Republic of Lithuania Communications Regulatory Authority Public Consultation on the Future Use of the 6425–7125 MHz Radio Frequency Band

Qualcomm response

Qualcomm would like to thank the Communications Regulatory Authority of the Republic of Lithuania for the opportunity to respond to its Consultation on the future use of the 6425–7125 MHz radio frequency band.

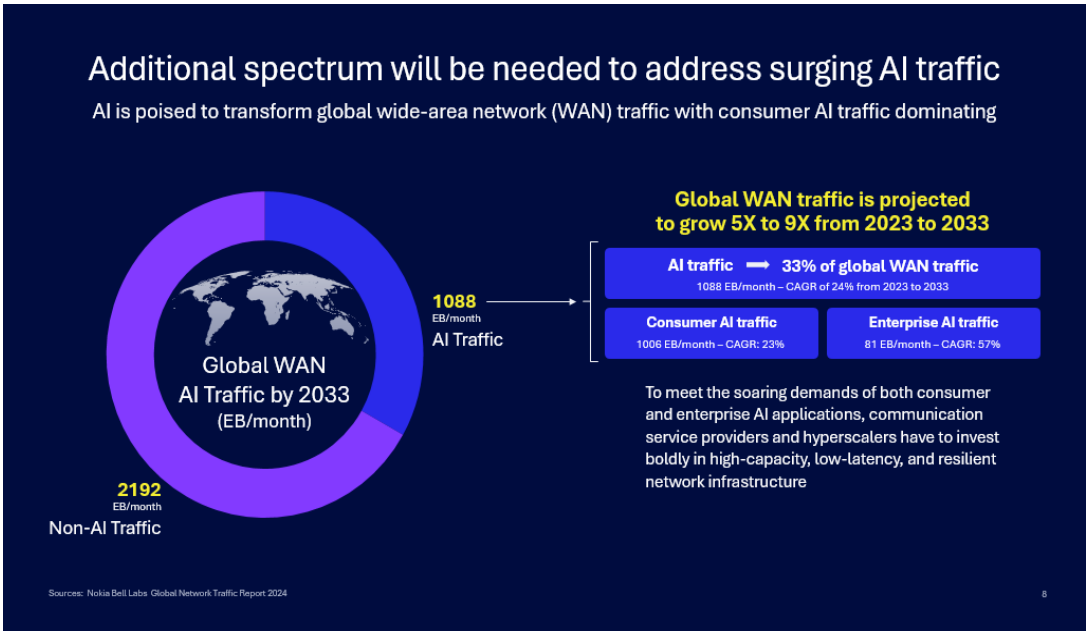
As a leading provider of both mobile and Wi-Fi technologies, Qualcomm has a unique viewpoint on the 6 GHz band. Qualcomm was the driving force behind 3G, 4G, and 5G, and is now leading the development of 6G to be deployed throughout the world later this decade. At the same time, Qualcomm is at the forefront of Wi-Fi innovation and is the world leading provider of chipsets that support Wi-Fi operations in license exempt spectrum.[1].

As we march toward 2030 and the 6G-enabled communications infrastructure, the relentless demand for wireless data will continue to reshape the connectivity landscape. Wireless connectivity has become the backbone of global digital transformation. The proliferation of smartphones, Internet of Things (IoT) devices and connected vehicles — each supported by wireless broadband — has driven a massive surge in data consumption. It is expected that by 2030, global mobile data traffic will quadruple, reaching a staggering 465 exabytes per month, with a compound annual growth rate (CAGR) of 23%[2] from 2023. This surge is powered by key trends such as the continued proliferation of 5G networks, enhanced video streaming quality, the rise of extended reality (XR), cloud gaming, and the increasing prevalence of AI-driven applications and services. AI is reshaping data flows, with global wide-area network (WAN) traffic

[1] Qualcomm's Wi-Fi chipsets operate in the 2.4 GHz band, the 5 GHz U-NII bands and in 6 GHz bands (in the lower 500 MHz from 5.925-6.425 GHz and in the full 1200 MHz from 5.925-7.125 GHz)

[2] GSMA. (2024). The Mobile Economy 2024. Retrieved on Dec 2, 2024 from: https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/.

projected to grow five to nine times from 2023 to 2033. By then, AI is estimated to account for 33% of all WAN traffic[3].



As the world moves from 5G to 6G, the capabilities of 5G wireless networks will be improved, and new 6G capabilities, applications and services will be added. 6G will address, at its foundational level, environmental sustainability concerns and incorporate technology enablers that extend the platform capability beyond connectivity. In the 6G era, capabilities such as RF sensing, Machine Learning/Artificial Intelligence ("ML/AI") and compute will merge with enhanced communication capabilities and foster ubiquitous access to use cases such as immersive multisensory devices, supporting Digital Twins and collaborative robotic applications, among other innovations. 6G also is being designed from the ground up to be more energy efficient and more cost-efficient, allowing mobile network operators to maximize their return on investment ("ROI")[4]. With a focus on reducing capital and operating expenditure, 6G will improve network efficiency while driving down network costs.

Meeting these continually increasing demands requires a well-orchestrated strategy to secure new spectrum and optimize existing bands. The success of 6G, with commercial deployments expected to start in 2030 (or earlier), hinges on the timely availability of new spectrum in mid bands with wide channels of 200-400 MHz. 6G will use a combination of frequency resources in the low, mid and high band spectrum to meet coverage and enhanced capacity requirements as well as providing improved performance and serve new and emerging use cases.

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[3] Nokia. (2024). Global network traffic report. Retrieved on Dec 2, 2024 from: https://onestore.nokia.com/asset/213660.

[4] For instance, according to a report by GSMA, "20% of operators rate energy efficiency as the No.1 attribute to prioritise in 6G networks from a business standpoint." See GSMA Intelligence, The Next Generation of Operator Sustainability: Greener Edge and Open RAN at 6 (Sep. 2023).

In this context, RRT's consultation is timely and critical as the Upper 6 GHz band is the only feasible spectrum opportunity to launch 6G in the Lithuania and in Europe within this timeframe. The availability of the entire U6 GHz band without undue restrictions or harmful interference to mobile services is vital for the successful introduction of 6G, and making the entire band available for mobile services is a key prerequisite to maintain Lithuania and Europe competitiveness and ambitions to place it ahead of, or at least in line with, leading markets, like the U.S., China, Brazil, India.

Please find below Qualcomm's answers to the questions in the consultation.

A. **What would be the need to use the 6425–7125 MHz (U6 GHz) radio frequency band for public mobile radio (IMT) network services in Lithuania, and when could such a need arise?**

1. What is the current need for new radio frequency resources? Indicate how loaded the existing spectrum resources are (1800/2100/2300/2600/3600 MHz)?

The current need for new radio frequency resources is driven by the rapid growth in mobile data traffic, the expansion of 5G networks, and the rapid development and take up of IoT and AI. The increasing demand for mobile data and the rollout of 5G networks are putting significant pressure on existing spectrum resources. As a result, there is a strong need for new frequency bands to ensure that networks can continue to meet the growing demand for high-speed, reliable connectivity.

Qualcomm believes that the entire upper 6 GHz band should be made available for mobile use and become the home of the next generation of wireless technology. 6G will need a combination of various dedicated frequency resources across the low, mid and high-band spectrum to meet coverage and enhanced capacity demands, as well as to support the anticipated growth of emerging use cases in 2030 and beyond. While existing low-mid-band spectrum (3.5 GHz and below) offers good wide-area coverage, its limited bandwidth, even with 6G spectral efficiency improvements, will not suffice. That's why the availability of the entire upper 6 GHz band without undue restrictions for mobile services is vital for the introduction of 6G in Lithuania and Europe. Making this new upper-midband spectrum available to mobile is a key prerequisite to maintain Lithuania and Europe's competitiveness.

The EU and its Member States have allocated €11 billion to 6G research and development programs[5], but access to the entire upper 6 GHz spectrum band is key to ensuring the successful deployment of these technologies. The U6 GHz is the only feasible spectrum opportunity to launch wide-area 6G in the UK and in Europe at the end of this decade, as Europe has opposed identification of additional IMT resources in the range 7.250 – 8.400 MHz at WRC-23. It's notable that this range could possibly be extended by additional 125 MHz in the 7.125 – 7.250 GHz (under sturdy for WRC-27).

Making the upper 6GHz available for initial 6G launch is also critical, because coordinated timing for a launch of 6G services does not appear practical at EU level in the current harmonized bands due to technology neutrality and operators' migration plans for switching to enhanced technologies. Timing of 6G launch will depend on mobile operator's strategy, availability of spectrum resources and expiration dates of existing authorizations. Therefore, the availability of an additional spectrum band such as U6 GHz in Lithuania and the EU could facilitate coordinated timing for 6G launch.

[5] https://www.vodafone.com/news/public-policy/open-letter-european-telecom-companies-6ghz-spectrum

It is important to note that U6 GHz as a primary 6G band will facilitate larger blocks sizes compared to those available in current harmonized bands. This would be particularly beneficial for targeted new 6G services that require larger bandwidth. Furthermore, on the basis of this spectrum being made available, new usages not initially targeted when developing the technology roadmap could emerge triggered either by new technology opportunities or by evolving MNOs' strategies.

2. If you were to use the U6 GHz band, what bandwidth of the radio frequency band would be needed for one operator?

Qualcomm believes that the entire upper 6 GHz band should be made available for mobile use and become the home of the next generation of wireless technology. The U6 GHz is the only feasible spectrum opportunity to launch wide-area 6G in Lithuania and in Europe at the end of this decade, as Europe has opposed identification of additional IMT resources in the range 7.250 – 8.400 MHz at WRC-23. It's notable that this range could possibly be extended by additional 125 MHz in the 7.125 – 7.250 GHz (under study for WRC-27).

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U6 GHz spectrum responds to capacity and coverage needs for 6G immersive communications usage scenarios and helps reduce Capex by enabling the reuse of existing base stations sites. Without wide-area, wide-bandwidth channels for 6G mobile systems (200 to 400 MHz-wide), such as those available in the Upper 6 GHz band, 6G systems will be unable to provide comparable multi-Gigabit speeds to large numbers of mobile users outdoors and in other locations where mobile systems are the only source of connectivity. Larger bandwidths of at least 200MHz per MNO will drive down the costs of the transmitted traffic unit (EUR/G Byte)

Thus, Qualcomm would like to recommend:

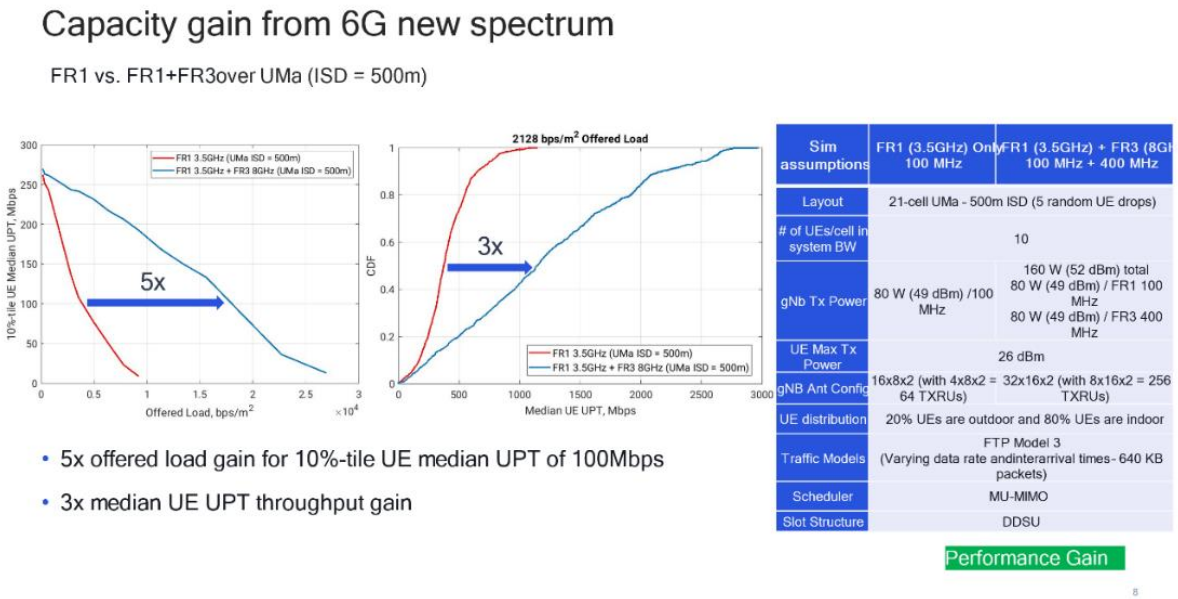
- Making available the entire upper 6GHz band (6425 – 7125 MHz) for full power macro base station deployments and without undue regulatory restrictions to mobile
- Extending the upper 6GHz band with additional 125 MHz in the 7125 – 7250 MHz range (through WRC-27 process)
- making available at least 200 MHz of contiguous spectrum per MNOs in upper mid bands in the range 6425 – 7250 MHz

3. What network infrastructure would you develop in the U6 GHz band (e.g., macro/micro cells, etc.)? Would you densify the existing network infrastructure, and if so, how?

Very similar to the 3.5 GHz band being the primary band for 5G deployments in Europe, we foresee the Upper 6 GHz band to be the primary band for 6G. It not only supports high capacity but can achieve wide-area coverage, especially in urban and dense environments using the same deployment infrastructure as that used for 5G in the 3.5 GHz band. Research has shown that with the new innovative 6G technologies, bands like 6GHz can achieve wide-are coverage, transforming the U6 GHz band to a coverage band for 6G and the primary band for 6G deployments. Qualcomm's 6G R&D has been focusing on numerous

innovative technological solutions, including implementing next generation Giga-MIMO technology that will provide wider coverage using the same network deployment architecture akin to that available in the lower 3 GHz band. For example, the Giga-MIMO technology will increase the number of antenna elements from 192 for typical 3.5 GHz systems to 1024 (or more) for 6G U6 GHz base stations, resulting in higher antenna gain without increasing power consumption. Uplink waveform switching allows devices to operate their power amplifiers closer to maximum output. Higher power device classes, up to 29 dBm (+6 dB from typical 3.5 GHz devices), and more antennas on devices (e.g., 4 antennas instead of 2 at 3.5 GHz, leading to +3 dB enhancement) are also being developed. As a result, 6G network deployments will be more cost-efficient, allowing for more universal connectivity at affordable prices.

At MWC 2025, Qualcomm demonstrated that 6G systems using 8 GHz band (a band above the U6 GHz with more challenging propagation characteristics) can provide comparable performance and coverage (indoors and outdoors) to that of 5G systems using 3.5 GHz spectrum.[6] In challenging scenarios, like deep indoors, carrier aggregation can extend service by combining U6 GHz band carriers with those from lower frequency bands. Energy-efficient materials, such as frequency-selective surfaces, are also being considered. Thermal-efficient buildings will feature designs that reduce losses at 6 GHz compared to the C-band, including windows with target frequency selectivity.



4. What effective isotropic radiated power (e.i.r.p.) of base stations would you use (e.g., up to 50 dBm/100 MHz, between 50–60 dBm/100 MHz, between 60–83 dBm/100 MHz, etc.)? Please justify this need.

[6] https://www.qualcomm.com/news/onq/2025/02/mwc-barcelona-2025-tech-advancing-us-to-next-era-of-wireless-connectivity

Qualcomm believes that Upper 6gHz would be highly effective in addressing demand where it is generated but this hinges on being deployed with full power on the existing 3.5GHz Macro grid. An EIRP (Effective Isotropic Radiated Power) of 83 dBm is needed to match the cell range of 3.5GHz. Full power is necessary to get full utility out of U6, and to maximize economic efficiency. Without full power, U6 could not be deployed productively on macro sites. Reducing EIRP would cause a loss of range that will have to be compensated through site densification which would be costly, if at all practicable, and certainly undesirable also from a social standpoint.

5. Where would you plan to ensure radio communication (e.g., outdoors and indoors, only outdoors, only indoors)?

Please see answer to question n.3

6. In which areas would you plan to provide services using the U6 GHz band (e.g., urban, suburban, rural, industrial areas, etc.)?

The upper 6 GHz band is expected to be the primary band for 6G (similarly to 3.5 GHz spectrum for 5G) in Europe. The Upper 6 GHz band can support high capacity and wide area coverage, especially in urban and dense environments. Qualcomm believes that U6 GHz will enable broad 6G coverage.

7. What new services could be offered using the U6 GHz band (or part of it)

6G will address, at its foundational level, environmental sustainability concerns and incorporate technology enablers that extend the platform capability beyond connectivity. In the 6G era, capabilities such as RF sensing, Machine Learning/Artificial Intelligence ("ML/AI") and compute will merge with enhanced communication capabilities and foster ubiquitous access to use cases such as immersive multisensory devices, supporting Digital Twins and collaborative robotic applications, among other innovations. 6G also is being designed from the ground up to be more energy efficient and more cost-efficient, allowing mobile network operators to maximize their return on investment ("ROI")[7]. With a focus on reducing capital and operating expenditure, 6G will improve network efficiencies while driving down network costs.

8. When would you start deploying networks in the U6 GHz band?

According to the CEPT 6G roadmap, national authorizations for new frequency bands, particularly for the upper 6GHz band, are expected to commence from the year 2029 onward. Consequently, the initial commercial launch in CEPT countries is projected to begin from 2029 onward.

9. How many and what kind of base stations do you plan to build within the first 5 years of operation?

No comment

[7] For instance, according to a report by GSMA, "20% of operators rate energy efficiency as the No.1 attribute to prioritise in 6G networks from a business standpoint." See GSMA Intelligence, The Next Generation of Operator Sustainability: Greener Edge and Open RAN at 6 (Sep. 2023).

10. Which of the mechanisms for sharing the U6 GHz band (see draft ECC report) would be most advantageous for the combined use of IMT and WAS/RLAN?

Qualcomm has been working closely with the UK Department for Science, Innovation and Technology (DSIT) through a sandbox project to explore sharing opportunities between licensed IMT and unlicensed RLANs in the upper 6 GHz band. The objective of this technically challenging work effort has been to assess the costs and benefits of the sharing solutions, i.e., implementation cost and performance impact from an interference perspective versus performance improvements through sharing, and the regulatory mechanisms that may help achieve the country's desired goals. The sandbox project highlighted that co-channel spectrum sharing between IMT and Wi-Fi may lead to a significant degradation of both technologies when Wi-Fi deployment is close to 5G UE. Technical solutions like cross-technology signaling (XTS) by 5G Base stations and UEs though technically feasible, present also significant challenges:

- XTS must be standardized, harmonized and compliance tested as a pre-condition for deployment which creates a longer timeline to deployment
- Standardization is challenging because:
    1. 3GPP would need to define how to transmit specific Wi-Fi waveform in the relevant band;
    2. the 3GPP work will have to be followed up by work in ETSI TFES and ETSI BRAN.
    3. followed by testing and conformance, with associated conformance tests to be developed by ETSI
- XTS functionality would also have to be implemented at global level for devices, to enable global devices intended to roam into these European bands, adding cost and complexity.
- XTS functionality will have to be included in all WAS/RLAN equipment intended for Europe, requiring specific certification and importation rules for such devices.

The observations provided above emphasize that defining a sharing solution between IMT and Wi-Fi involves complex technical details and the need for stakeholders from both the RLAN and mobile industries to work together in standardization bodies, regulatory proceedings, and compliance testing plans to ensure success and certainty that the sharing solution performs as designed.

To enable successful co-channel spectrum sharing between mobile operations and license exempt operations in Upper 6 GHz, stakeholders from both RLAN and mobile industry must work collaboratively and in good faith to develop and put in place a stable implementation framework. Specifically, before any license-exempt or mobile equipment is deployed in the Upper 6 GHz Band, all stakeholders would need to define in standards a viable sharing mechanism and work with regulatory bodies to implement enabling rules and a compliance testing framework with which all equipment must comply.

This would require substantial resources from the commercial sector and from regulators and would take more than a few years. While Qualcomm has invested substantial resources into this effort, it does not appear that many other stakeholders are interested in investing the resources and time in enabling co-channel sharing. Given that we are less than five years away from initial 6G deployments and there is not a consensus view on co-channel sharing in the Upper 6 GHz band, Qualcomm believes it is critically important that countries prioritize the need for 6G spectrum and identify the upper 6 GHz band for mobile operations, especially since Wi-Fi 7 has spectrum allocations in the lower 6 GHz band and 5 GHz bands that can support multi-gigabit speeds. Finally, Qualcomm recommends that RRT does not make decisions in isolation from the rest of Europe and encourages RRT to collaborate and engage with the rest of Europe

in the harmonization process. Sharing of U6 with RLAN in Europe also risks fragmenting the global U6 ecosystem, with further damage to sector sustainability.