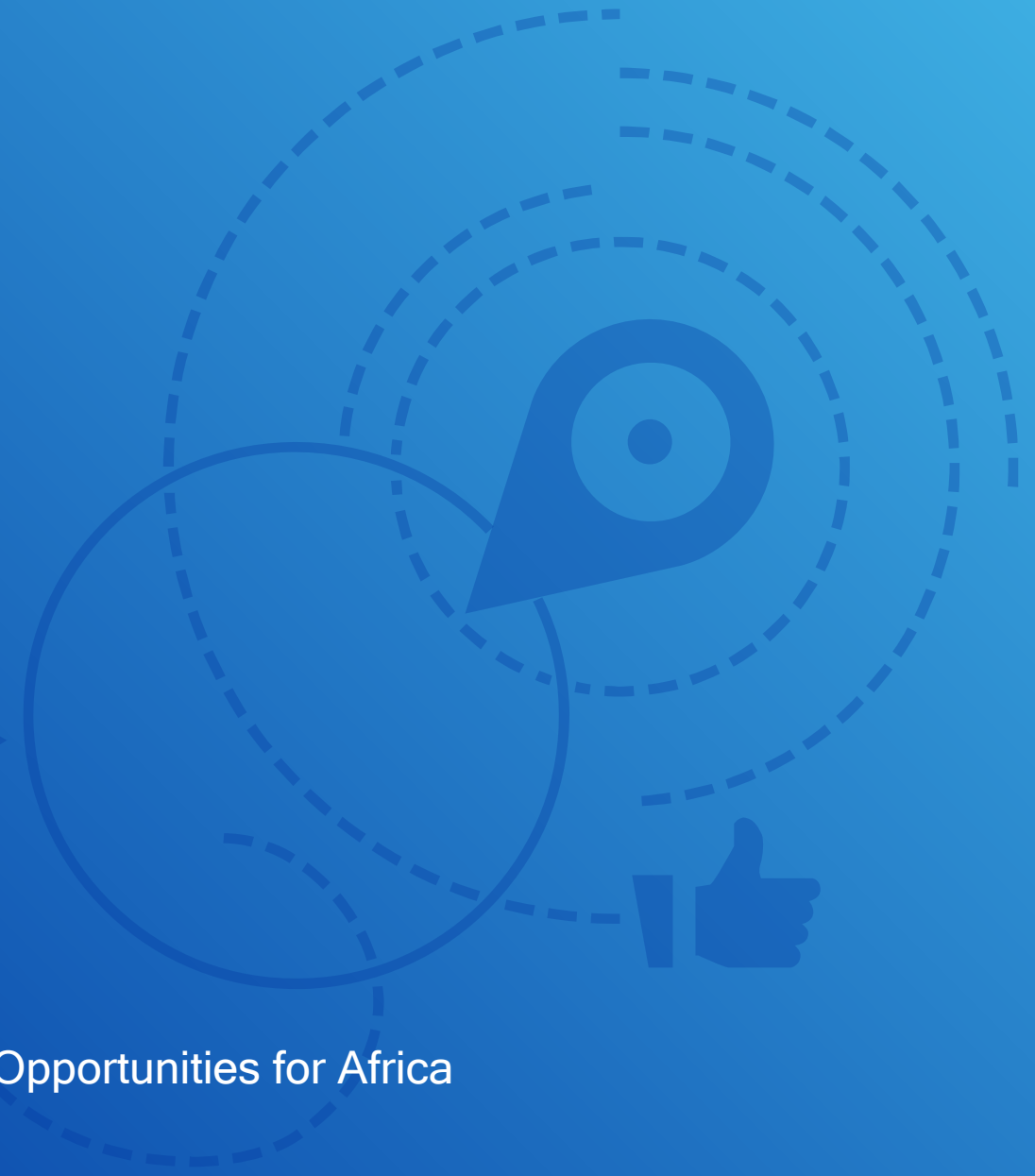
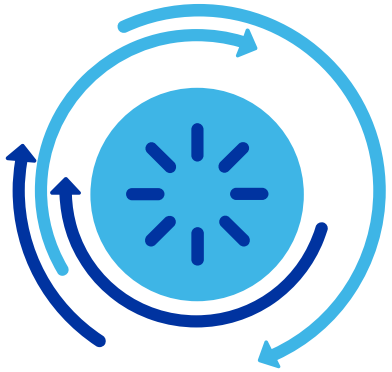
Innovative Wireless Technologies for Mobile Broadband

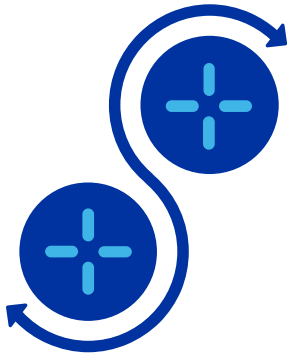


RRS-17-Africa Forum - WRC-19 Agenda : Challenges and Opportunities for Africa
Emerging Innovative Technologies
Dakar, Senegal, 31 March, 2017

Qualcomm business model



Invent



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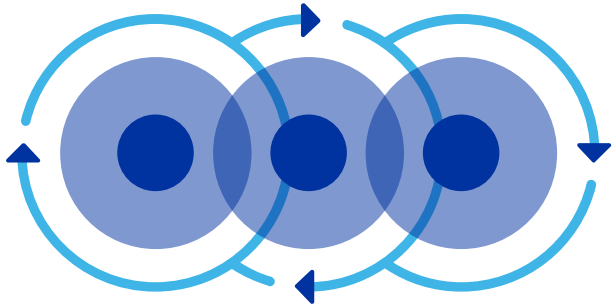


Collaborate

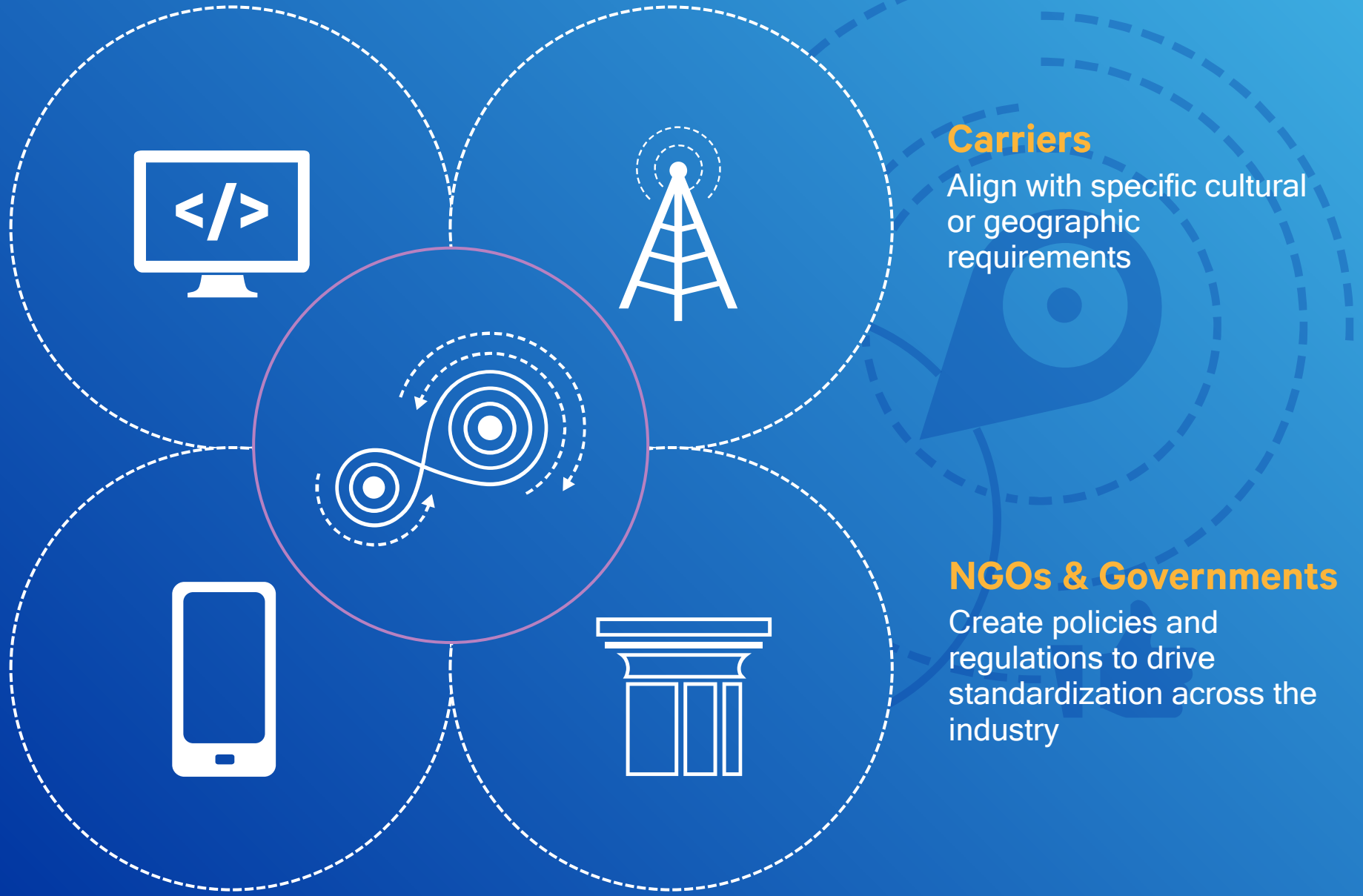
QUALCOMM®

Developers

Incorporate custom capabilities in hardware and software

Carriers

Align with specific cultural or geographic requirements



Manufacturers

Collaborate to drive technology evolution and growth

NGOs & Governments

Create policies and regulations to drive standardization across the industry

A unifying connectivity fabric

Always-available, secure cloud access

5G

Enhanced mobile broadband

Mission-critical services

Massive Internet of Things

Converged connectivity

Unified design for all spectrum types and bands

Enhancing mobile broadband with new levels of performance and efficiency

Gigabit LTE is an essential pillar for the 5G mobile broadband experience

- Gigabit LTE and multi-connectivity will be essential to the viability of delivering seamless Gigabit-class connectivity during the early years of 5G
- Multimode solutions (4G/5G) are expected to play an important role in ensuring a smooth 5G transition
- Delivering Gigabit LTE by pioneering many new LTE Advanced Pro technologies
  - Evolving carrier aggregation to achieve wider bandwidths (e.g., 80 MHz),
  - Supporting higher-order modulations (e.g., 256-QAM), and leveraging many more antennas (e.g., 4x4 MIMO)
  - Extending LTE into shared and unlicensed spectrum (e.g., LAA),

New spectrum sharing paradigms–opportunity to innovate

Using all spectrum: low-band, mid-band, & high-band for mobile broadband

Licensed spectrum

Exclusive use

Over 40 bands globally for LTE

Shared spectrum

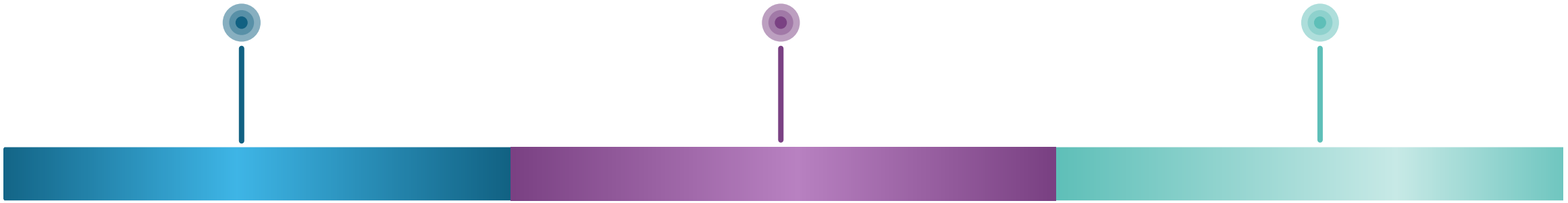
New shared spectrum paradigms

Example: 2.3 GHz Europe / 3.5 GHz USA

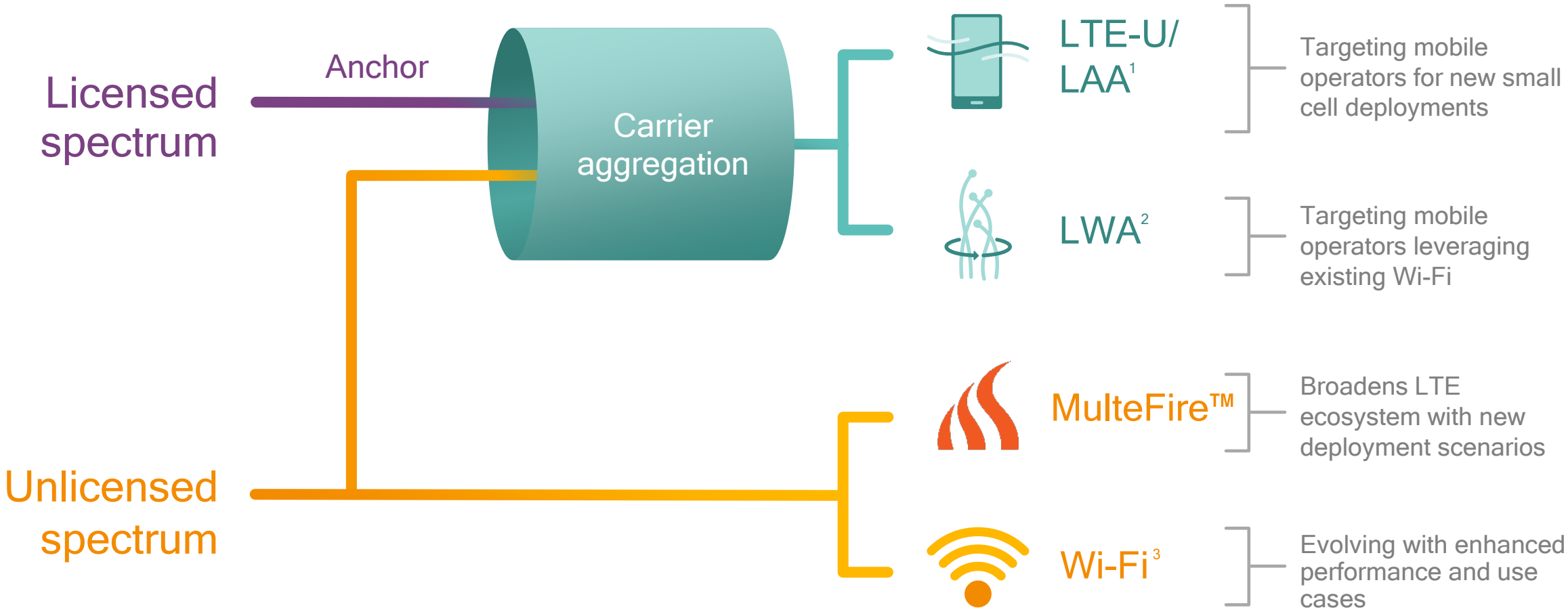
Unlicensed spectrum

Shared use

Example: 2.4 GHz / 5 GHz / 60 GHz global

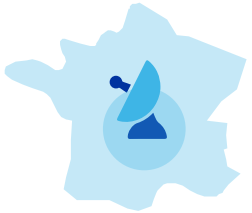


Making best use of unlicensed spectrum with LTE technologies as well



1 Licensed-Assisted Access (LAA) evolving to enhanced LAA; 2 LTE Wi-Fi Link Aggregation (LWA) evolving to enhanced LWA. An alternate is LTE Wi-Fi radio level integration with IPsec tunnel (LWIP); 3 802.11ac /.11ad /.11ax /.11ay

We are pioneering shared/unlicensed spectrum in 4G LTE



LSA[1]

Extensive technical pilot in France/Italy with Ericsson, Nokia, Red Technologies, and the EC in 2016

LTE-U

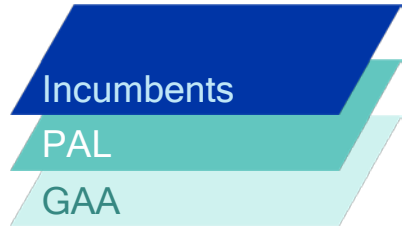
We designed the original proposal, commercialized by the LTE-U forum

LAA[2]

Performed world's first over-the-air trials; LAA with Deutsche Telekom Nov 2015 & eLAA with SKT Oct 2016

MULTEFIRE

A founder of the MulteFire Alliance and a key contributor to its specification



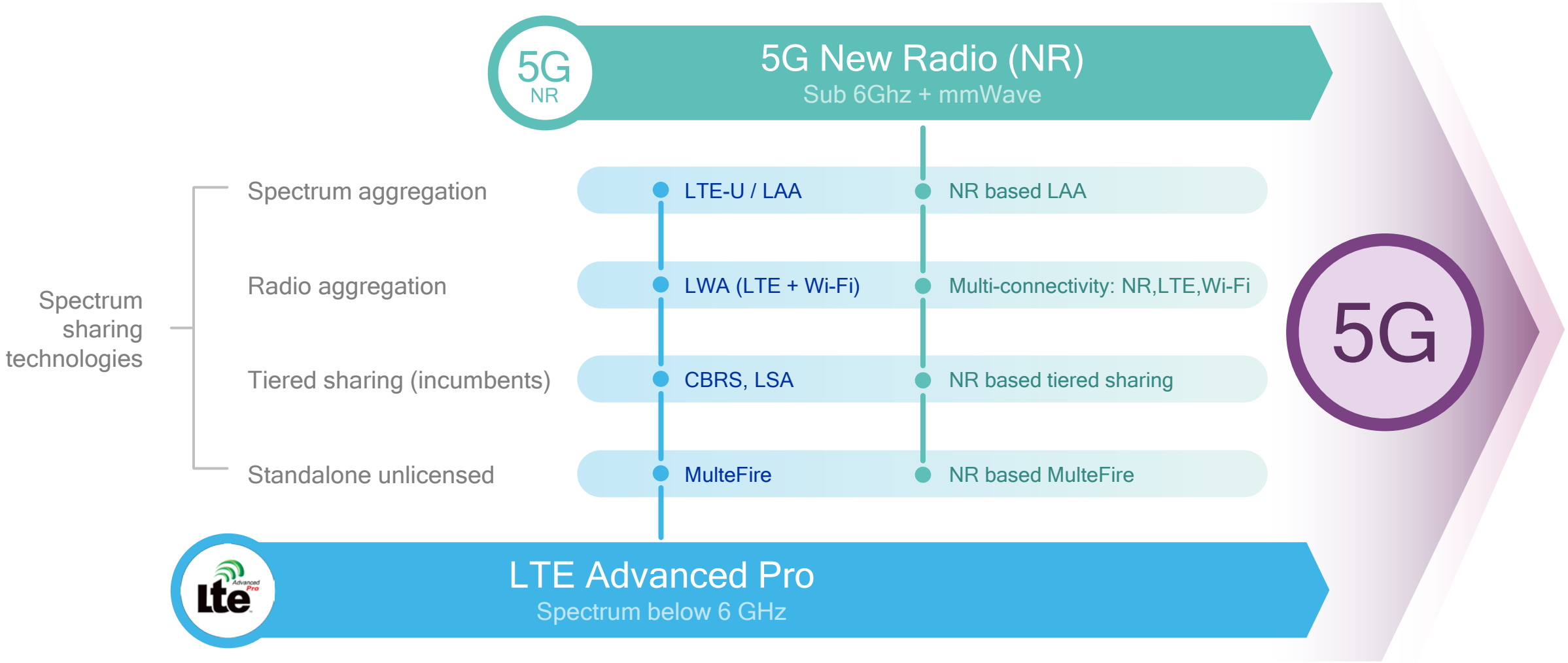
CBRS[3]

A founder of the CBRS Alliance that facilitates the rollout of 3.5 GHz in the US

1 Licensed Shared Access (LSA); 2 Licensed-Assisted Access (LAA); 3 Citizen Broadband Radio Service (CBRS), Priority Access Licenses (PAL), General Authorized Access (GAA)

We are pioneering 5G spectrum sharing today

Building on LTE-U/LAA, LWA, CBRS, LSA and MulteFire[1]



1) Licensed-Assisted Access (LAA), LTE Wi-Fi Link Aggregation (LWA), Citizen Broadband Radio Service (CBRS), Licensed Shared Access (LSA)

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Conclusion

- Just like previous mobile generational transitions, the proliferation of the new 5G NR networks is unlikely to happen overnight.
- Gigabit LTE and multi-connectivity will be essential to the viability of delivering seamless Gigabit-class connectivity during the early years of 5G
  - Multimode solutions are expected to play an important role in ensuring a smooth 5G transition
- At Qualcomm, we are enabling future wireless innovations and capabilities such as Gigabit LTE which will require much more spectrum, beyond what exclusively assigned spectrum can accommodate
- Therefore, all available spectrum—including licensed, shared & unlicensed spectrum should be used for mobile broadband
- In future scenarios (including evolution to 5G), spectrum sharing will be one of the key element for the expansion of mobile broadband, and Qualcomm is pioneering new spectrum sharing paradigms such as LSA, LTE-U, LAA, MulteFire etc.

Thank you

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