

Global 5G spectrum update

Luigi Ardito

Director, Government Affairs

Qualcomm Incorporated



European Commission driving a Gigabit Society¹

Deploying 5G across Europe by 2020 with pre-commercial trials starting in 2018



EC 5G Action Plan - published in Sept. 2016

- Early trials in 2017, pre-commercial trials from 2018
- Full commercial 5G services (one major city per country) in 2020
- All urban areas and major terrestrial transport paths with 5G coverage by 2025

Pioneer spectrum bands - identify by 2016/E

- Low-band (700 MHz), mid-band (3.4-3.8 GHz), high-band (24.25-27.5 GHz)

Full set of 5G spectrum bands - agree on by 2017/E

- Works towards a recommended approach for the authorization of the specific 5G spectrum bands above 6 GHz - focus on the bands for WRC-19 (e.g., 31.8 - 33.4 GHz, 40.5 - 43.5 GHz in addition to 24.25 - 27.5 GHz)
- Maximizes spectrum sharing opportunities - sharing as regulatory tool central to European Electronic Communications Code

Opening more spectrum for 5G is a global effort

5G spectrum status in key Asian markets and Australia

China



- Currently focusing on sub-6 GHz spectrum bands
- Approved trials at 3.4-3.6 GHz, looking at opening 3.3-3.4 GHz & 4.8-4.99 GHz
- Also working on mmWave, initially 24.25-27.5 GHz and longer term 27.5-29.5 GHz

Korea



- Initially focusing on higher frequency mmWave bands
- 27.5-28.3 GHz for 2018 Olympics trial, can be targeted for early deployments after trial
- Also looking at 37.5-40 GHz

Japan



- Focusing on both Sub-6 GHz and mmWave bands
- Sub-6 GHz: 3.6-4.2 GHz & 4.4-4.9 GHz
- mmWave: 27.5 GHz-29.5 GHz

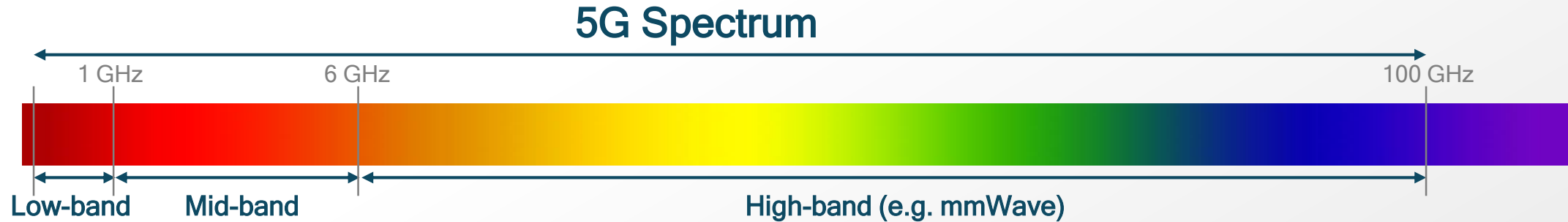
Australia



- Investigating Sub-6 GHz, primarily 3.4-3.7 GHz, and monitoring mmWave bands

The FCC is driving key spectrum initiatives to enable 5G

Across low-band, mid-band, and high-band including mmWave



Low-band

Broadcast Incentive Auction

- First stage auction opened up 126 MHz in 600 MHz band, auction failed to close with clearing cost set at \$88.4B
- Second stage auction opens up 114 MHz, auction started on 9/13
- Spectrum availability timing aligns with 5G

Mid-band

Citizens Broadband Radio Service

- Opening up 150 MHz in 3.5 GHz band
- 3-tier spectrum sharing with incumbents, PAL¹, and GAA²
- CBRS Alliance formally launched to drive an LTE-based ecosystem

High-band

Spectrum Frontiers Ruling³

- Opening up 11 GHz in multiple mmWave bands
- 70% of newly opened spectrum is shared or unlicensed
- Unanimously approved by FCC with additional candidate bands identified for IMT-2020

¹ Priority Access Licenses to be auctioned; ² General Authorized Access; ³ FCC ruling FCC 16-89 on 7/14/2016 allocated 3.25 MHz of licensed spectrum and 7.6 MHz of shared/unlicensed spectrum.

Spectrum Frontiers ruling for 5G mmWave

Shared and unlicensed spectrum is key for more bandwidths

Licensed access

- 27.5 - 28.35 GHz: 850 MHz (2x425 MHz)
- 37.6 - 38.6 GHz: 1 GHz (5x200 MHz)
- 38.6 - 40 GHz: 1.4 GHz (7x200 MHz)

Shared and unlicensed access

- 37 - 37.6 GHz: 600 MHz (3x200 MHz)
- 64 - 71 GHz: 7 GHz expansion of existing 60 GHz band

Total spectrum
= ~11 GHz

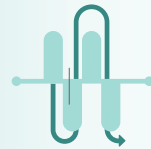
FCC also identified additional candidate bands for IMT-2020

Including 24.25-24.35, 24.75-25.25, 31.8-33.4, 42-42.5, 47.2-50.2, 50.4-52.6, 71-76 GHz

5G NR

5G NR will natively support all different spectrum types

NR shared spectrum will support new shared spectrum paradigms



Licensed Spectrum
Exclusive use



Shared Spectrum
New shared spectrum paradigms



Unlicensed Spectrum
Shared use

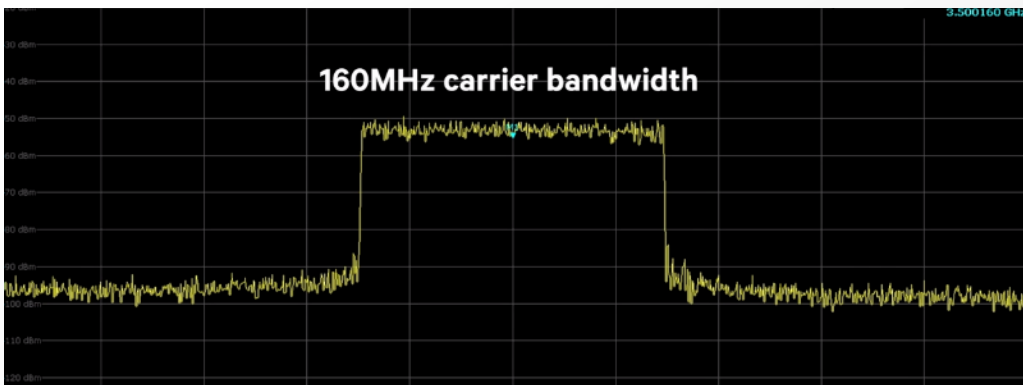
High bands above 24 GHz (mmWave)
Extreme bandwidths

Mid bands 1GHz to 6 GHz
Wider bandwidths for e.g. eMBB and mission-critical

Low bands below 1 GHz
Longer range for e.g. mobile broadband and massive IOT

Bringing new level of performance for sub-6 GHz

5G NR sub-6 GHz prototype system and trial platform



Operating in sub-6 GHz spectrum bands

Allows for flexible deployments with ubiquitous network coverage and a wide range of use cases

Achieving multi-Gbps at low latency

Showcases innovative Qualcomm® 5G designs to efficiently achieve multi-gigabit per second data rates and low latency

Driving standardization on 5G NR

OFDM-based designs implemented on the prototype system are being utilized to drive 3GPP standardization

Will enable impactful 5G NR trials

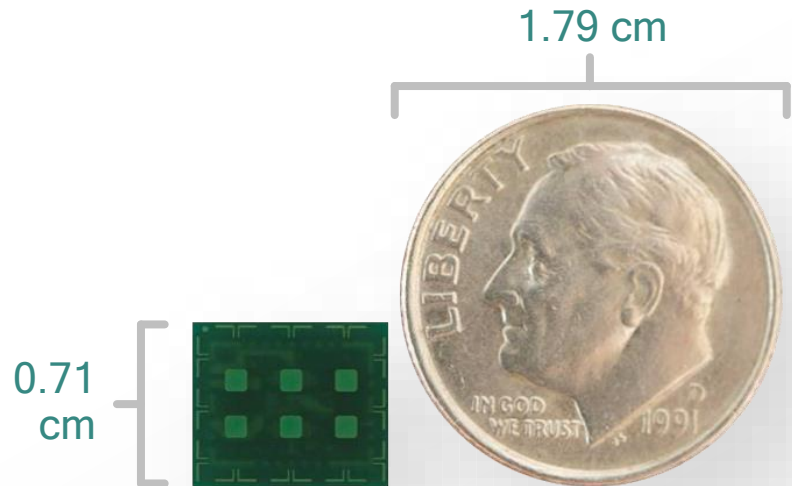
Designed to flexibly track 3GPP standardization and be utilized as a trial platform for impactful and timely 5G NR trials

Watch the demo video at: <https://www.qualcomm.com/videos/5g-nr-sub-6ghz-prototype-system>

Driving technology innovations to mobilize mmWave

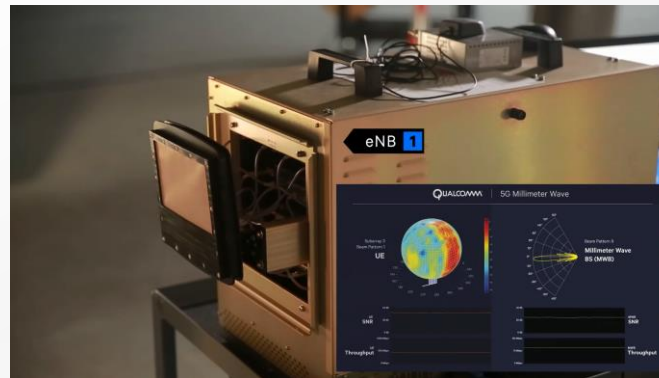
Operator trials & early deployments expected to start late 2017/early 2018¹

802.11ad 60 GHz chipset commercial for mobile devices



Qualcomm® 802.11ad 60 GHz technology with a 32-antenna array

5G mmWave prototype system and trial platform



End-to-end system operating at 28 GHz demonstrating NLOS operation and robust mobility

Qualcomm Technologies' First 5G Modem

Qualcomm® Snapdragon™

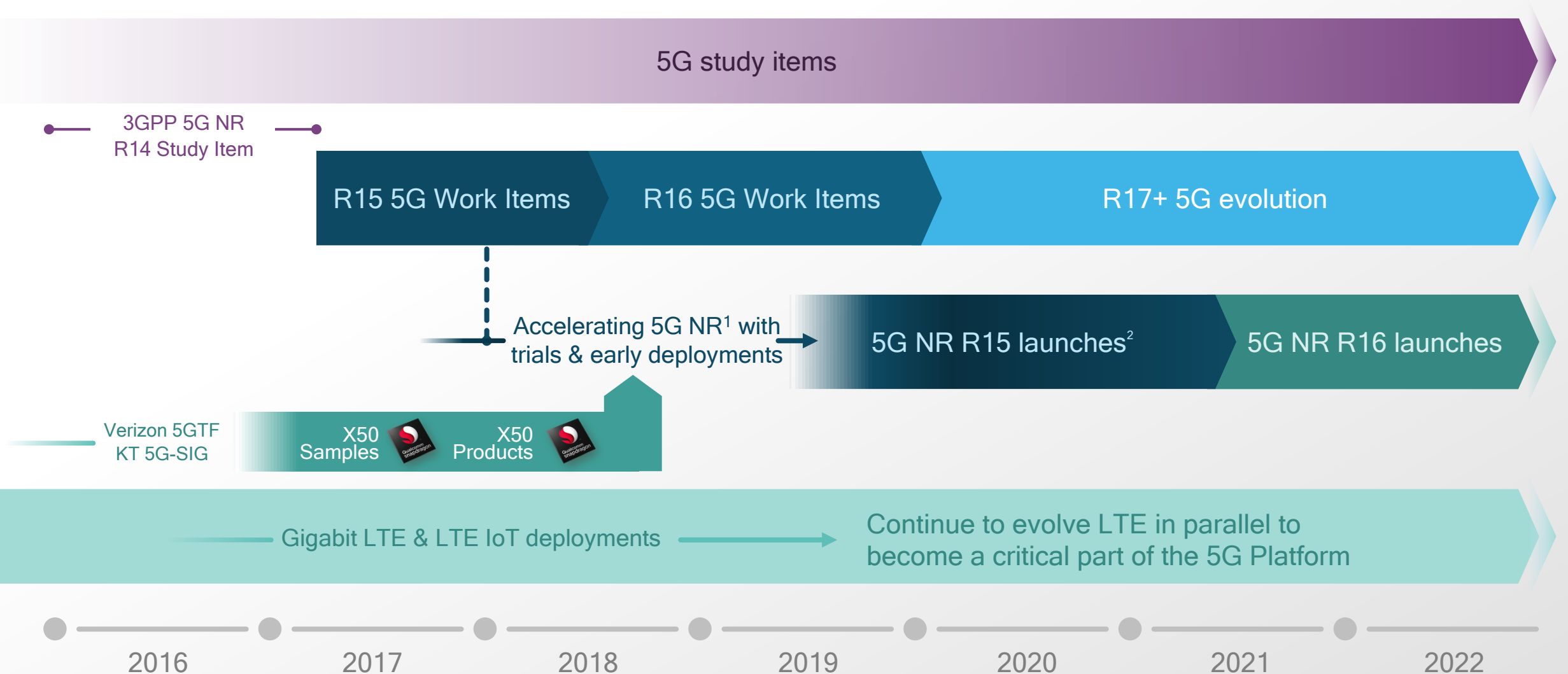
X50

28 GHz support, 4G/5G Multi-mode with dual connectivity, up to 5 Gbps download speed

Qualcomm Snapdragon is a product of Qualcomm Technologies X50 sampling expected 2H 2017 Commercial devices expected in 1H 2018

¹ For limited regional fixed wireless deployments, e.g. Korea and US (VZ 5GTF and KT 5G-SIG) operating at 28 and 39 GHz; also will be utilized for mobile wireless access trials to drive 5G NR standardization

Accelerating 5G NR, the global standard for 5G



Snapdragon™ is a trademark of Qualcomm Technologies, Inc. X50 sampling expected 2H 2017 Commercial devices expected in 1H 2018

Note: Estimated commercial dates. 1 The latest plenary meeting of the 3GPP Technical Specifications Groups (TSG#72) has agreed on a detailed workplan for Release-15; 2 Forward compatibility with R16 and beyond

Thank you

Follow us on:    

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2016 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm, Snapdragon, and VIVE are trademarks of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm’s licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm’s engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.

