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April 18, 2025

Re: Consultation “Public survey on the prospects for the use of the radio frequency band 6425-7125 MHz”

Dear Respected Officer,

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks Communications Regulatory Authority (RRT) for providing an opportunity to comment on the consultation “Public survey on the prospects for the use of the radio frequency band 6425-7125 MHz”.

IEEE 802 LMSC is a leading consensus-based open standards development committee for networking standards that are used by industry globally. It produces standards for networking devices, including wired and wireless local area networks (“LANs” and “WLANs”), wireless specialty networks (“WSNs”), wireless metropolitan area networks (“Wireless MANs”), and wireless regional area networks (“WRANs”). Technologies produced by implementers of our standards are a critical element for all networked applications today.

IEEE 802 LMSC is a committee of the IEEE Standards Association and of Technical Activities, two of the Major Organizational Units of the IEEE. IEEE has over 460,000 members in more than 190 countries and its core purpose is to foster technological innovation and excellence for the benefit of humanity. IEEE is also a major accredited standards development organization whose standards are recognized worldwide. In submitting this document, IEEE 802 LMSC acknowledges and respects that other components of IEEE Organizational Units may have perspectives that differ from, or compete with, those of IEEE 802 LMSC. Therefore, this submission should not be construed as representing the views of IEEE as a whole¹.

IEEE 802 LMSC applauds RRT for issuing a public survey in collecting stakeholders’ opinions on their use of the 6425 MHz to 7125 MHz frequency band (i.e., the upper 6 GHz band). Please find below the responses of IEEE 802 LMSC to selected questions in Part B of this consultation (*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 access to the upper 6 GHz band is critical to meeting the goals of the European Union’s Gigabit Infrastructure Act² and the Digital Decade Policy Programme 2023³.

¹ This document solely represents the views of IEEE 802 LMSC and does not necessarily represent a position of either the IEEE or the IEEE Standards Association or the IEEE Technical Activities.

² See European Commission: Gigabit Infrastructure Act. (“Achieving the targets set out in Decision (EU) 2022/2481 requires that, by 2030, all end users at fixed locations be covered by a gigabit network up to the network termination point and all populated areas be covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technological neutrality.”)

³ See paragraph 1.(2)(a) of Article 4 (Digital Targets), Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030 (Text with EEA relevance), 19 December 2022. (“all end users at a fixed location are covered by a gigabit network up to the network termination point, and all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G, in accordance with the principle of technological neutrality”).

According to Plum⁴, the current spectrum for Wi-Fi access in Europe is not sufficient to support these goals. For example, the current allocation of five 160 MHz channels in the 5 GHz and lower 6 GHz bands can support gigabit coverage to only approximately 50% to 60% of residential building area. To ensure complete gigabit coverage, a minimum of ten channels is necessary, thus necessitating operation of Wi-Fi technologies in the upper 6 GHz band.

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

IEEE 802 LMSC does not provide a response to this question.

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

Wi-Fi is the indoor wireless connectivity technology of choice for people in Europe. According to BNetzA⁵ and Ofcom⁶, majority of internet use occurs over fixed networks primarily delivered through Wi-Fi. A recent survey also finds that the vast majority (93.9%) of the European Union's enterprises use fixed broadband connections to access the Internet via Wi-Fi⁷.

The volume of Wi-Fi traffic is growing much faster than the volume of traffic carried over mobile networks. BNetzA reports that the increase in the volume of fixed traffic in 2023 was more than four times the increase in the volume of mobile traffic in the same year⁸. Arthur Little⁹ forecasts, that the growth in fixed data traffic (and therefore Wi-Fi traffic) in Europe between 2022 and 2030 is similar to past elevated levels, and the total volume of fixed data traffic is significantly more than that of the mobile data traffic over the same period of time. The estimated significant increase in the volume of fixed data traffic is supported by two recently released marketing reports from the FTTH Council Europe^{10,11}. The report shows that the number of FTTH/FTTB (Fiber-To-The-Home or Building) services is expected to increase from 121 million in 2023 to 201 million by 2029, and the number of homes equipped with FTTH/FTTB will be increased from 244 million in 2023 to 312 million in 2029 as telcos lay more fiber in the ground.

⁴ See Plum Consulting: Wi-Fi Spectrum requirements, 25 March 2024, <https://plumconsulting.co.uk/wi-fi-spectrum-requirements/#:~:text=To%20ensure%20whole%2Dbuilding%20coverage,of%20Wi%2DFi%20in%20Europe> [accessed: 8 April 2025]

⁵ See Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen: Jahresbericht Telekommunikation 2023, 16 May 2024, https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2024/20240516_JB_TK2023.html [accessed: 8 April 2025]

⁶ See Ofcom: Communications Market Report 2024, 18 July 2024, <https://www.ofcom.org.uk/phones-and-broadband/service-quality/communications-market-2024/> [accessed: 8 April 2025] ("Seventy-one per cent of broadband connections were provided using fibre technologies at the end of 2023.")

⁷ See eurostat: Fixed internet connection in 94% of EU enterprises, 25 January 2024, <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240125-2> [accessed: 8 April 2025].

⁸ See Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen: Press release of Jahresbericht Telekommunikation 2023, 16 May 2024, https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2024/20240516_JB_TK2023.html?nn=659670 [accessed: 28 March 2025] ("In 2023, a total data volume of around 132 billion GB was transmitted in fixed networks in Germany. This corresponds to an average data volume of around 287 GB per connection per month. Compared to 2022, the data volume transmitted in fixed networks in Germany increased by around 11 billion GB.") and ("According to surveys by the Federal Network Agency, the data volume transmitted via mobile networks in Germany in 2023 amounted to 9,118 million GB, compared to 6,714 million GB in 2022.")

⁹ See: Arthur Little: The evolution of data grow in Europe, <https://www.adlittle.com/en/insights/report/evolution-data-growth-europe> [accessed: 28 March 2025] ("We expect average fixed data consumption to grow from approximately 225 GB/month in 2022 to 900 GB/month per home by 2030, accounting for an overall annual growth rate of 20%, similar to past elevated levels.") and ("We expect Europe's mobile data consumption per user to continue growing in the coming years, increasing from the 2022 level of approximately 15 GB/month to 75 GB/month by 2030, creating an annual growth rate of 25%.")

¹⁰ See FTTH Council Europe: European FTTH/B Market Panorama 2024, <https://www.ftthcouncil.eu/committees/market-intelligence/2043/european-ftth-b-market-panorama-2024> [accessed: 8 April 2025].

¹¹ See FTTH Council Europe: FTTH Market Forecast 2023-2029, <https://www.ftthcouncil.eu/committees/market-intelligence/2046/ftth-market-forecasts-2023-2029> [accessed: 8 April 2025].

Currently available Wi-Fi 6/6E products based on the IEEE Std 802.11ax-2021¹² and Wi-Fi 7 products based on the IEEE Std 802.11be-2024¹³ are already capable of operating in the entire 6 GHz band. By enabling Wi-Fi operation in the upper 6 GHz band, a significant number of large bandwidth (i.e., 160 MHz and 320 MHz) channels will be available which would enable latency sensitive high throughput applications like real-time XR for health, education and gaming, robotics, and industrial automation and sensors. One such example of innovative use case is in medical school training where using AR/VR technologies requires the entire 6 GHz band¹⁴. The availability of the entire 6 GHz band is also critical in enabling relevant applications in dense residential environments as well as scaling of applications in enterprise and industrial deployments (e.g., large public venues, university campuses) where multiple of these application sessions would need to be supported simultaneously. The upper 6 GHz band is also crucial for enabling deployments of wireless mesh networks in 6 GHz, since out-of-band channels are required to establish wireless backhaul links between infrastructure and Wi-Fi access points (in addition to existing wireless links between Wi-Fi access points and client devices).

Projections¹⁵ forecasts that real-time locating services are expected to grow by almost 15% a year between 2021 and 2030, and there is an increasing importance of real-time location and sensing services with high (sub-meter) accuracy. By allocating the upper 6 GHz band for license-exempt operation, the above-mentioned large bandwidth channels enable Wi-Fi based location and sensing services with sub-meter positioning and sensing accuracy based on IEEE Std 802.11az-2023¹⁶ and IEEE P802.11bk¹⁷.

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)?

RRT's current designation of 500 MHz of the 6 GHz band from 5945 MHz to 6425 MHz for Wi-Fi operation provides for only one contiguous 320 MHz channel, while the 5945 MHz to 7125 MHz frequency band would allow three such channels to support Gigabit connectivity with the intended services as noted in the response to Question 3.

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

¹² "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 1: Enhancements for High-Efficiency WLAN," in IEEE Std 802.11ax-2021 (Amendment to IEEE Std 802.11-2020), vol., no., pp.1-767, 19 May 2021, doi: 10.1109/IEEESTD.2021.9442429.

¹³ See IEEE Approved Draft Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment: Enhancements for Extremely High Throughput (EHT), <https://standards.ieee.org/ieee/802.11be/7516> [accessed: 8 April 2025]. With introduction of 320 MHz channel bandwidth, Wi-Fi 7 doubles throughputs relative to Wi-Fi 6E and significantly improves latency for Extended Reality, bringing determinism through enablement of Multi-Link Operation over multiple bands in 2.4 GHz, 5 GHz, and 6 GHz bands. Wi-Fi 7 also provides higher efficiency, relative to Wi-Fi 6E, through offering of 4096 QAM. In addition, spectrum puncturing improves flexibility in utilizing spectrally efficient wide channel bandwidth, e.g., 160 MHz and 320 MHz, while protecting incumbent operation in the band. Of particular relevance is the multi-link operation feature which when used in the 6 GHz band, achieves and exceeds the performance expectations of Wi-Fi 7.

¹⁴ See Wi-Fi Alliance: Wi-Fi Alliance® demonstrates the impact of 6 GHz Wi-Fi® for advanced AR/VR in healthcare (<https://www.wi-fi.org/beam/the-beacon/wi-fi-alliance-demonstrates-the-impact-of-6-ghz-wi-fi-for-advanced-arvr-in>) [accessed: 8 April 2025].

¹⁵ See ABI Research: Indoor Positioning and RTLS: Technology Infrastructure, Applications, and Revenue <https://www.abiresearch.com/market-research/product/1031357-indoor-positioning-and-rtls-technology-inf> [accessed: 8 April 2025]

¹⁶ "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 4: Enhancements for Positioning," in IEEE Std 802.11az-2022 (Amendment to IEEE Std 802.11-2020 as amended by IEEE Std 802.11ax-2021, IEEE Std 802.11ay-2021, IEEE Std 802.11ba-2021, and IEEE Std 802.11-2020/Cor 1-2022) , vol., no., pp.1-248, 3 March 2023, doi: 10.1109/IEEESTD.2023.10058117.

¹⁷ See IEEE P802.11bk, https://www.ieee802.org/11/Reports/tgbk_update.htm [accessed: 8 April 2025].

It is quite common that for carpeted office environments, Wi-Fi networking fully replaces wireline Ethernet networks for device connectivity. In those environments all enterprise applications (e.g., voice/video conferencing, office productivity applications, access to server/cloud-based systems) run over the Wi-Fi network. Wi-Fi networking for enterprise users is not restricted to office environments. One European construction customer for example has deployed a software-defined branch solution including Wi-Fi for offices and for large and medium construction sites across Europe and beyond. Currently approximately 1,400 Access Points (APs) are in use on approximately 200 sites, providing connectivity for office areas as well as for construction sites. Wi-Fi is critical for both business operation and for the needs of the digitized construction site.

Below are a few publicly available examples of the types of locations that currently have the greatest demand for radio frequency resources.

- Universities:
 - Cyprus University of Technology¹⁸, Cyprus
- Stadiums:
 - Ghelamco Stadium¹⁹, Belgium
- Container shipping terminals:
 - Port of Thessaloniki²⁰, Greece
 - La Spezia Container Terminal²¹, Italy
 - Malta Freeport Terminal²², Malta
- Public transportation:
 - Cable Car Operation Cortina d'Ampezzo²³, Italy
- Manufacturing:
 - Mettis Aerospace²⁴, UK

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)?

IEEE 802 LMSC respectfully asks RRT to consider allowing Wi-Fi devices to operate between 5945 MHz and 7125 MHz and using no greater than 25 mW outdoors (a.k.a., very low power (VLP) mode) or no greater than 200 mW indoors (a.k.a., low power indoor (LPI) mode) without causing harmful interference to existing authorized communications and without protection from any interference caused by existing authorized communications.

In addition, IEEE 802 LMSC respectfully asks RRT to initiate proceedings to authorize Standard Power (SP) mode under supervision of an automatic frequency coordination (AFC) system in the 6 GHz band. SP mode enables Wi-Fi operation at higher power (up to 36 dBm / 4W EIRP) than LPI mode, to optimally utilize the 6 GHz spectrum. AFC technology is used to protect incumbent services during SP outdoor and indoor Wi-Fi operation.

¹⁸ See <https://www.cisco.com/c/dam/en/us/services/collateral/se/cyprus-case-study.pdf> [accessed: 8 April 2025].

¹⁹ See <https://www.commscope.com/resources/case-studies/ghelamco-stadium/> [accessed: 8 April 2025].

²⁰ See <https://www.cisco.com/c/en/us/about/case-studies-customer-success-stories/thessaloniki-port-authority.html?dtd=odicdc000509> [accessed: 8 April 2025].

²¹ See <https://www.cisco.com/c/en/us/products/wireless/ultra-reliable-wireless-backhaul/index.html#~customer-stories> [accessed: 8 April 2025].

²² See <https://www.cisco.com/c/en/us/about/case-studies-customer-success-stories/malta-freeport-terminals.html> [accessed: 8 April 2025].

²³ See <https://www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/faloria-case-study.html> [accessed: 8 April 2025].

²⁴ See <https://wballiance.com/wireless-broadband-alliance-members-successfully-complete-first-phase-Wi-Fi-6-industry-4-0-trials-with-mettis-aerospace/> [accessed: 8 April 2025].

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?

IEEE 802 LMSC respectfully asks RRT not to consider any defined period for the WAS/RLAN system to be switched off from the upper 6 GHz band in the future by considering the following two points.

A growing number of countries, including Argentina, Canada, Saudi Arabia, South Korea, and the USA have already allocated the entire 6 GHz band for license-exempt operation.

In addition, UK Ofcom recently proposed²⁵ a phased approach that balances low power indoor Wi-Fi access to the upper 6 GHz band (“*We intend to do this as early as feasible, ideally before end 2025*”) with future consideration of IMT operation in the upper 6 GHz band based on the conclusion of ongoing coexistence studies. The benefit of this approach is that it enables UK businesses and consumers to benefit immediately from the latest generation of IEEE 802.11-based Wi-Fi technologies. Once the European harmonisation of specific sharing mechanism between Wi-Fi and mobile in the same frequency band is available, then IMT operation using a proposed sharing mechanism will be proposed.

Conclusion

IEEE 802 LMSC thanks RRT for the opportunity to provide this submission and respectfully asks RRT to consider the above responses when deciding the future use of 6 GHz band.

Respectfully submitted,

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²⁵ See UK Ofcom consultation “Proposals for AFC in Lower 6 GHz and mobile / Wi-Fi sharing in Upper 6 GHz,” February 2025.