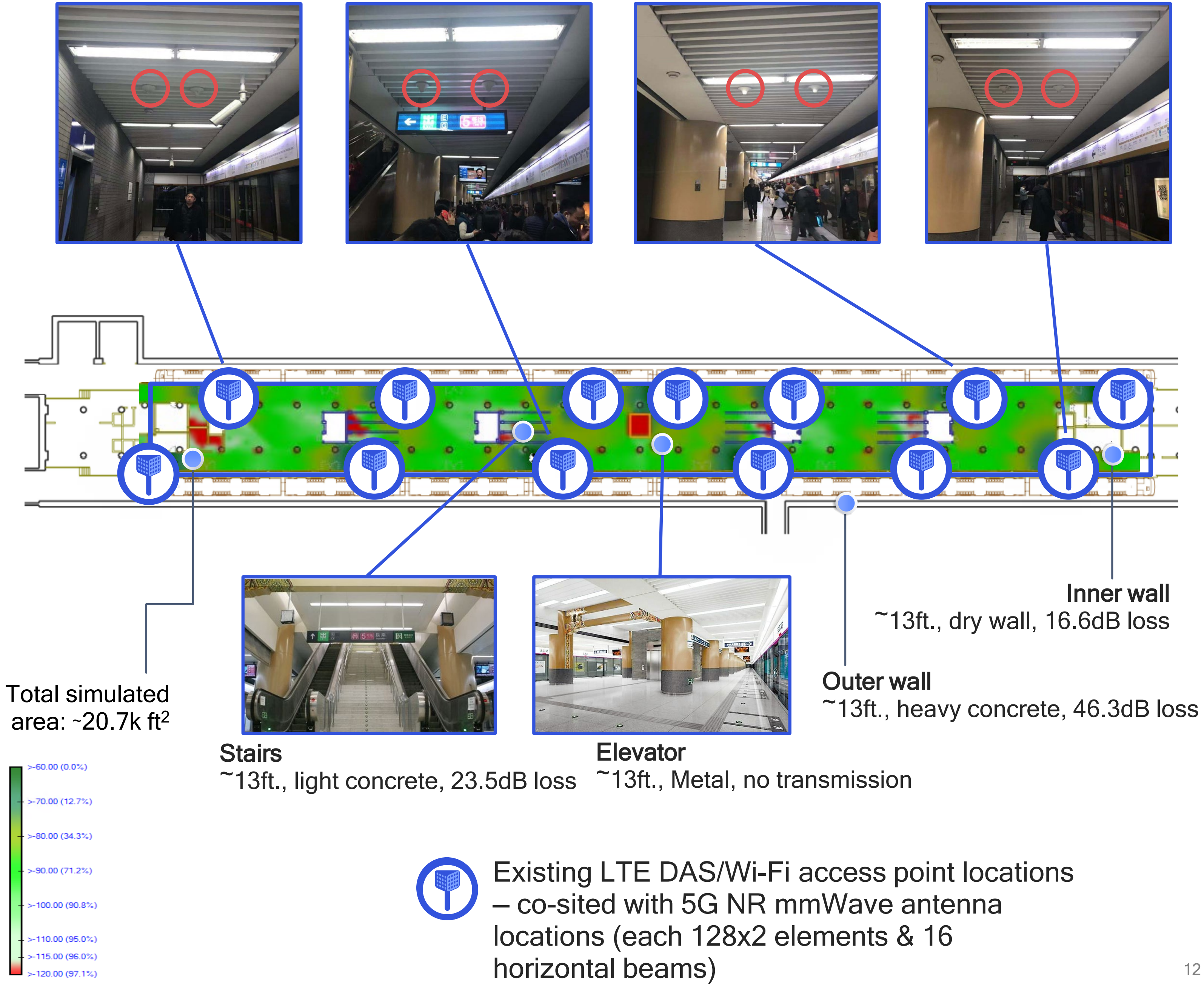
Achieving significant coverage at 28 GHz[1]

- Downlink coverage of ~**96%** with 115 dB MAPL[2]
- Uplink coverage of ~**97%** with 117 dB MAPL

Realizing multi-gigabit user experience[3]

- Downlink median burst rate of ~**4.6 Gbps**

1 Coverage simulation based on MAPL (maximum allowable path loss) analysis with ray tracer propagation model and measured material and propagation loss; minimum 0.4/0.1 bps/Hz for downlink/uplink data and control; 2 Maximum Allowable Path Loss; 3 Using 800 MHz DL bandwidth and 100 MHz uplink bandwidth with 7:1 DL:UL TDD



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