To: Communications Regulatory Authority of the Republic of Lithuania

Date: April 18, 2025

Re: Public Survey on the Prospects for the Use of the Radio Frequency Band 6425-7125 MHz

From: Amazon Inc.
Broadcom Inc.
Cisco Systems Inc.
Extreme Networks
Hewlett Packard Enterprise
Intel Corporation

The undersigned companies, representing an important cross-section of the world's leading silicon vendors, system manufacturers and application providers, welcome the opportunity to comment on the Communications Regulatory Authority of Lithuania ("RRT") Public Survey on the Prospects for the Use of the Radio Frequency Band 6425-7125 MHz ("Survey"). Given the increasing economic and social value of wireless broadband connectivity, we fully support RRT's efforts to accurately assess spectrum usage and demand so that spectrum can be managed in an efficient and flexible manner, while fostering conditions for ongoing innovation.

As RRT considers the future use of the 6425–7125 MHz band ("U6 GHz band"), we encourage RRT to take a balanced approach that supports both industry growth and broader societal needs while also fostering international cooperation. Such an approach will ultimately contribute to the successful and sustainable deployment of advanced wireless technology and services and strengthen Lithuania's position in the global digital economy.

Below, the undersigned companies provide responses to RRT's questions.

A. What would be the need to use the 6425-7125 MHz (U6 GHz) radio frequency band for mobile radio communications?

Question 1. What is the current need for new radio frequency resources? Please indicate how busy the available spectrum resources (1800/2100/2300/2600/3600 MHz) are?

Some of the undersigned companies provide equipment for both private 5G ("P5G") and Wi-Fi enterprise networks. Enterprise and industrial network demand for P5G and Wi-Fi is expected to experience significant growth over the next several years. For P5G, 400 MHz of harmonised spectrum in the 3.8-4.2 GHz band is being made available in Europe (an EC Decision is expected to be published later this year), which should be sufficient to support all relevant 5G use cases for the verticals market for the foreseeable future.

Question 2. If you were to use the U6 GHz band, how much radio bandwidth would one operator need?

The undersigned companies do not address this specific question. However, were RRT to enable both mobile and Wireless Access Systems and Radio Local Area Networks ("WAS/RLAN") in the U6 GHz band, the companies recommend a phased approach, similar

to what UK Ofcom is proposing. Under the UK Ofcom proposal, low-power indoor ("LPI") WAS/RLAN would be authorised in the 6425-7125 MHz band in the near future (i.e., by the end of 2025). If CEPT develops mechanisms and rules to support the future introduction of Mobile/Fixed Communications Networks ("MFCN") on a prioritised basis in part of the U6 GHz band, those mechanisms and rules could be implemented at that time.

Question 3. What network infrastructure would you develop in the U6 GHz band (e.g. macro/micro cells, etc.)? If so, how? Would you like to consolidate your existing network infrastructure?

The undersigned companies do not address this question.

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

The undersigned companies do not address this question. However, we note that the WRC-23 decision to identify 6425-7125 MHz for IMT relied upon studies that assumed a max EIRP of 73 dBm/100 MHz.

Question 5. Where do you plan to ensure radio communication (e.g. outside and indoors, outside only, indoors only)?

Given the propagation characteristics at 6 GHz, indoor reception from wide area public mobile networks will be challenging due to building entry loss. Lower frequency bands are better suited to provide indoor mobile coverage. We believe high throughput connectivity indoors should ideally be supplied by indoor networks such as public 5G indoors, Wi-Fi, and indoor P5G in the 3.8-4.2 GHz band. We also recommend the introduction of suitable solutions to enable seamless handover of devices between public 5G, P5G and Wi-Fi networks (e.g. PassPoint, OpenRoaming, etc.), which would enable more cost effective and environmentally sustainable high-throughput indoor connectivity for Lithuanian network providers, consumers, and citizens.

Should RRT decide to allow MNOs to use portions of the U6 GHz band to provide extra outdoor capacity where needed, RRT could maximise the use of the U6 GHz band by permitting LPI and Very Low Power ("VLP") both indoors and outdoors, under similar regulatory conditions as the lower 6 GHz band ("L6 GHz band").

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

As previously stated, given the propagation characteristics at 6 GHz, wide area coverage from mobile networks operating in the U6 GHz band will be limited. We anticipate mobile deployments will likely be limited to dense urban/suburban areas.

Were RRT to enable both mobile and WAS/RLAN in the U6 GHz band, licence-exempt LPI and VLP (indoors and outdoors) could be deployed across all of the morphologies identified.

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

The undersigned companies do not address this question.

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

The undersigned companies do not address this question.

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

The undersigned companies do not address this question.

Question 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?

The undersigned companies acknowledge there is growing interest by European regulators to enable both MCFN/IMT and WAS/RLAN in the U6 GHz band. As such, it will not be realistic to allocate the entire U6 GHz band exclusively to either service. We note, however, that there are numerous Wi-Fi products available today that support the L6 GHz and U6 GHz bands. These products supporting full 6 GHz have had Wi-Fi Alliance certification for some time and products supporting the U6 GHz could be made available quickly for use in Europe.

The undersigned companies support UK's approach of permitting LPI (as well as VLP) WAS/RLAN products to access the entire U6 GHz band on an opportunistic basis recognising that Wi-Fi current polite protocols would already provide possible solutions to enable regulators to introduce MFCN/IMT in a later phase, such solutions or any advanced solutions could be implemented at that time. Should RRT choose to pursue a U6 GHz band split as described in the UK Ofcom proposal, we urge RRT to take a balanced approach and to adopt the L6 GHz band rules for the Wi-Fi allocation.

With respect to the band split discussions, it should be noted, that across Europe, ~90% of Internet traffic travels via fixed lines and is relayed to end users via Wi-Fi[1] while only ~10% is relayed to end users by public MFCN. This trend is expected to continue for the rest of this decade and beyond 2030. As fixed-line and Wi-Fi traffic grows rapidly, we believe Wi-Fi access to the entire 6 GHz band will be necessary to meet future consumer demand. We further note that UK Ofcom has proposed, as a starting point, allocating to Wi-Fi a minimum of 160 MHz from the bottom of the U6 GHz band (6425 – 6585 MHz) and at least 300 MHz to MFCN from the top of the U6 GHz band (6825 – 7125 MHz). We also recognise that, at the most recent ECC meeting, Germany and France proposed to provide Wi-Fi access to a minimum of 160 MHz at the bottom of the U6 GHz band.

In light of these proposals, we could support a multi-phased approach that begins with allocating the first 160 MHz of the U6 GHz band in the immediate future under the same conditions as the L6 GHz band for Wi-Fi followed by the UK Ofcom proposal to permit opportunistic access to the remainder of the U6 GHz band. In later phases, other sharing/coordination mechanisms in addition to those previously studied could be considered to enable sharing between business-critical WAS/RLAN enterprise networks and MFCN networks across the rest of the U6 GHz band.

[1] Approximately, 92% of fixed broadband traffic in Europe is relayed via Wi-Fi, according to the ASSIA "State of Wi-Fi" report.

Finally, we continue to believe that WAS/RLAN needs access to a minimum of 1200 MHz of spectrum to meet future Lithuanian demands for indoor low power and very low power portable applications. Should RRT choose not to allow WAS/RLANs to operate within portions of the U6 GHz band that may be allocated to MFCN in the future, we strongly encourage RRT to consider making additional spectrum available within the tuning range of a Wi-Fi radio to meet the upcoming future demand.

B. What would be the need to use the 6425–7125 MHz (U6 GHz) radio frequency band for wireless access systems in Lithuania, including radio local area networks (WAS/RLAN), and when could such a need arise?

Question 1. What is the current need for new radio frequency resources? Please indicate how crowded the available spectrum resources are (2400–2483.5 MHz, 5150–5350 MHz, 5470–5850 MHz and 5945–6425 MHz)?

Wi-Fi has become indispensable to broadband connectivity. Over 21.1 billion Wi-Fi devices are currently in use worldwide, with 4.1 billion shipped annually, according to research firm IDC[2]. The technology has consistently enabled affordable internet access and facilitated business operations. New Wi-Fi advancements, such as Wi-Fi 6E and Wi-Fi 7, and soon Wi-Fi 8, are expanding these benefits further, driving both social and economic progress.

Traffic in existing licence-exempt bands (i.e., 2.4 GHz and 5 GHz) has intensified significantly in recent years. In many markets, Wi-Fi use of the 2.4 GHz band has become impractical given the myriad other short range that access the same frequencies. Similarly, the 5 GHz band is becoming increasingly crowded with surveillance/doorbell cameras. Dynamic frequency selection ("DFS") restrictions in 5 GHz make use of the band for broadband services particularly challenging.

The need for additional licence-exempt spectrum is becoming increasingly urgent. Governments worldwide have harnessed the transformative potential of Wi-Fi by unlocking access to the full 6 GHz band. Lithuania has an excellent opportunity to follow this proven model by ensuring sufficient spectrum is available to support the latest generations of Wi-Fi technology. The undersigned companies anticipate that a minimum of fifteen 80 MHz channels or seven 160 MHz channels will be needed to exploit the full capabilities of the Wi-Fi 7 and future Wi-Fi 8 protocols for a variety of wireless broadband and very low power applications. The undersigned companies expect even more spectrum to be required in the future to support a minimum of four 320 MHz channels.

Across Europe, about 90% of Internet traffic travels via fixed lines and is relayed to end users via Wi-Fi[3]. This trend is expected to continue for the rest of this decade and beyond 2030. As fixed-line and Wi-Fi traffic grows rapidly, licence-exempt access to the entire 6 GHz band will be necessary to meet consumer demand.

The volume of traffic carried by Wi-Fi is growing much faster than the volume of traffic carried by mobile networks. In Germany, for example, the absolute increase in the volume of fixed traffic in 2023 (11 billion GB) was more than four times the absolute increase in the volume of

[2] Source: https://www.wi-fi.org/beacon/the-beacon/wi-fi-by-the-numbers-technology-momentum-in-2023.

[3] Approximately, 92% of fixed broadband traffic in Europe is relayed via Wi-Fi, according to the ASSIA "State of Wi-Fi" report.

mobile traffic (2.4 billion GB) in the same year[4]. Across most of Europe, the difference in volume between fixed and mobile data traffic is huge (see Table 1 below), and substitution is rarely strong, according to a paper by Analysys Mason.[5] This analysis shows fixed networks are the more likely beneficiaries of any surge in growth brought about by widespread adoption of augmented reality ("AR") and virtual reality ("VR"), whereas high mobile usage is driven by the absence or unaffordability of fixed networks, which is usually a temporary phenomenon, rather than applications.

Table 1: Data traffic based on official administration reports.
The variation compared to the previous year is represented in EB and indicated in parentheses..

Country	Fixed data traffic [EB/year] (difference from previous year)	Mobile data traffic [EB/year] (difference from previous year)
Czech Republic (2023)	16.0 (+1.9)	1.3 (+0.4)
Denmark (2022)	12.2 (+0.9)	2.5 (+0.3)
Finland (2023)	6.4 (+2.2)	4.8 (+0.8)
Germany (2023)	132.0 (+11.0)	9.1 (+2.4)
Italy (2023)	54.9 (+8.4)	15.0 (+3.3)
Portugal (2023)	15.5 (+2.3)	1.2 (+0.3)
Romania (2023)	18.4 (+2.7)	2.5 (+0.6)
Spain (2022)	62.0 (+8.3)	6.2 (+1.6)

According to the FTTH Council for Europe,[6] the number of subscribers to FTTH/B (fibre-to-the-home or building) services in Europe is set to rise to 201 million by 2029 from 121 million in September 2023. At the same time, the number of homes passed will jump to 312 million in 2029 from 244 million in September 2023 as telcos lay more fibre in the ground.

According to cable.co.uk,[7] average broadband speeds across the EU increased by 37% per year between 2017 and 2024. The average downlink speed is now more than 109 Mbps.

In February 2025, the difference between the average median country speed of fixed and mobile networks in the EU was 31.2 Mbps for download and 56.3 Mbps for upload, according to Ookla,[8] which also says that the average median latency and jitter on fixed networks were, respectively, 12.7 and 5.3 ms lower than on mobile networks.

UK Ofcom has forecasted that Wi-Fi demand in residential environments could grow between six and ten times between 2020 and 2030, driven by increased video quality and the adoption of virtual reality devices. In public venues, such as arenas or concert halls, demand could increase up to 15 times over the same period[9].

As these statistics demonstrate, the L6 GHz band (5945-6425 MHz) on its own will be insufficient to meet the fast-rising demand for indoor wireless connectivity. In Europe, there are currently only five 160 MHz channels available for licence-exempt usage, two of which are in the 5 GHz band and have DFS and backward compatibility restrictions making them

[4] Source: Jahresbericht Telekommunikation 2023.

[5] Source: https://www.analysysmason.com/research/content/articles/bandwidth-overproduction-crisis-rdns0/.

[6] Source: https://www.ftthcouncil.eu/resources/blog/ftth-market-forecasts-2023-2029.

[7] Cable.co.uk collated and analysed over 1.5 billion speed tests in 12 months ending 30 June 2024 to reveal broadband speeds in 229 countries. Source: https://www.cable.co.uk/broadband/speed/worldwide-speed-league/.

[8] Source: https://www.speedtest.net/global-index (updated March 2025).

[9] See UK Ofcom Improving Spectrum Access for Wi-Fi, July 2020, section 3.24.

unavailable or having significant reductions in capacity for the most part[10]. With access to only the L6 GHz band, Wi-Fi can only support gigabit coverage for approximately 50-60% of a residential building area[11]. To provide a higher likelihood of wireless gigabit broadband a minimum of seven 160 MHz channels in the 6 GHz band are necessary. However, to provide the highest likelihood of whole-building coverage, RRT would need to provide sufficient spectrum to support 320 MHz channels. Therefore, Wi-Fi access to both the L6 GHz and U6 GHz bands is imperative to support the goals of the EU's Gigabit Infrastructure Act and the Digital Decade Policy Programme 2030[12].

In highly dense user environments, including universities, hospitals, conference centres, concert halls, arenas, hotels, large retail sites, factories, and logistics centres, a large number of sufficiently wide (40/80/160 MHz) non-overlapping channels are needed to provide high per-user data rates at low latency. In Lithuania, there are more than 40 universities and colleges serving 100,000 students. With access to the full 6 GHz band, these academic institutions would have the ability to upgrade existing networking infrastructure with cost-effective Wi-Fi that could meet the growing bandwidth intensive needs of each student. In addition, Wi-Fi networks are expected to carry numerous different use cases not only on the home network but more so in Enterprise and industrial networks. In a recent meeting with regulators we heard that a healthcare network provider was in desperate need for more spectrum as they were running over 160 different use cases over their Wi-Fi network in hospitals and that number, and their data throughput needs were only increasing. Normal MFCN networks are dominated by one use case, internet provision for smartphones, and even here we see that most of the smartphone traffic is carried over Wi-Fi.

Question 2. What is the current distribution of WAS/RLAN device standards used on the market (e.g. WiFi-5, WiFi-6/6E, WiFi-7, etc.)?

Where the full 1200 MHz in the 6 GHz band is made available on a licence-exempt basis, there are already thousands of Wi-Fi 6E and Wi-Fi 7 products available that can operate across the entire band. The undersigned companies encourage RRT to review the 6 GHz Wi-Fi Information Center on the Wi-Fi Alliance website (available at: https://www.wi-fi.org/discover-wi-fi/6-ghz-wi-fi-information-center) to see the latest information regarding available Wi-Fi 6E and Wi-Fi 7 equipment. To cope with greatly increasing demand for local wireless broadband connectivity, enterprises have been upgrading their networks with Wi-Fi 6E and Wi-Fi 7 equipment[13]. And, in countries that opened the full 6 GHz band, there has also been an enormous interest from universities, hospitals, manufacturing and logistics to upgrade their Wi-Fi infrastructure with 6 GHz capable equipment[14].

[10] Also, in practical deployments, smaller channel widths will generally be selected at 5 GHz to give more channel reuse options and accommodate legacy devices.

[11] "Wi-Fi Spectrum Requirements" by Plum Consulting. Source: https://plumconsulting.co.uk/wi-fi-spectrum-requirements/.

[12] See Gigabit Infrastructure Act at https://digital-strategy.ec.europa.eu/en/policies/gigabit-infrastructure-act; Europe's Digital Decade Policy Programme available at https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade.

[13] IDC Research notes that Wi-Fi 6E accounted for 31.7% of the enterprise access point market's revenues in the third quarter (3Q24). https://my.idc.com/getdoc.jsp?containerId=IDC_P23464&_gl=1*505bgk*_gcl_au*ODk3NzE5MzUwLjE3NDQ2NTk1NDY.*_ga*MjEwMzg4NTU5MC4xNzQ0NjU5NTQ2*_ga_541ENG1F9X*MTc0NDY1OTU0Ni4xLjAuMTc0NDY1OTU0Ni42MC4wLjA.

[14] https://edtechmagazine.com/higher/article/2024/08/how-higher-ed-taps-wi-fi-6e-expand-wireless-access.

Question 3. What new services could be offered using the U6 GHz band (or part of it)?

With access to the full 6 GHz band, Wi-Fi 6E and Wi-Fi 7 can support industrial applications, such as factory robots and sensors, AR, healthcare monitors and wireless medical equipment, that have stringent QoS (quality of service) requirements. Unlike previous generations of Wi-Fi, Wi-Fi 6/6E and Wi-Fi 7 are based on OFDMA technology and are thereby able to achieve very high QoS levels, particularly in managed networks. According to Intel,[13] AR/VR applications require a minimum throughput of between 400 Mbps and 2.35 Gbps and a maximum streaming interactive latency in the order of 10ms.

For enterprise applications (such as large public venues, healthcare, education, hospitality, logistics, and manufacturing), a large number of available channels and a wide range of channel widths (from 20 MHz to 320 MHz) enable performance enhancements and the realisation of new services and architectures. Examples include multi-layer operation, service segmentation and prioritisation, context-aware wireless networks, and hyper-aware access points. If a sufficient amount of additional spectrum in the U6 GHz band in not made available, the business case for these types of networks and use cases will be less cost effective in Lithuania than in countries where 1200 MHz has been made available. And, in some instances, the business case may not be economically viable at all once a cost/benefit analysis of upgrading the existing Wi-Fi network occurs.

With access to 320 MHz channels, Wi-Fi can reliably support a wide range of demanding use cases, from telesurgery and haptic applications to controlled vehicles and augmented reality. Wide channels also enable Wi-Fi to identify the position of a connected asset within one meter, enabling enterprises to better track and monitor their equipment and inventory. Finally, 320 MHz channels enable whole premises wireless residential broadband coverage, even at some distance from the Wi-Fi access point.

5G and Wi-Fi 6/7 can work together to support a wide range of AR applications. A 5G smartphone could connect to an AR headset or another wearable using Wi-Fi 6/7, giving people access to immersive entertainment, educational, e-health and industrial applications, improving training, accelerating product design and enabling new business models. For such use cases, the performance requirements on the link between headsets and smartphones are much more stringent than those between the smartphone and a 5G base station.

Question 4. What is the minimum amount of radio frequency spectrum resources required for a WAS/RLAN system to meet the quality and diversity of the intended services? What are the requirements for new services (e.g. virtual/augmented reality devices?

As discussed above in response to Question B. 1, fifteen 80 MHz channels or seven 160 MHz channels, and a minimum of three or even four 320 MHz channels will be needed to exploit the full capabilities of Wi-Fi 7 and future Wi-Fi 8 technology for a variety of wireless broadband and very low-power applications. We should also recognise that modern enterprise and industrial Wi-Fi networks are being designed to deliver advanced use cases that require more predictable QoS, very high throughput, or a combination of both. They will also need to address backward compatibility and DFS in legacy bands while accommodating enough spare spectrum for other peer-to-peer connections or ad-hoc VLP networks as part of their overall spectrum resource management plans.

Should European regulators choose to enable both MCFN/IMT and WAS/RLAN in the U6 GHz band, we support UK Ofcom's proposal (described in response to Question A. 2 above)

to permit LPI WAS/RLAN products to access the entire U6 GHz band while solutions are developed to introduce MFCN/IMT in a later phase. We also support the introduction of VLP products in the U6 GHz band. Ultimately, shared use of U6 GHz via a prioritised band-split could bring the greatest overall benefits to citizens and consumers by enabling both MFCN/IMT and WAS/RLAN. However, as indicated above, we continue to support WAS/RLAN access on an opportunistic basis even if portions of the band are prioritized for MFCN/IMT. Furthermore, mechanisms enabling business-critical WAS/RLAN enterprise and industrial networks access to the U6 GHz band will have also to be considered.

In addition, we continue to believe that WAS/RLAN needs access to a minimum of 1200 MHz of spectrum to meet Lithuanian demands for LPI and VLP portable applications. Should RRT choose not to allow WAS/RLANs to operate within portions of the U6 GHz band - even on an opportunistic basis - we strongly encourage RRT to consider making additional spectrum available within the tuning range of a Wi-Fi radio to meet the upcoming demand.

Question 5. What types of locations (e.g. airports, hospitals, universities, residential areas, etc.) currently have the greatest demand for radio frequency resources?

As discussed above in response to Question B. 3, industrial applications, including factory robots, sensors, AR, healthcare monitors, and other wireless medical equipment, all of which have stringent QoS requirements, need additional licence-exempt spectrum. Other enterprise applications, such as large public venues, educational institutions, and hospitality, have similarly high spectrum demands. In countries where the full 6 GHz band has already been made available, consumers are already seeing significantly reduced congestion and boosted Wi-Fi performance, indicating that demand for spectrum to support next-generation Wi-Fi is both substantial and persistent.

Question 6. What maximum effective isotropic radiated power (eirp) would you use (e.g. 25 mW, 200 mW, 4 W) in the U6 GHz band (or part thereof) and where would you plan to provide radio communication (e.g. outdoors and indoors, outdoors only, indoors only)?

As described above, the undersigned companies encourage RRT to permit VLP (14 dBm EIRP indoors and outdoors) as well as LPI (24 dBm EIRP) across the U6 GHz band, aligned with the conditions for WAS/RLAN in the L6 GHz band. In particular, LPI operations, which have been found to coexist with a wide range of similar incumbent operations in lower bands, could potentially be used to satisfy expected Wi-Fi 7 and Wi-Fi 8 demand.

If, at a later date, MFCN/IMT were introduced on a prioritised basis in part of the U6 GHz band, WAS/RLAN access could be permitted on an opportunistic basis in unused MFCN/IMT spectrum.

Should RRT chose to enable MFCN/IMT in the U6 GHz band, we urge RRT to enable additional spectrum for Wi-Fi under the same rules as the 5945-6425 MHz frequency range. However, as indicated above, we continue to support WAS/RLAN access on an opportunistic basis even if portions of the band are prioritized for MFCN/IMT. Mechanisms enabling business-critical WAS/RLAN enterprise networks to access this band will have also to be considered.

Question 7. Would it be relevant to use the entire U6 GHz band for the WAS/RLAN system for a defined period? (e.g. until 2030, 2032) indoors and/or outdoors on a non-interference basis with the proviso that the equipment may be required to be switched off in the future?

As discussed above, the undersigned companies recommend that the entire U6 GHz band be made available for LPI and VLP operations. Were RRT to enable both mobile and WAS/RLAN in the U6 GHz band, devices could be introduced through a band split where licence-exempt devices could operate in a portion of the U6 GHz band under the same regulatory requirements as the L6 GHz band, and possibly on an opportunistic, shared basis in the remainder of the U6 GHz band.

Conclusion.

The undersigned are committed to supporting RRT in its efforts to ensure spectrum is managed in an efficient and flexible manner and to enable different users and industries to take advantage of technological advancements. We look forward to working with RRT on the successful and sustainable deployment of advanced wireless technology and services and strengthening Lithuania's position in the global digital economy.

/s/

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