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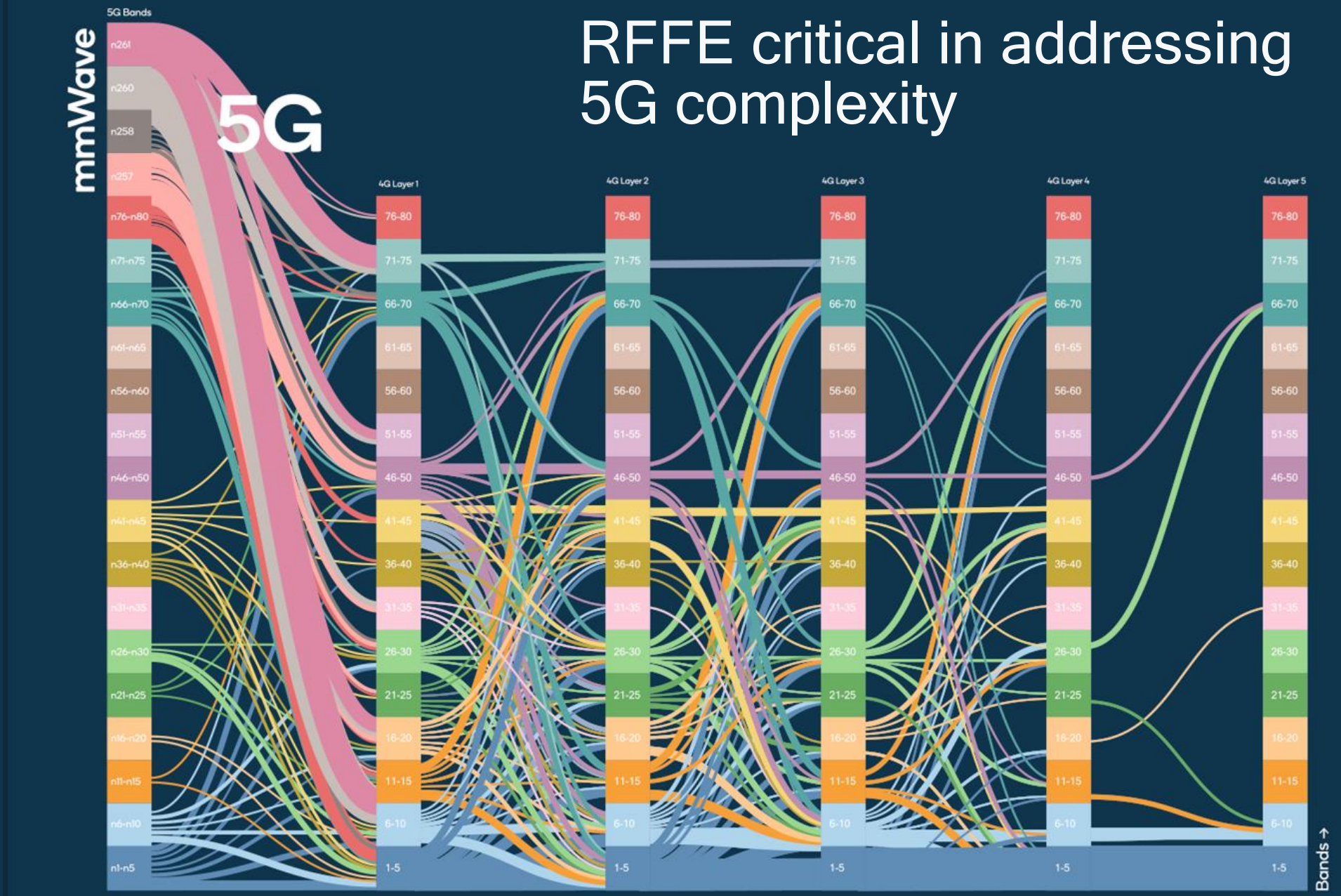
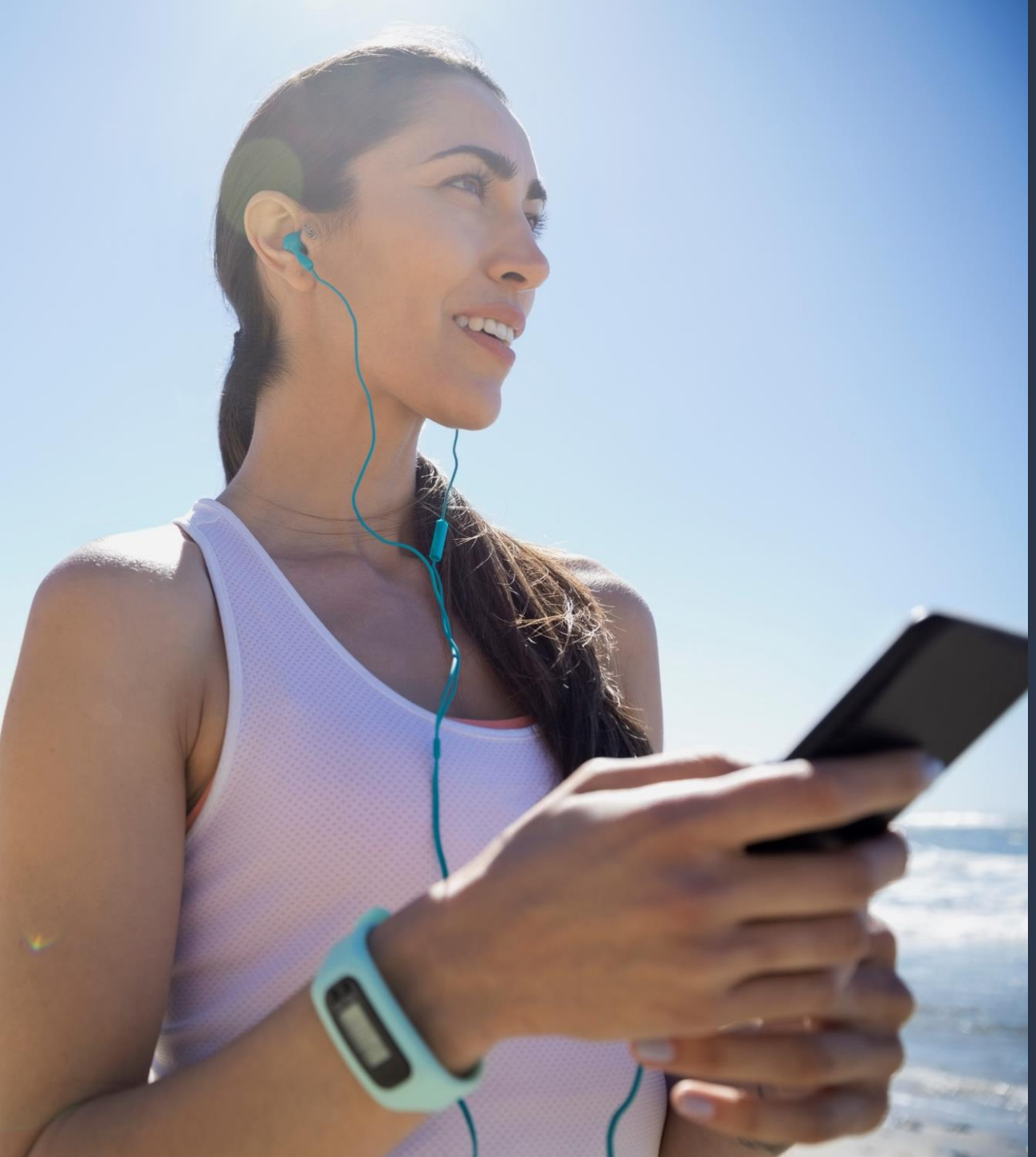
5G

RFFE critical in addressing 5G complexity

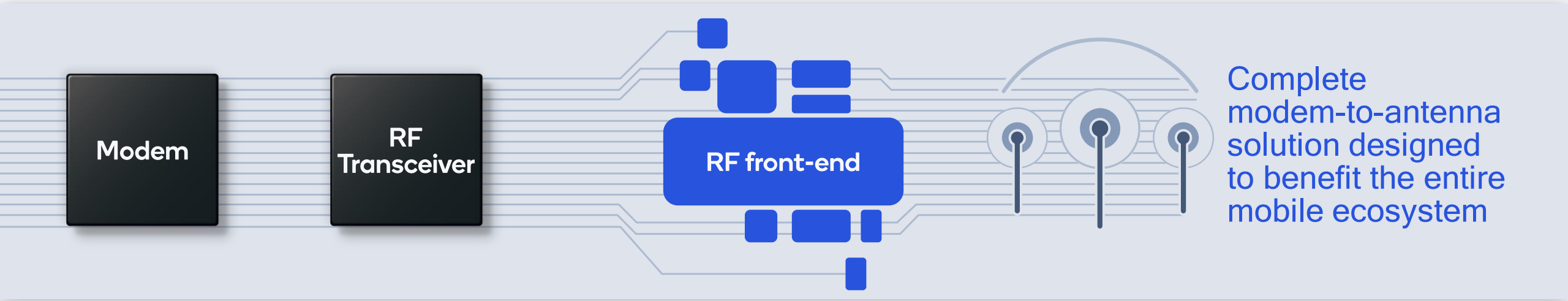




Challenges in designing 5G devices

- Cost
- Power efficiency
- mmWave connectivity
- Form factors
- Thermal performance
- Regulatory compliance

RFFE a critical piece for modem-to-antenna solution



Complete modem-to-antenna solution designed to benefit the entire mobile ecosystem

Radio frequency front end:
transmit/receive chain shaping and managing all signals

- Acoustic filters
- RF modules
- Power amps
- LNAs
- RF switches
- Envelope trackers

Virtually all Snapdragon-based smartphones feature Snapdragon Modem-RF Systems

Selected examples

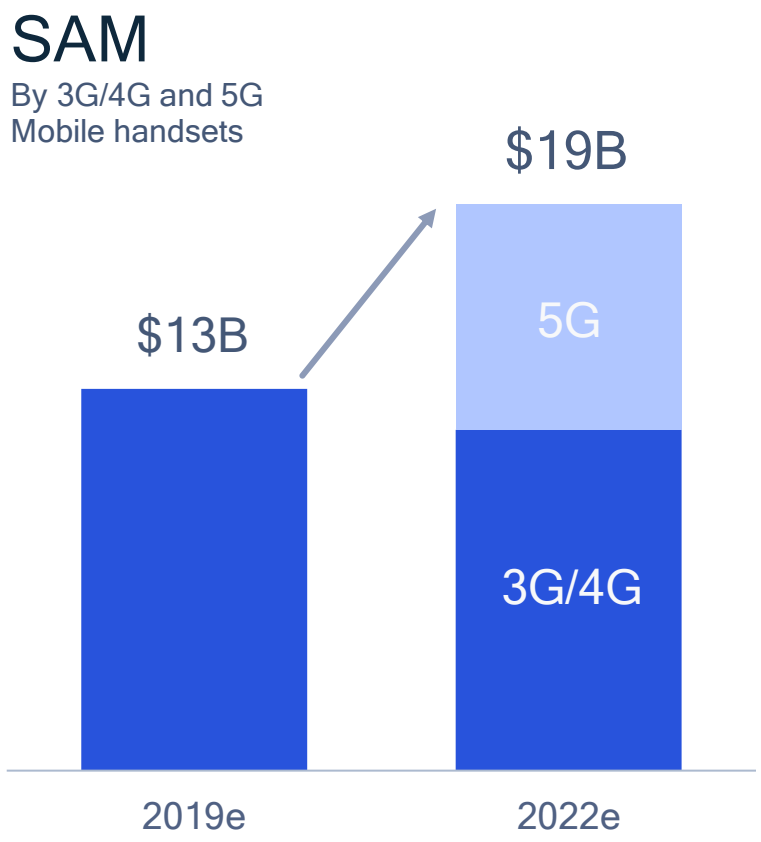
Snapdragon 5G modem-RF

	 Samsung Galaxy S21 5G (select markets)	 Samsung Galaxy S21 Ultra 5G (select markets)	 Samsung Galaxy A52 5G	 Google Pixel 5 5G	 Motorola Razr 5G	 vivo iQOO7	 vivo X60 Pro +	 Xiaomi Mi 11	 OnePlus 9 Pro	 OPPO Find X3
Modem+Transceiver	● [1]	● [1]	● [3]	● [2]	● [2]	● [1]	● [1]	● [1]	● [1]	● [1]
5G PA Module (TX)			● [4]	●	●	●	●	●	●	● [4]
4G PA Module (TX) [6]	●	● [4]	●	●	●					
5G DRx Module	●	● [4]	●	●	●	●	●	●	●	●
4G DRx Module [6]	●	● [4]	● [4]	●	●			●	●	●
Power Tracker (ET+APT)	●	●	●	●	●	●	●	●	●	●
Antenna Tuner	●	●	●	●	●	●			●	●
Low Noise Amplifier (LNA)				●	●	●		●		●
Discrete Filter/Extractor	● [4]	● [4]	● [4]	●	●	●	●	●	●	●
mmWave Module[5]	●	●	●	●	N/A	N/A	N/A	N/A	●	N/A

Source: Qualcomm Technologies data as of Q2FY21

1) Snapdragon 888; 2) Snapdragon 765G; 3) Snapdragon 750G; 4) Partial volumes include Snapdragon; 5) N/A denotes phones that do not support mmWave modules; 6) supporting 4G and 5G signals at sub 3GHz frequencies

RFFE a Key Growth Area



SAM: Serviceable Addressable Opportunity
RF Front-End (RFFE) includes 4G, 5G Sub-6 and 5G mmWave
Source: Combination of third-party and internal estimates

Growth driven by higher RFFE complexity and 5G expansion

Target >20% RFFE SAM

On track to exceed target by 2022

Max Rodrigues

Manager, Product Marketing
RF360 Europe GmbH

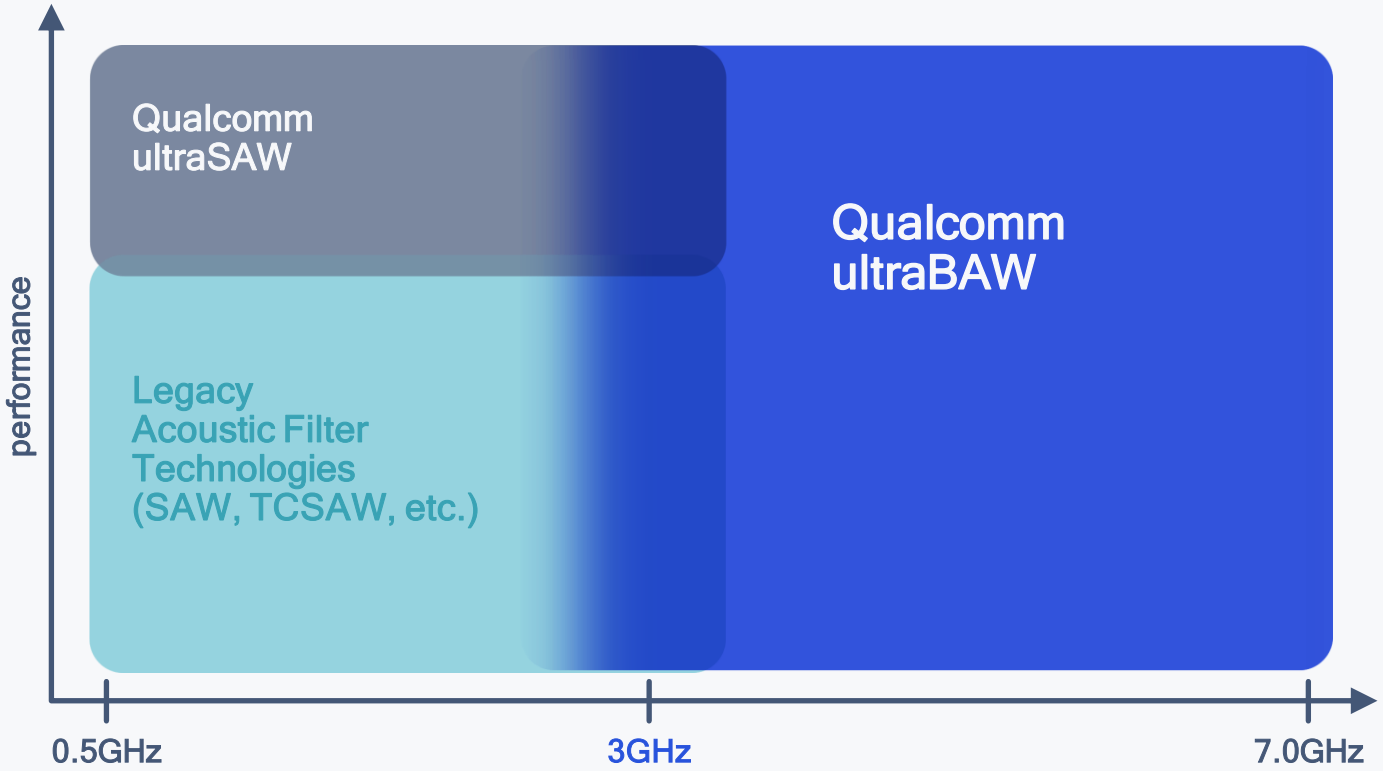
Qualcomm

5G


Announcing
Qualcomm®
ultraBAW Filter
Technology
Qualcomm ultraBAW is a product of Qualcomm Technologies, Inc. and/or its subsidiaries.

Extending the performance of existing Micro Acoustic Filter Solutions

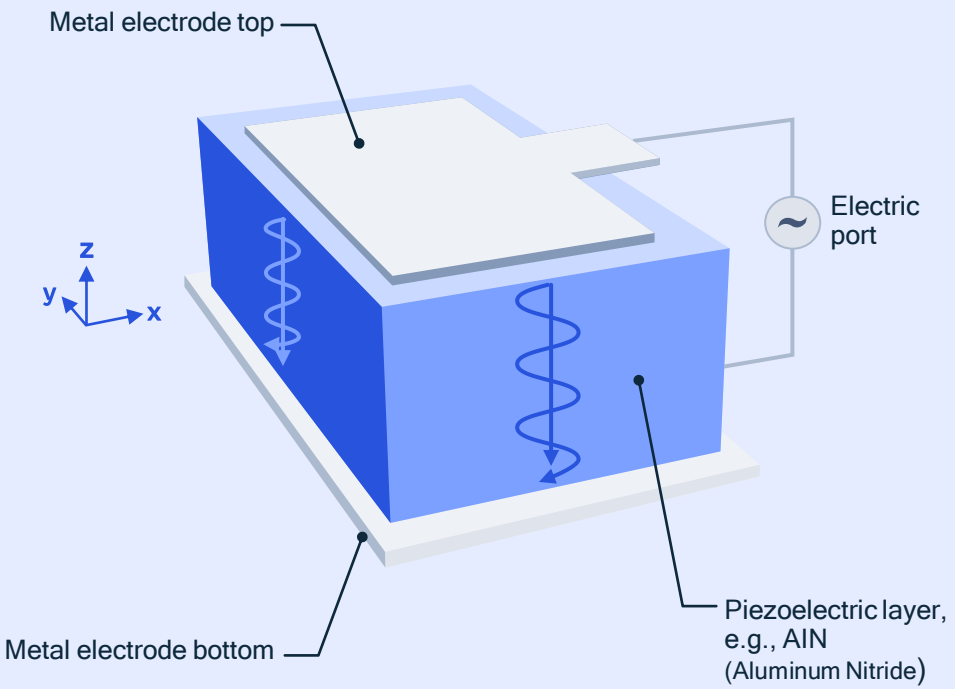
- **Qualcomm® ultraBAW** complements Qualcomm® ultraSAW filter technology and legacy micro-acoustic filter technologies (SAW, TC SAW, etc.)
- **Applications:** 5G, Wi-Fi, Automotive, Compute, IoT, Industrial Applications, etc.



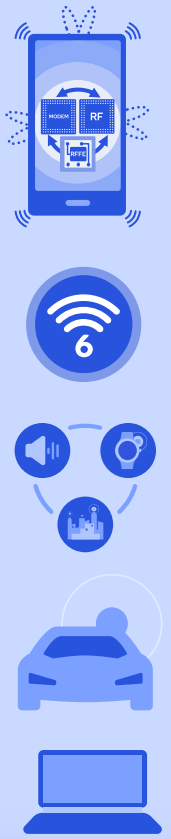
*Simplified view for illustrative purposes

Introducing Qualcomm® ultraBAW sub-7GHz filter technology

New filter technology for enhanced high-frequency performance

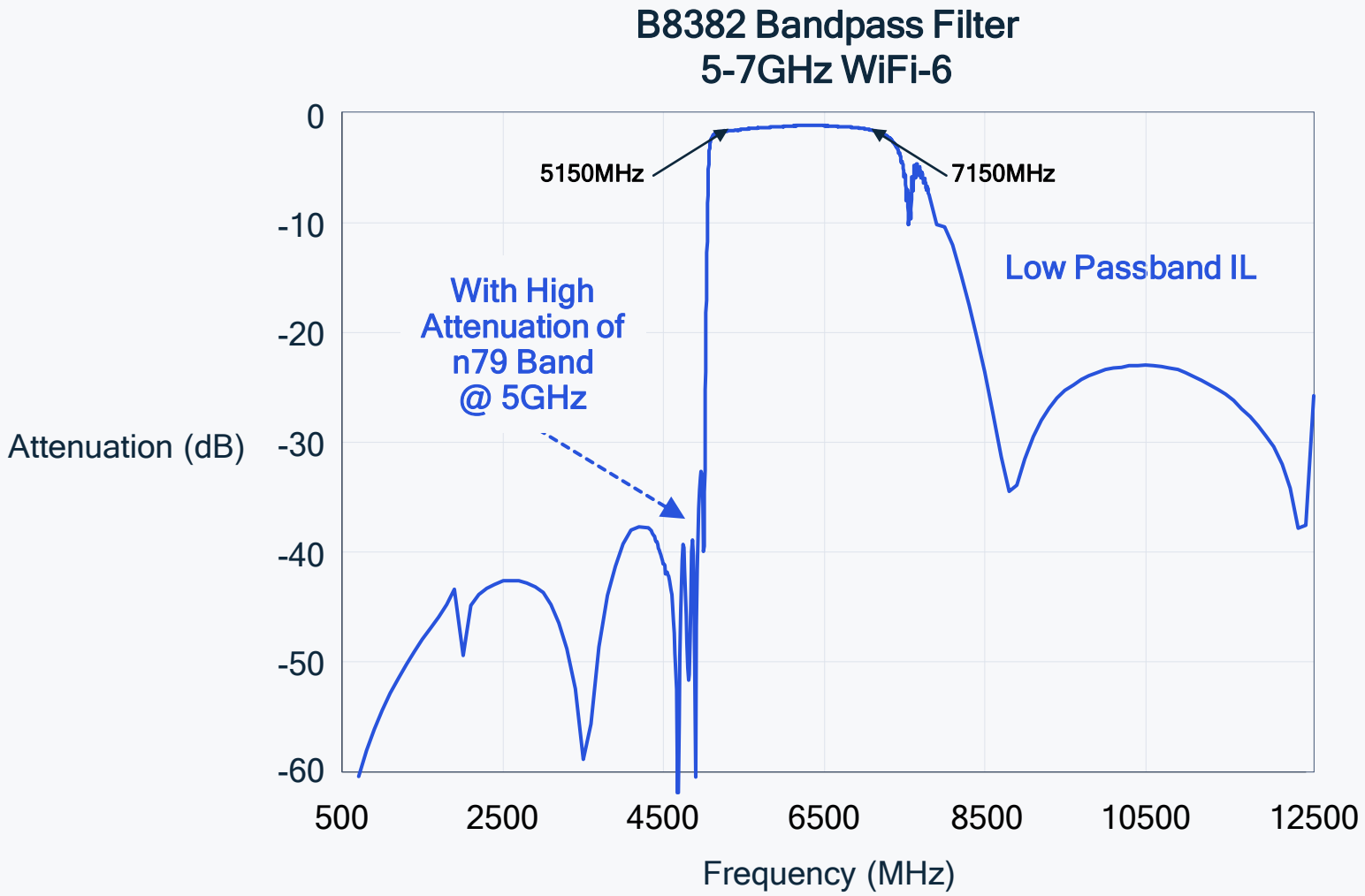


- Power amplifier modules
- Diversity modules
- Wi-Fi modules / extractors / filters
- Discrete filters

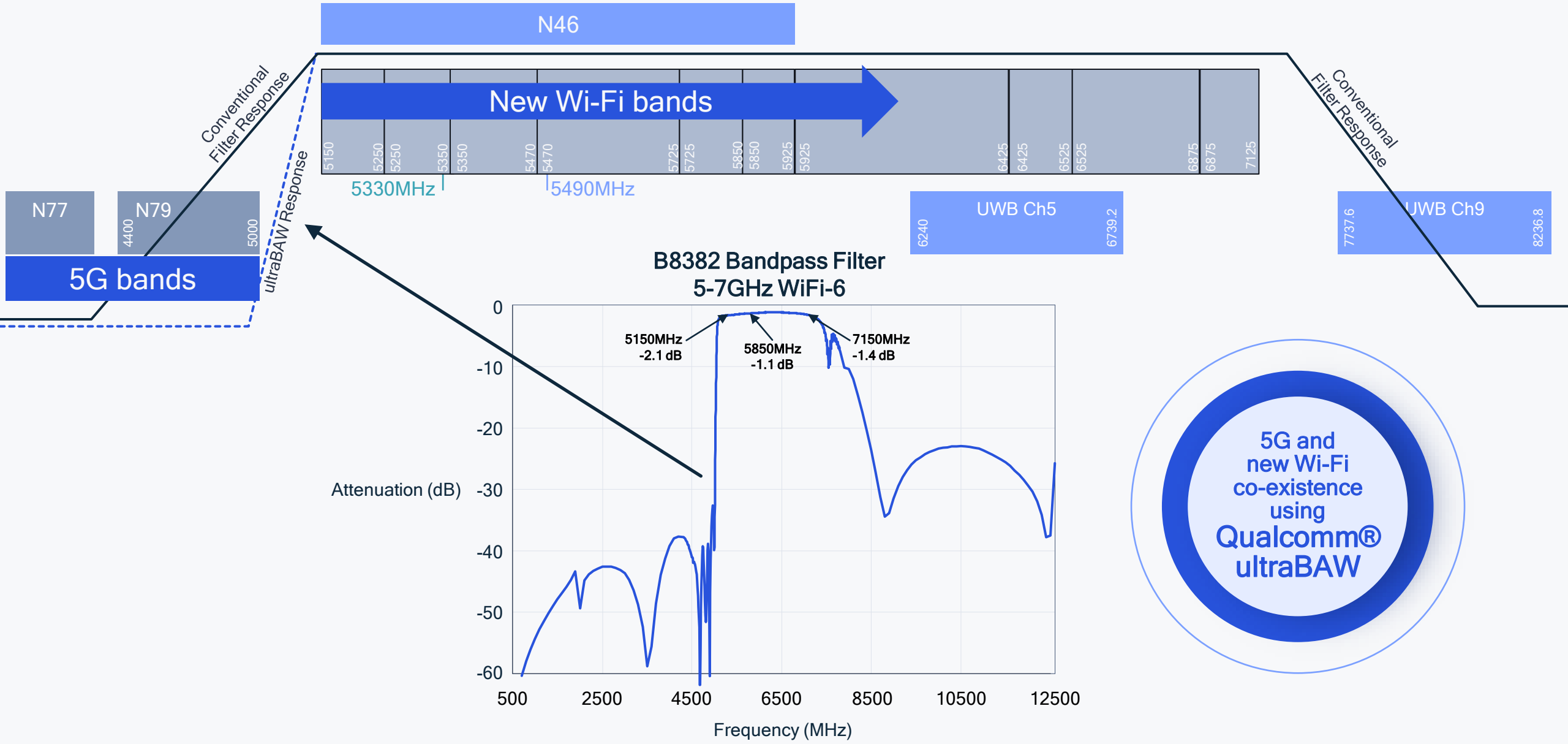


Qualcomm ultraBAW filter technology enhances performance at frequencies above 2.7GHz

- **High-frequency selectivity** allowing 5G NR and Wi-Fi co-existence at frequencies 2.7GHz -7.2GHZ
- **Low UHB (ultra high band) insertion loss** (Q-factor as high as 1500 @5GHz) achieving high filter selectivity
- **Very high coupling factor** to meet larger bandwidths and high data rates
- **High power handling** at UHB frequencies with extreme low insertion loss
- **Applications beyond smartphones**: Automotive, Compute, CPE, IoT, etc.



Next-Gen Filter Technology for Next-Gen Wi-Fi



5G and new Wi-Fi co-existence using Qualcomm® ultraBAW

Strong adoption of Qualcomm ultraSAW filter technology launched in 2020

Selected examples

Snapdragon 5G modem-RF

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Modem+Transceiver	1	1	3	2	2	1	1	1	1	1
5G PA Module (TX)			4							4
4G PA Module (TX) [6]		4								
5G DRx Module		4								
4G DRx Module [6]		4	4							
Power Tracker (ET+APT)										
Antenna Tuner										
Low Noise Amplifier (LNA)										
Discrete Filter/Extractor	4	4	4							
mmWave Module [5]					N/A	N/A	N/A	N/A		N/A

ultraSAW enabled

ultraSAW Enabled

Source: Qualcomm Technologies data as of Q2FY21

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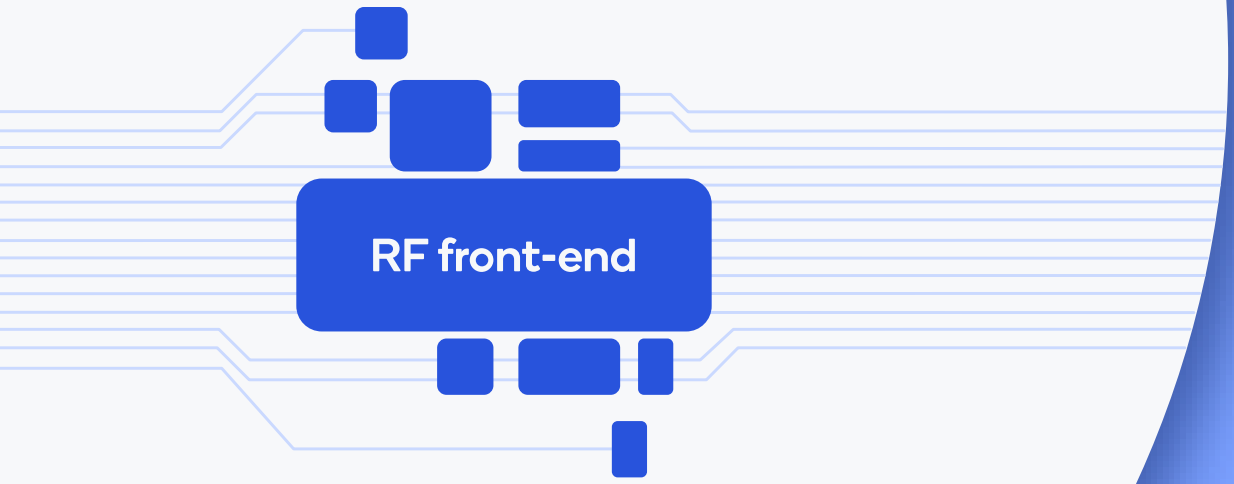
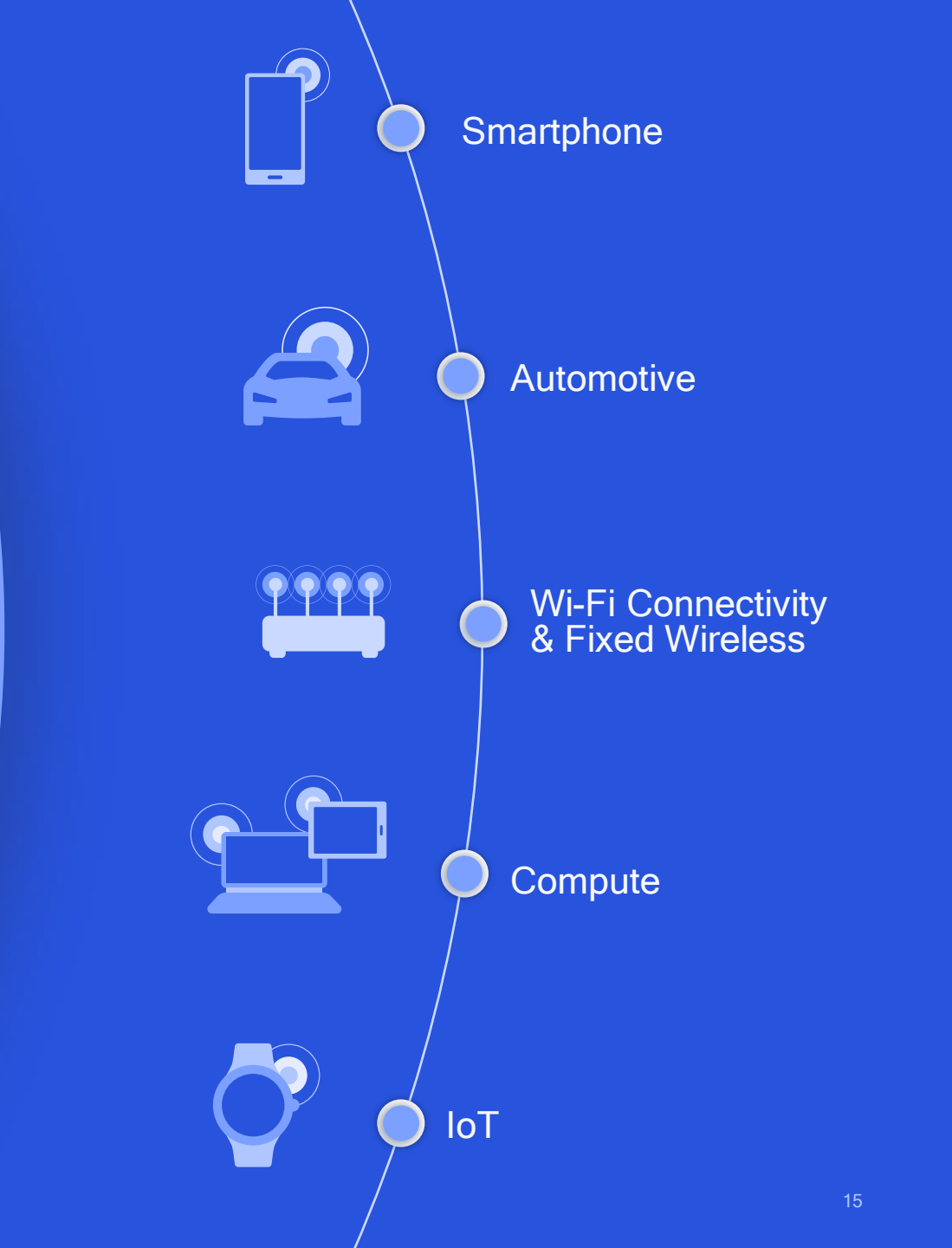
Extending RFFE leadership and innovation





Qualcomm

Thank you

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