IEEE P802.18
Radio Regulatory Technical Advisory Group (RR-TAG)

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| Draft Response Czech Spectrum Strategy Consultation |
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This contribution proposed a response to:

Czech Republic Czech Telecommunications Office (CTU)’s call for comments on the update of the Radio Spectrum Management Strategy consultation. See <https://www.ctu.eu/call-comments-update-radio-spectrum-management-strategy>

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Electronic filing August 21, 2023

Re: Czech Republic CTU’s call for comments on the update of the Radio Spectrum Management Strategy update.

Dear Chairman, CTU, Radio Department, Policy and Strategy Unit

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks Czech Republic Czech Telecommunications Office (CTU) for providing this opportunity to participate in the process of updating the current version of the Radio Spectrum Management Strategy (“report”).

IEEE 802 LMSC is a leading consensus-based industry standards body, producing standards for wireless networking devices, including wireless local area networks (“WLANs”), wireless specialty networks (“WSNs”), wireless metropolitan area networks (“Wireless MANs”), and wireless regional area networks (“WRANs”). We also produce standards for wired Ethernet networks, and technologies produced by implementers of our standards are critical for all networked applications today.

IEEE 802 LMSC is a committee of the IEEE Standards Association and Technical Activities, two of the Major Organizational Units of the Institute of Electrical and Electronics Engineers (IEEE). IEEE has about 400,000 members in over 160 countries. IEEE’s core purpose is to foster technological innovation and excellence for the benefit of humanity. 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 whole[[1]](#footnote-1).

Please find below the comments of IEEE 802 LMSC to selected sections of the report.

**Updates on UWB in Section 6.4.4.2: Short-range devices (SRD)**

As referred to Section 6.4.4.2 of the report, it states “*Applications using the ultra-wideband technology (UWB) met the expectations only to a very limited extent and tend to be used in industrial applications (cable detection, identification of vehicles and surveillance applications, support of safety in industry, etc.)*”. IEEE 802 LMSC would like to inform the CTU that the application and deployment of UWB technology has changed dramatically since the publication of the report. Today, UWB technology based on IEEE Std 802.15.4 is part of mass market consumer devices, including smartphones, vehicles, and consumer accessories. UWB is a key technology in indoor location tracking, material sensing and other industrial applications. Growth into consumer products, however, is a profound change.

***Current and future state of IEEE 802.15.4 UWB***

IEEE 802.15 standards specify Ultra Wideband technology operation. IEEE Std 802.15.4-2020 [1] and IEEE Std 802.15.4z-2020 [2] are standards for precision ranging that support data communication, location discovery, and device ranging. The standards support operation in many frequency ranges including sub-1 GHz bands and 3.1 GHz to 10.6 GHz bands [3] and are increasingly used in many high value applications. The capability of IEEE Std 802.15.4z-2020 to support secure ranging has led to a renewed interest in UWB from industry. The automotive industry was the driving force behind IEEE Std 802.15.4z-2020 and the first to include UWB in consumer products. Mobile handset makers have followed closely. This is generating significant economic and social value, attracting further interest in developing a robust and diverse industry ecosystem. For example, the UWB Alliance supports members in many application areas; the FiRa Consortium is focused on precise (fine) ranging applications and localization; OmLox is supporting industrial localization; the Car Connectivity Consortium has been focused on automotive uses; while the Connectivity Standards Alliance is focused on secure premises access for, but not limited to corporate, hospitality, university, single-family homes, and multi-family homes. Other organizations are also building upon the IEEE 802.15.4 UWB standard. It is worth noting that there is a tight cooperation among these organizations to support the broad needs of the industry in complimentary ways. The harmonization of the ecosystem supports healthy growth and overcomes some of the barriers that led to the limited adoption CTU may have observed in the (distant) past.

IEEE 802 LMSC is supporting to expand the capabilities of UWB consumer devices, beyond ranging and localisation, in the IEEE 802.15.4ab task group [4]. IEEE P802.15.4ab is developing the next generation of UWB standard based on industry needs to fuel the next round of innovative products. The project is built on IEEE Std 802.15.4z-2020 which are capable of using both the 6 GHz and 7 GHz frequency bands and has been widely implemented and is supported by a rich ecosystem of industry alliances, silicon vendors and product developers. New developments supported by the project include features to improve link budget and/or reduce air-time, sensing capabilities to support presence detection and environment mapping, improved accuracy, precision and reliability for high-integrity ranging, interference mitigation techniques to support greater device density and higher traffic use cases and provide improved coexistence in the presence of other services in support of different regulatory regions, additional means to reduce complexity and power consumption, enhance support for ultra low energy, low latency streaming, while ensuring compatibility with the deployed base of products based upon IEEE Std 802.15.4z-2020. In addition, the project is built on the IEEE Std 802.15.4-2020 standard that supports peer-to-peer, peer-to-multi-peer, and station-to-infrastructure topologies and includes enhanced infrastructure synchronization mechanisms.

***Expanded applications and massive growth***

It can be noted that the uses which CTU identified in 2015 were, then and still today, critically important uses. UWB is still used for location tracking and material sensing in industrial environments extensively. The market has significantly expanded. Following completion of ECC Report 278 and IEEE Std 802.15.4z-2020, UWB has become ubiquitous and there are lots of active UWB development and deployments. For example, UWB is now used to secure passive keyless entry systems in many vehicles and for premises access. Mobile phone manufacturers have also been integrating ultra-wideband in their smart phones.

Sensing based upon UWB is another area of explosive growth. The ultra-low transmit power (at or below unintentional emissions limits) and very high dynamic response of impulse radio-UWB (IR-UWB) enables precise, fast, and accurate sensing for uses such as present detection of children left in vehicles.

As another example of current market trends, UWB is emerging as a leading technology for ultra-low power, ultra-low latency moderate data rate communications such as real time audio and real-time ultra-low latency human interface devices for gaming.

In summary, while it may have appeared in 2015 that UWB had not lived up to original expectations, presently UWB deployments are numbering over a billion devices and are growing exponentially [5]. Compared to other popular wireless access technologies, the time to mass market adoption of UWB is slightly faster. While it traditionally took about 20 years for technologies to be included in mobile handsets, for UWB this happened about 16 years after the rules first allowed it.

***It is an appropriate time to develop a strategic plan for UWB***

Given the increasing importance of UWB, IEEE 802 LMSC would like to encourage the CTU to include a strategy for UWB developments in its radio spectrum management strategy.

Within CEPT, ECC Report 327 led to an update of ECC Decision (06)04 last year, removing the prohibition on fixed outdoor devices, simplifying the use of UWB in vehicular applications and enhancing the transmit power of indoor devices. We would like to encourage the CTU to include these measures in the Czech Republic’s national regulations. Harmonization of regulations has many benefits, both technical and economic. In addition, CEPT ECC SE24 is beginning to revisit the UWB regulations in 8.5 GHz to 10.6 GHz. The UWB industry looks forward to cooperating with the CTU on these investigations.

Furthermore, as the number and variety of applications of IEEE 802.15.4 UWB devices continues to grow, radio spectrum policy and spectrum regulations can help combat climate change by creating conditions conducive to lowering power usage. For example, with the constraint of -41.3 dBm/1 MHz power spectral density, or in other terms, 37 nJ/ms, the IEEE 802.15.4 UWB radios cause very little or no interference to other users of the same spectrum (e.g., there are defined restrictions for UWB radios to operate from 3.1 GHz to 10.6 GHz bands), but the IEEE 802.15.4 radios themselves may become blocked by strong nearby signals. While regulations do not protect IEEE 802.15 radios from interference, spectrum policy can keep parts of the spectrum suitable for energy efficient low power device use.

Additional information that CTU may find helpful in updating spectrum strategy, including potential updates to current rules for UWB, can be found in the references [6] [7].

**Updates on IEEE 802.11/Wi-Fi to Section 6.4.4.1: WiFi radio access networks**

***IEEE 802.11 technologies provide significant economic value***

IEEE 802.11 technologies are integral to the modern communications infrastructure and vital for sustaining social and economic progress of citizens, enterprises, and governments in the Czech Republic and worldwide.

IEEE 802.11 technologies directly support quality communication services, spur economic development, and foster innovation, benefiting established and developing communities alike. For example, Wi-Fi technology, which is based on the IEEE 802.11 standard, serves as an important platform for offering free internet access, fostering educational and business opportunities in underserved communities. IEEE 802.11 technologies are a key enabler of emerging applications such as augmented and virtual reality (AR/VR), industrial IoT, and dense deployment scenarios such as stadiums. With a global device estimate of 18 billion and an annual addition of 4 billion devices [8], IEEE 802.11 technologies drive economic growth and innovation. As shown in an industry consortia report [9], Wi-Fi contributes USD $458 billion in European Union’s economic value in 2021, and the economic value is expected to increase to USD $637 billion by 2025.

***Current and future state of IEEE 802.11***

IEEE 802.11 technologies include a number of mechanisms that lead to efficient and sustainable utilization of the radio spectrum. IEEE 802 technologies, for example, adopt a Listen-Before-Talk (LBT)-based interference avoidance procedure and incorporate power saving mechanisms such as Target Wake Time (TWT). As discussed below, the new generation of IEEE 802.11 technologies, currently under development in the IEEE P802.11be amendment, will continue to improve performance and enhance spectrum coexistence capacities.

Of note, the IEEE Std 802.11ax-2021 [10] standard supports operation in the 6425 MHz to 7025 MHz and 7025 MHz to 7125 MHz bands, and products based on this standard are seeing significant adoption where regulatory rules permit deployment [11]. The significance of unlocking the 6 GHz band for Wi-Fi radio access networks cannot be overstated, as access to larger, contiguous bandwidths in the 6 GHz band reduces the potential for harmful interference [12] and allows for IEEE 802.11 technologies to support more effectively emerging delay-sensitive residential, enterprise, and industrial applications. A new generation of IEEE 802.11 technologies, currently under development in the IEEE P802.11be amendment, will continue to enhance coexistence strategies and provide even more effective spectrum sharing and sustainable utilization in these bands. Moreover, the Wi-Fi industry is taking the lead in specifying coexistence strategies for bands with incumbent users, such as automated frequency coordination [13], [14] and other coexistence mechanisms supported by different regulatory methods in the 6 GHz band (i.e., 5925 MHz to 7125 MHz) [15].

***Suggested modifications to*** ***Section 6.4.4.1. WiFi radio access networks***

*Note: The text that follows suggests modifications to Section 6.4.4.1 as it appears in the current Radio Spectrum Management Strategy (May 2015). The suggested modifications describe what is proposed to be changed by using ~~strikethrough~~ (to remove text from the current Radio Spectrum Management Strategy) and underscore (to add new material).*

6.4.4.1. WiFi radio access networks

From economic point of view, the use of WiFi technology is among the most important ones. WiFi technology is used for wireless access networks as well as for offloading of 3G/4G/5G data traffic terminals (data off-loading109). Bands 2400 – 2483.5 MHz (frequency band 2.4 GHz), ~~and~~ 5150 – 5350 MHz and 5470 – 5725 MHz (frequency band of 5 GHz), and 5945 – 6425MHz (frequency band 6 GHz) are harmonised in Europe for WiFi technology144 and are used by computers, tablet PCs, smart phones and other devices designed for connection to public and private networks. It is estimated145 that WiFi connection is used by 75 % of the users of smart phones. In most regions of the world WiFi is understood as a key component of development of Internet connection. Standard IEEE 802.11n practically enables speed over 100 Mbit/s, and standards IEEE 802.11ac and IEEE 802.11ax speeds of over 1000 Mbit/s ~~and 802.11ac gigabit speed~~.

The IEEE Std 802.11ax-2021 [Ref] standard supports operation in the 6425 MHz to 7025 MHz and 7025 MHz to 7125 MHz bands with channel bandwidth of up to 160MHz, and products based on this standard are seeing significant adoption where regulatory rules permit deployment [11]. IEEE 802 technologies are designed not to cause interference with other users in these bands. The Wi-Fi industry is taking the lead in specifying a number of co-existence strategies for bands with incumbent users, such as automated frequency coordination [13], [14].

The new generation of IEEE 802.11 technologies, currently under development in the IEEE P802.11be amendment, will continue to improve performance and enhance spectrum coexistence capacities. To achieve the targeted performance improvements, IEEE P802.11be introduces advanced features including channel bandwidths of up to 320 MHz, multiple resource units to a single station, multi-link operation, enhanced quality of service (QoS), improved Target Wake Time (for improved battery life for IoT or other applications), and improved punctured transmission/subchannels to accommodate coexistence with incumbents more effectively and efficiently. The P802.11be amendment currently supports carrier frequency operation between 1000 MHz and 7125 MHz with extension to 7250 MHz under consideration.

For the Wi-Fi 6 generation of products, IEEE 802.11ax introduced a trigger mechanism where the Wi-Fi AP can schedule uplink transmissions of a client, enabling predictability of access. Moreover, if a Wi-Fi 6 AP knows the QoS (throughput, latency) requirement of a client, the AP can schedule the clients accordingly. IEEE 802.11be, known as Wi-Fi 7 in the marketplace, further enhances the ability to control the medium (e.g., through restricted target wake time service periods, a.k.a. rTWT, advertised in Beacon frames). These scheduling mechanisms introduced in IEEE 802.11ax and IEEE 802.11be work well to deliver predictable QoS in environments where the spectrum environment is controlled by a network manager, e.g., in industrial and manufacturing sites and stadiums. Additionally, IEEE 802.11be defines Multi- Link Operation (MLO) and wide channel bandwidths up to 320 MHz to further support high determinism and QoS.

The related standards IEEE 802.11ad and IEEE 802.11ay (WiGig), approved in 2013, ~~will~~ enable gigabit communication at short distance in the bands 57 – 71~~66~~ GHz.

The potential of WiFi is based on the possibility of license-free operation and on continuous innovation – relative to the first specification of devices with speed 11 Mbit/s today’s standards have exceeded the achievable speed almost by ~~two~~ three orders.

Popularity and development of WiFi will be also supported by the development of 4G and 5G networks which, in a certain phase of development, envisage offloading of the traffic by means of WiFi. WiFi networks ~~could become~~ are an integral part of mobile communication networks (e.g., by means of the WiFi hotspots). ~~The decision on the expansion, if any, of additional frequencies for mobile access networks in the frequency band of 5 GHz will be made by the international conference WRC-15. In this context, the European Commission issued mandate to CEPT in 2013 to prepare a~~ *~~study of utilisation of the sections 5350 – 5470 MHz and 5725 – 5925 MHz by FWA networks~~* ~~designated for provision of broadband services of electronic communications146.~~



Figure No. 3 – Current and possible future configuration of the band of 5 GHz for FWA/WiFi



Figure No. – Current and possible future configuration of the band of 6 GHz for FWA/WiFi

The expansion of bands pro FWA is conditional upon compatibility with other civil and non-civil use of the bands, in particular the radiolocation service, scientific services147 and intelligent transport systems ITS148 which are or will be important for ensuring security, fluency and economy of road traffic. The expansion of the bands would enable homogenous use of the spectrum by BWA/FWA/WiFi systems using channel width up to 320~~160~~ MHz which enable gigabit data throughput for enterprise and dense usages of innovative applications such as AR/VR. In some countries, the frequency band 5.725 – 5.825 GHz is now used149 under the so-called light license usually in rural areas for wireless access. The preliminary internal analysis of the Office prepared according to the measurement results suggests compatibility of the existing ITS systems with BWA/FWA/WiFi systems. In the frequency band of 5350 – 5470 MHz the facilitation of mutual coexistence is significantly more complicated and it would require sophisticated procedures preventing mutual interference (e.g., geo-location databases).

*Consequences of utilisation of the spectrum by WiFi networks:* In both frequency bands of 2.4 GHz and 5 GHz designated for the operation of WiFi networks there have been cases of mutual local interference of the networks and other signs indicating quite high load on the band. In a part of the 5GHz band designated for the operation of outdoor networks there are instances of interference with meteorological radars due to WiFi operators’ failure to comply with the operating conditions. Since this phenomenon has very adverse implications for the quality of the services using the information from the meteorological radars the problem is dealt with both on international level and on national level (see Article 3.6).

**Conclusion**

IEEE 802 LMSC thanks the CTU for the opportunity to provide this submission. We encourage the CTU in future version of the Radio Spectrum Management Strategy to take into account the latest development of IEEE 802.11 and IEEE 802.15 technologies and consider a strategic plan for UWB.

Respectfully submitted

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References:

[1] “IEEE Standard for Low-Rate Wireless Networks,” in IEEE Std 802.15.4-2020 (Revision of IEEE Std 802.15.4-2015), vol., no., pp.1-800, 23 July 2020, doi: 10.1109/IEEESTD.2020.9144691.

[2] “IEEE Standard for Low-Rate Wireless Networks--Amendment 1: Enhanced Ultra Wideband (UWB) Physical Layers (PHYs) and Associated Ranging Techniques,” in *IEEE Std 802.15.4z-2020* (Amendment to IEEE Std 802.15.4-2020), vol., no., pp.1-174, 25 Aug. 2020, doi: 10.1109/IEEESTD.2020.9179124.

[3] IEEE 802.18 Wireless Standards Table of Frequency Ranges, Sept. 2022. [Available online](https://mentor.ieee.org/802.18/dcn/22/18-22-0009-01-0000-ieee-802-wireless-standards-table-of-frequency-ranges.xlsx)  [accessed: 21 August 2023]

[4] IEEE P802.15.4ab. [Available online](https://www.ieee802.org/15/pub/TG4ab.html) [accessed: 21 August 2023]

[5] FiRa Consortium, “Unleashing the Potential of UWB: Regulatory Considerations,” Dec. 2022. [Available online](https://www.firaconsortium.org/sites/default/files/2022-12/Unleashing-the-Potential-of-UWB-Regulatory-Considerations-December-2022.pdf) [accessed: 21 August 2023]

[6] FiRa Consortium, “Spectrum Position Statement,” Jul. 2023. [Available online](https://www.firaconsortium.org/sites/default/files/2023-07/spectrum-position-statement-july-2023.pdf) [accessed: 21 August 2023]

[7] Car Connectivity Consortium. “UWB Spectrum Regulatory Position, Car Connectivity Consortium Digital Key – The Future of Vehicle Access,” Dec. 2022, [Available online](https://carconnectivity.org/wp-content/uploads/2022/12/UWB-Spectrum-Regulatory-Position_v2-1.pdf) [accessed: 21 August 2023]

[8] Wi-Fi Alliance: Value of Wi-Fi. [Available online](https://www.wi-fi.org/discover-wi-fi/value-wi-fi) [accessed: 21 August 2023].

[9] Wi-Fi Alliance: Global Value of Wi-Fi. [Available online](https://www.wi-fi.org/news-events/newsroom/wi-fi-global-economic-value-to-reach-5-trillion-in-2025) [accessed: 21 August 2023]

[10] “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), pp.1-767, 19 May 2021, doi: 10.1109/IEEESTD.2021.9442429.

[11] Wi-Fi Alliance: Wi-Fi 6E momentum underscores need for entire 6 GHz band, November 2022. [Available online](https://www.wi-fi.org/news-events/newsroom/wi-fi-6e-momentum-underscores-need-entire-6-ghz-band) [accessed: 21 August 2023].

[12] CEPT: Section 6.2.6, ECC Report 302 - Sharing and compatibility studies related to Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) in the frequency band 5925-6425 MHz, May 2019. [Available online](https://docdb.cept.org/document/10170) [accessed: 21 August 2023].

[13] Dynamic frequency coalition: Automated frequency coordination - an established tool for modern spectrum management, March 2019. [Available online](https://dynamicspectrumalliance.org/wp-content/uploads/2019/03/DSA_DB-Report_Final_03122019.pdf) [accessed: 21 August 2023].

[14] Intel: Spectrum Sharing Using Automated Frequency Coordination, [Available online](https://www.intel.com/content/dam/www/central-libraries/us/en/documents/2022-12/spectrum-sharing-auto-frequency-coord-whitepaper.pdf) [21 August 2023].

[15] UK Ofcom: Update on the upper 6 GHz band. [Available online](https://www.ofcom.org.uk/__data/assets/pdf_file/0028/248770/update-on-upper-6hz-band.pdf) [accessed: 21 August 2023]

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. [↑](#footnote-ref-1)