Qualcomm @QCOMResearch University of Chicago Center in Delhi October 16th, 2023

6G Spectrum and Innovations

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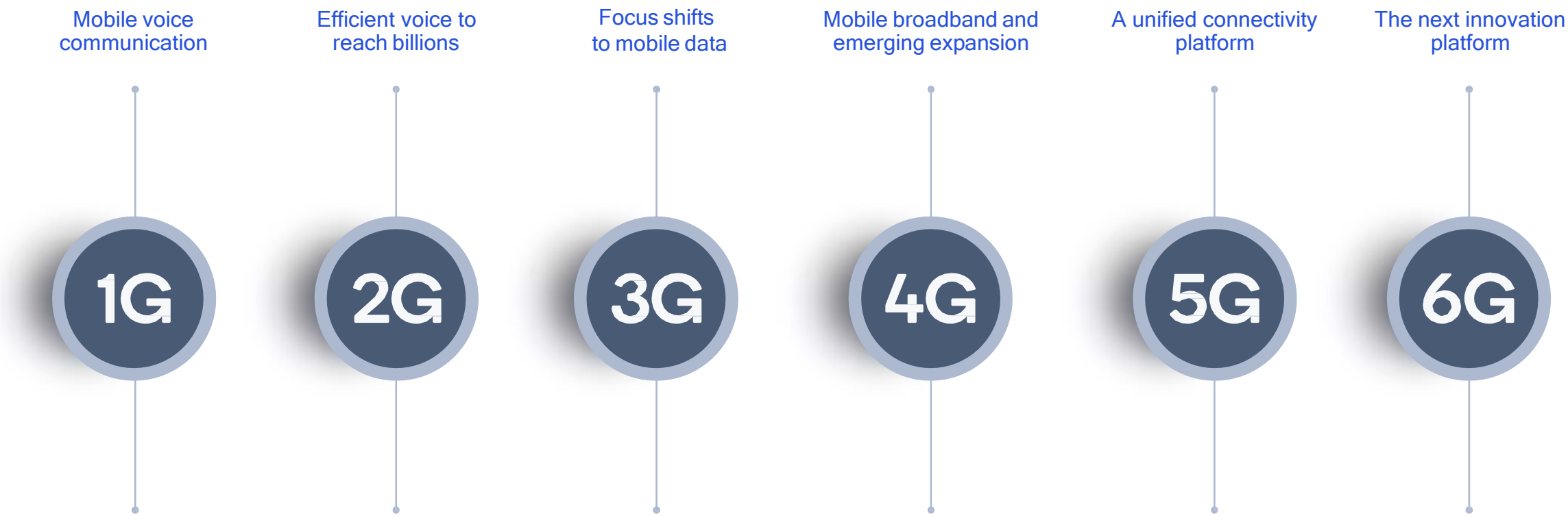
Mobile has made a leap every ~10 years



Spectrum is the “lifeblood” of future wireless innovations

Fully realize the 5G potential and lay groundwork for the 6G future

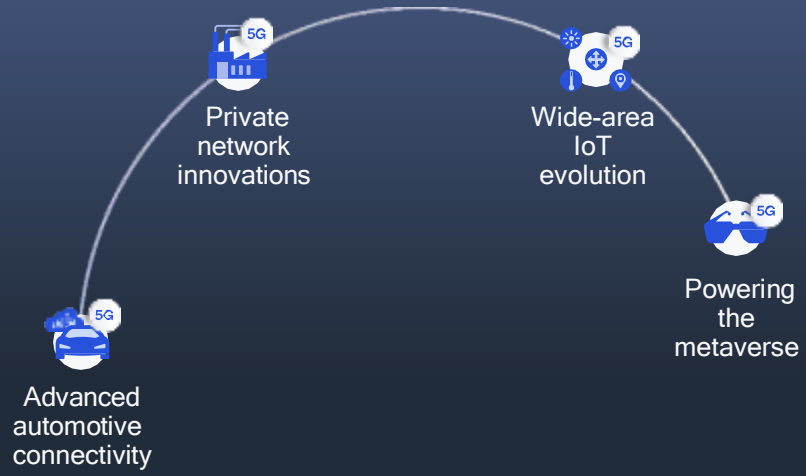
Immediate Term

Focus on commercializing 5G mmWave in a timely manner to meet rapidly growing capacity and user experience requirements

5G mmWave

Short-to-Medium Term

Focus on opening additional lower-band capacity to fuel the growth of 5G Advanced use cases



Longer Term

Focus on identifying, studying, clearing, and allocating new bands for sustained growth into 2030 and beyond

6G

Key longer-term research vectors

enabling the path towards 6G

AI-native E2E communications

Data-driven communication and network design, with joint training, model sharing and distributed inference across networks and devices

Scalable network architecture

Disaggregation and virtualization at the connected intelligent edge, use of advanced topologies to address growing demand

Expanding into new spectrum bands

Expanding to THz, wide-area expansion to higher bands, new spectrum sharing paradigm, dynamic coordination with environmental awareness

Air interface innovations

Evolution of duplexing schemes, Giga-MIMO, mmWave evolution, reconfigurable intelligent surfaces, non-terrestrial communications, waveform/coding for MHz to THz, system energy efficiency

Merging of worlds

Physical, digital, virtual, immersive interactions taking human augmentation to next level via ubiquitous, low-power joint communication and sensing

Communications resiliency

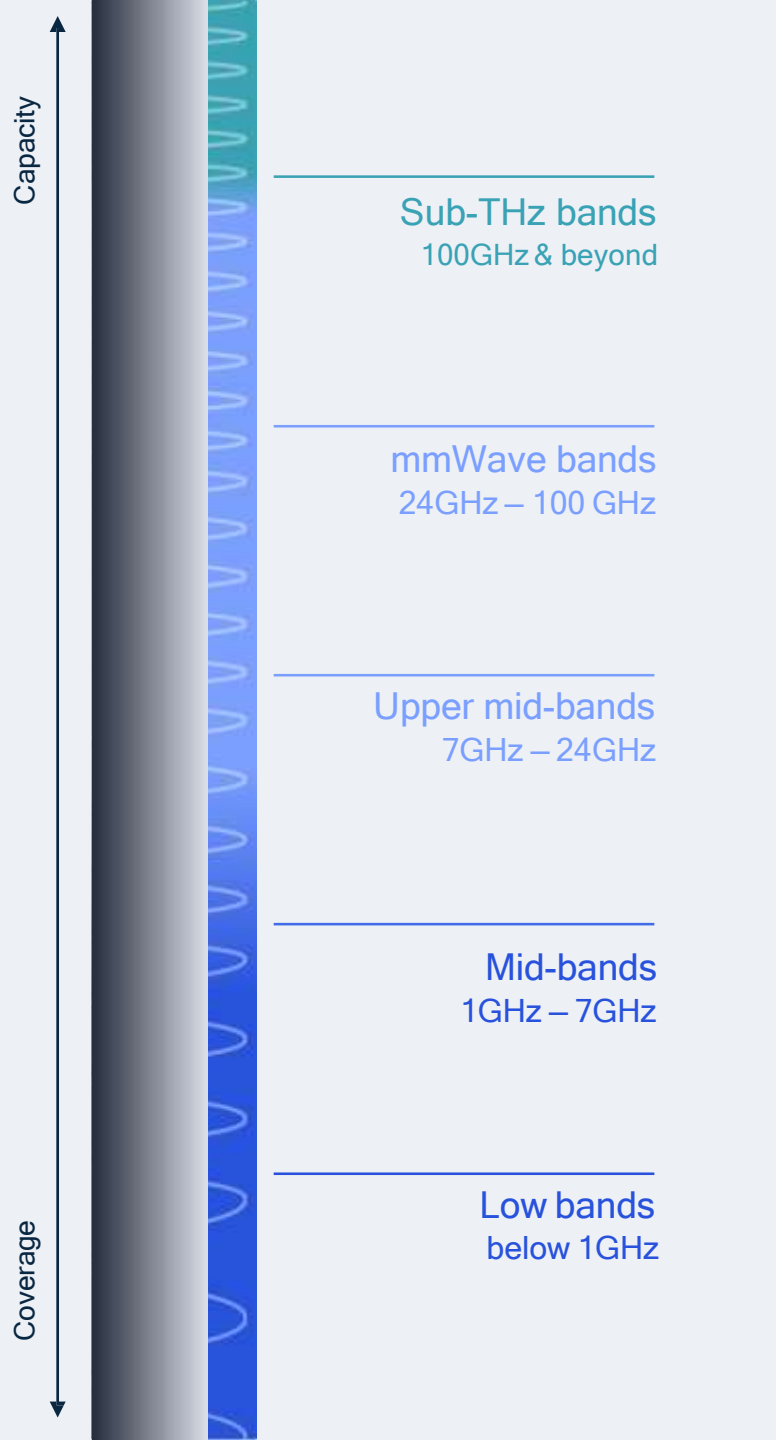
Multifaceted trust and configurable security, post quantum security, robust networks tolerant to failures and attacks

Qualcomm Webinar

Qualcomm Whitepaper

6G system targets all spectrum types and bands

Critical for the success of next-generation wireless systems



Licensed spectrum

Exclusive use of spectrum that remains the industry's top priority

Unlicensed spectrum

Shared use of more available spectrum

Shared spectrum

Evolving spectrum sharing that allow fair and more efficient sharing

New upper mid-band brings order of magnitude more wide-area capacity

Larger contiguous bandwidths (500 MHz +) can bring efficiencies, fuel growing data demand, and enable new applications

Delivering new capacity for wide-area broadband (e.g., smartphones, smart cities, automotive, verticals)

Fueling scalable boundless XR user support in wide area through wider bandwidth availability

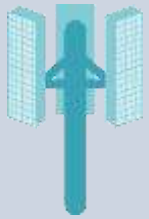
Supporting high-resolution RF sensing for new use cases (e.g., environmental monitoring, activity detection)

Opportunity to co-site with existing sub-7 GHz deployments for comparable coverage in higher band

Upper Mid-Band

Focus on 7 to 15 GHz

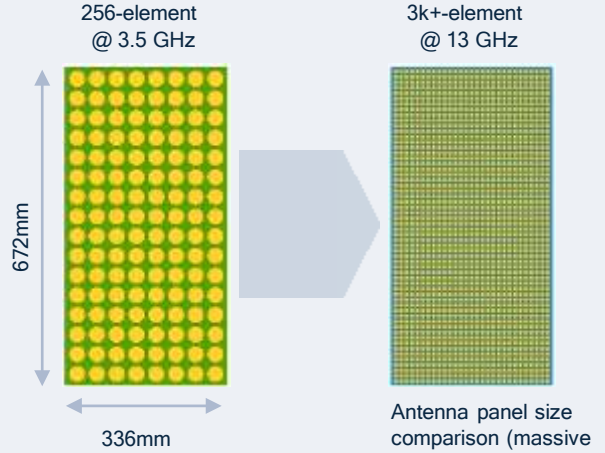
Best of wide-area coverage of sub-7 GHz and wide-band capacity of mmWave



Giga-MIMO expands network coverage to upper mid-band

Giga MIMO with wide bandwidth and large number of antenna elements (i.e., >2k)

More antenna elements with same aperture, 3-4x wavelength reduction vs. sub-7 GHz

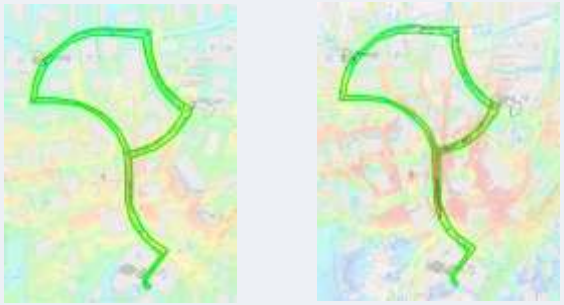


Antenna panel size comparison (massive MIMO vs. Giga MIMO)

For supporting wide-area use cases in X-band (8–12 GHz) and Ku-band (12–18 GHz)

Global spectrum discussions underway

Experimentations ongoing



256-element
@ 3.5 GHz

2048-element
@ 10 GHz

Network coverage testing near Qualcomm campus in San Diego, CA

Best of wide-band mmWave and wide-area sub-7 GHz

GHz bandwidth –10x more capacity than existing massive MIMO systems

Comparable wide-area coverage to massive MIMO in sub-7 GHz

Higher positioning, radar, and RF sensing resolutions

Note: Part of the spectrum may be studied or supported already in 5G NR Release 19+

Qualcomm Giga-MIMO prototype

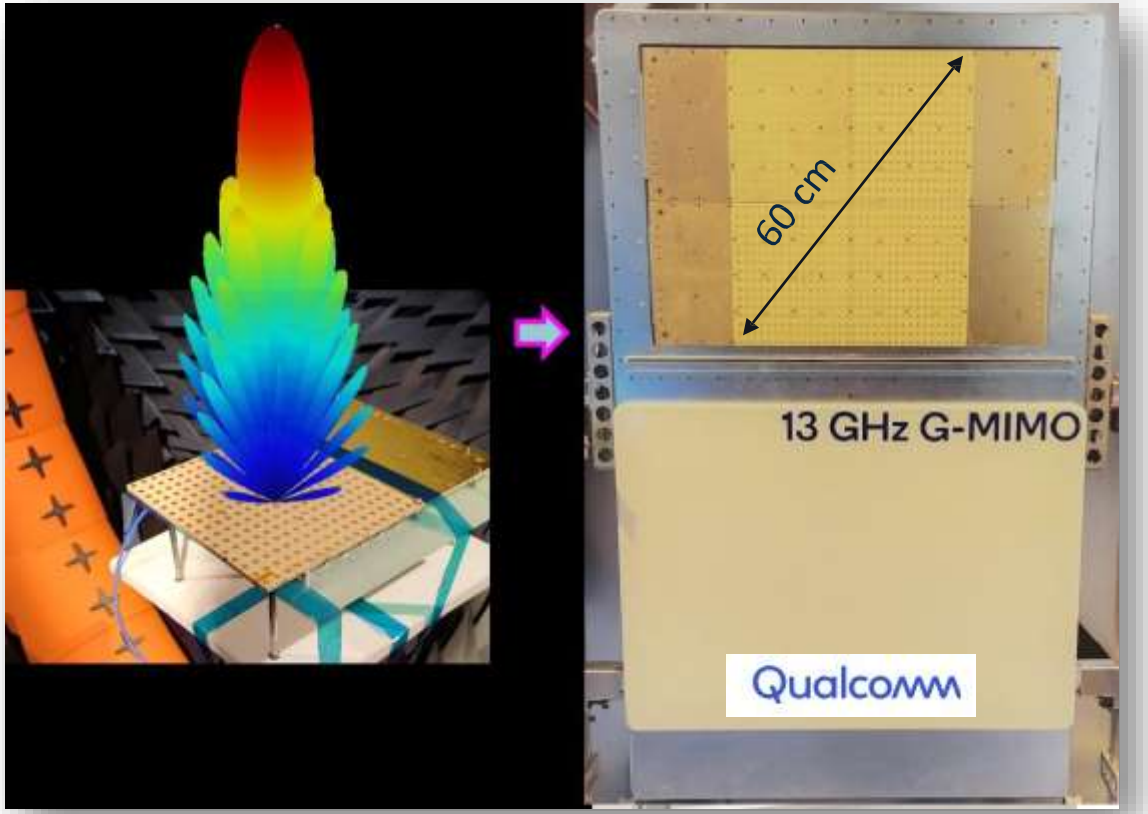
Experimental license granted around San Diego Morehouse campus

Large bandwidth of 500 MHz (12.75 - 13.25 GHz) to showcase advanced 6G applications defining industry roadmap

Wide area coverage

Novel approaches to Giga-MIMO design and validation – compact antenna test range

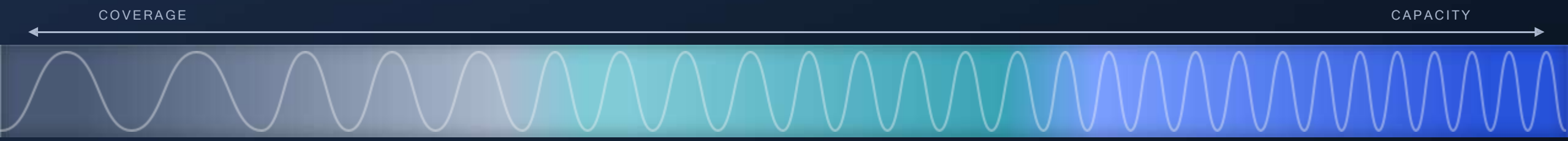
Identify and solve key challenges ahead of time, to prepare 6G eco-system



13 GHz Giga-MIMO Antenna Panel

Spectrum sharing can work well in all spectrum types and bands

Critical for the success of next-generation wireless systems



LOW BANDS	MID-BANDS	UPPER MID-BANDS	mmWAVE BANDS	SUB-THz BANDS
BELOW 1 GHz	1 GHz – 7 GHz	7 GHz – 24 GHz	24 GHz – 100 GHz	100 GHz & BEYOND

LICENSED SPECTRUM

Exclusive spectrum remains mobile industry's top priority

UNLICENSED SPECTRUM

Shared use but no QoS guarantee

SHARED SPECTRUM

Evolving spectrum sharing to enable fair and more reliable shared operations

Thank you

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