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

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| Proposed Response to France ARCEP on Preparing for the Future of Mobile Networks |
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This contribution proposed a response to France ARCEP on Preparing for the Future of Mobile Networks.

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CPfrequencesmobiles@arcep.fr September 23, 2022

Re: “Réponse à la consultation publique “Preparing the Future of Mobile Networks”

**Dear ARCEP,**

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks ARCEP for issuing the consultation and the opportunity to provide feedback on “Preparing the future of mobile networks”. The Consultation is an important mechanism for soliciting feedback that will provide the ARCEP with the information necessary.

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 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 acknowledges and respects that other components of IEEE Organizational Units may have perspectives that differ from, or compete with, those of IEEE 802. Therefore, this submission should not be construed as representing the views of IEEE as a whole.

In the past ten years, the IEEE 802 LMSC has overseen the development of several standards that operate in the license exempt bands and are capable of providing gigabit through-put. In particular, IEEE Std. 802.11ax-2021 [3] and IEEE P802.11be [4] provide physical layer through-put capacity at gigabit speeds for current Wi-Fi 6/6E and upcoming Wi-Fi 7 technologies. These technologies have become an integral part of European citizens' lives, known best as "the 5 GHz network". Next generation technologies utilizing both 5 GHz and 6 GHz bands in order to satisfy new requirements in internet of things or lower latency and jitter requirements for applications such as home video, video conferencing or video gaming are already developed and continue to be improved by our hundreds of standards development contributors.

In light of the important role IEEE 802 technologies play in European network eco-systems and as related to “practical need for EU action”, IEEE 802 would like to highlight the importance of license exempt designation. Developments in Wireless Access Systems (WAS) including Radio Local Area Networks (RLAN) such as Wireless Local Area Networks (WLAN) (IEEE 802.11) and Wireless Specialty Networks (WSN) (IEEE 802.15) technologies are crucial components in realizing the gigabit connectivity targets envisioned in the European Commission’s [2030 Digital Compass: the European way for the Digital Decade](https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-01aa75ed71a1.0001.02/DOC_1&format=PDF) [1]. The proposal for a decision highlights the role of gigabit connectivity in the European digital transition for which we believe IEEE 802 technologies to be critical, also in supporting and complementing 5G.

In the following section, IEEE 802 LMSC would like to address the questions in the consultation listed below.

**Question 2.** What are the most significant developments brought by Wi-Fi 7? What is the timeline for these developments to become available on networks and devices? If applicable, what new frequency requirements will these developments generate?

IEEE 802.11 is currently working on finalization of the P802.11be standard expected to complete WG ballots in Nov 2022 and advancing to IEEE Standard Association ballot in 2023. Wi-Fi Alliance is currently working on development of air interface compliance specifications for Wi-Fi 7 technology. Wi-Fi 7 is based on IEEE 802.11be standard and capable of supporting maximum throughputs of at least 30Gbps to support superb performance, enable innovation and expand use-cases. Some of the emerging use-cases require a high level of user interactivity, immersion, reliability and stringent QoS management, such as Augmented Reality (AR) and Virtual Reality (VR), Industrial IoT and emergency services.

IEEE P802.11be and Wi-Fi 7 technology are targeting applications that require high performance in terms of peak throughput, high network and link efficiency, increased reliability, and low latency and jitter in both commercial/enterprise and consumer/residential deployments including airports, train stations, stadiums, malls, e-education, hospitals, public transportation, citywide Wi-Fi, apartment buildings, home, and office environments.

To support improved throughput and latency requirements as well as determinism of performance demanding applications of today and the innovations in the near future, Wi-Fi 7 technology introduces advance features based on IEEE P802.11be including channel bandwidths of up to 320MHz, 4K-quadrature amplitude modulation (QAM), multiple resource units (RUs) to a single station (STA), multi-link operation, enhanced quality of service (QoS), improved Target Wake Time to improved battery life (for IoT or other applications) and improved puncturing transmission to accommodate co-existence with incumbents more effectively and efficiently.

IEEE P802.11be is designed to meet the target application performance requirement and at the same time to scale to meet the requirements of enterprise, commercial and dense deployments when multiple simultaneous sessions of similar or different applications on multiple Wi-Fi networks are co-existing with incumbent operation. To effectively support this scaling requirement, IEEE P802.11be Global 6GHz channelization is designed for and on promise of availability of the entire 6GHz band to accommodate multiple 320MHz and 160MHz channels.

**Question 3.** Have you identified other developments in mobile technologies for specific uses that could generate new frequency needs, e.g. communications between devices or broadcasting/multicasting? If so, which and for what uses?

A number of target IEEE 802.11ax/802.11be (Wi-Fi 6E and Wi-Fi 7) use-cases such as Augmented Reality (AR) and Virtual Reality (VR) are optimized or naturally enabled in client to client (C2C) communications or broadcasting/ multicasting mode of operation. In many outdoor and indoor venues, such as sport tournaments and entertainments, events are broadcasted via streaming platforms in high definition, with enriched details, requiring high network capacity.

These deployments can be effectively scaled when multiple 320MHz channels are enabled in IEEE P802.11be. To enable communications between devices, portable modes of operations such as Very Low Power (VLP) and Low Power Indoor (LPI) C2C are already authorized by EU regulations and available for Wi-Fi 6E and Wi-Fi 7 in lower part of the 6GHz band that can be easily extended to the entire 6GHz if authorized. The extension to upper portion of the 6GHz band greatly facilitate scaling of services to enterprise and dense deployments.

**Question 8.** What other expected future applications and features can you identify?

To further expand on the applications listed in Section 1.4 of this consultation, IEEE 802 LSMC would like to highlight the following applications and use-cases as examples expected applications.

* Virtual and Augmented Reality in Remote Collaborative
* 4K/8K Video Streaming and Video Calling and Conferencing
* Remote/Wireless Office including social networking, gaming, e-education
* Multiple X Reality (XR) Applications
* Electronic Games and Esports
* Home Mesh to extend range and home coverage
* Medical Field applications including Mobile Health, Medical Device connectivity, Emergency Room at Hospital

**Question 10.** Among these applications, are some more likely to develop specifically within a fixed

environment, e.g. indoors, or rather in a mobile situation? If so, for what reasons?

IEEE 802.11 standard and associated Wi-Fi technologies, in particular Wi-Fi 6E and Wi-Fi 7, are designed to support various regulatory modes in EU and globally both indoor (LPI) and outdoor (VLP and Standard Power) in the 6GHz band. More specifically IEEE 802.11ax and 802.11be are supporting messaging protocol to facilitate compliance with various device modes according to local regulatory requirements. Also, support for portability is built in Wi-Fi technology through enabling of C2C LPI and VLP in the 6GHz band and in general in the 2.4GHz and 5Ghz bands. Having said that, majority of the use-cases and applications, including many of the applications mentioned in this response, are targeting indoor and fixed or portable environment.

**Question 11.** If applicable, which new mobile technologies would be needed to cover all of these

applications? To cover your applications as a user?

IEEE 802 LMSC believe that IEEE 802.11 and Wi-Fi technology complement and play a fundamental role in supporting 5G services today and 6G in the future as a cost effective, critical and indispensable element for an optimized solution to achieve France’s objectives for mid and long term frequency resources allocation and the European Commission’s [2030 Digital Compass: the European way for the Digital Decade](https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-01aa75ed71a1.0001.02/DOC_1&format=PDF).

For the first time, as the result of close collaboration between RLAN industry and regulators globally, a multi-mode regulatory framework (LPI/VLP/SP) and requirement was developed and implemented on the entire 6GHz band to optimally utilize the spectrum in the 6GHz band for indoor and outdoor while optimizing regulatory requirement for different deployment models. This multi-mode regulatory framework is an efficient vehicle to enable various industry use-cases while allowing multiple Wi-Fi networks co-exist with each other’s while FS and FSS incumbents continue operating and even expanding in the band as primary. IEEE 802.11 standard supports the enabling the regulatory requirements through protocol messaging.

**Question 12.** What new frequency requirements have you identified to enable these applications

using existing technologies and, if applicable, with the introduction of new technologies? For what

reasons (capacity, speed, coverage...)?

Please refer to responses to other questions including Question 3.

**Response to the Question not asked:** on Section 2 Vertical market players’ specific and emerging needs

IEEE 802.11 based technologies have already been incredibly successful in the home and enterprise markets where users benefit from a global ecosystem. In the office environment, both IT and service providers have been delivering both best-effort and voice/video collaboration services for many years and now with IEEE 802.11ax based Wi-Fi 6, Wi-Fi can support existing IOT applications such as retail, healthcare and industrial IOT!

All of these applications are what is considered as business-critical and require a much tighter degree of control of key parameters of the system such as latency, jitter and reliability. Starting from IEEE 802.11ax based Wi-Fi 6 extended to IEEE P802.11be based Wi-Fi 7, Wi-Fi technology, along with IEEE 802.11, are going through an evolution to further address the needs of vertical markets and Industrial IoT.

**Question 25.** What additional frequencies could help satisfy indoor coverage and quality of service needs, and how? In particular: is the 26 GHz band well suited to ad hoc and indoor solutions? Given their propagation properties, could the 450 MHz and 1.4 GHz bands enable indoor coverage gains via mobile networks? What other frequencies could be considered to address this need for improved indoor coverage?

IEEE 802.11ax and IEEE P802.11be (Wi-Fi 6E and Wi-Fi 7) in 6GHz band are optimized for high throughput and improved latency for indoor operation in LPI mode. To properly match coverage performance of Wi-Fi at 5GHz, while offering Gbps services, Wi-Fi 6 needs to operate in Standard Power mode indoor. In this case, to co-exist with in-band and adjacent band incumbents, using a frequency coordination or dynamic spectrum usage, Wi-Fi needs access to the entire 6GHz band. The reasons are 1) to make sure there are still sufficient SP channels available (especially in urban areas with high density of FS links) after restricting interfering channels and sub-bands into incumbent links and 2) to spread out the emission over the entire 1200MHz spectrum to control elevation of noise.

**Question 26.** What role does Wi-Fi play in all of the solutions for providing service indoors? If applicable, are there uses for which Wi-Fi is not technologically appropriate, and for what reasons?

At it is stated earlier in this response, Wi-Fi technology based on IEEE 802.11 is designed to optimally support indoor fixed and portable applications. Obviously, similar to any other technology, one can identify use-cases that are not supported by Wi-Fi today but as a vibrant innovative technology, IEEE 802 and Wi-Fi is thriving on reinventing itself to support the use-cases and the requirement needs of day-to-day life of people and businesses. Having said that, scalable, robust and flexible license exempt frequency and spectrum policies are critical in enabling and facilitating Wi-Fi to innovate for future use cases possibly unknown today.

**Question 34.** Of all the frequency bands listed above and detailed below, which rank highest for their ability to meet your needs?

Considering adoption of 6GHz band for license exempt in many countries and regions globally, availability of IEEE 802.11 standards and 6GHz optimized Wi-Fi technology and hundreds of 6GHz enabled certified Wi-Fi devices (capable of utilizing the entire 6GHz band) of different form factors already in the market, IEEE 802 LMSC believes that 6GHz band (5925-7125MHz) is the single most suitable band to meet the needs of short and mid-term of Wi-Fi Technology.

IEEE 802 LMSC recommends ARCEP support for license exempt designation of 6425-7125MHz for operation of Wi-Fi.

**Question 37.** If applicable, if these frequency bands were used for coexisting mobile and other uses (satellite, fixed link …), what sharing methods seem advisable to you?

As stated earlier in this response, for 6GHz band, a multi-mode optimized regulatory framework is developed and already adopted by many countries and regions globally. In this framework, also adopted (VLP, LPI and C2C LPI modes) by EU in ECC Decision (20)01 based on ECC Report 302, total transmit power level and power spectral density, indoor device category requirements, contention based (spectrum sharing) mechanism are specified to enable co-existence with FS and FSS incumbents. For Standard Power mode, IEEE 802 LMSC recommends consideration of Automated Frequency Coordination (AFC) to protect incumbent services when Wi-Fi is operating indoor and outdoor at higher transmit power than LPI and VLP.

**Question 77.** What uses do you expect to make of this band [66-71GHz], under this general authorisation framework? Does the introduction of 5G seem advisable? Under what timeline?

Wi-Fi CERTIFIED WiGig™ Technology based on IEEE 802.11ad and 802.11ay [2] currently uses the 66-71 GHz band as licensed exempt spectrum and Wi-Fi Alliance started certification of Wi-Fi CERTIFIED WiGig devices in 2016. Wi-Fi CERTIFIED WiGig™ expands the Wi-Fi® experience for virtual reality, multimedia streaming, gaming, wireless docking, and enterprise applications requiring high speed, data-intensive connections. Different category of products from various device manufacturers including connectivity, Computers and Accessories, Televisions and Set Top Boxes, Gaming, Media and Music have been certified and introduced to market. Some popular uses for WiGig products include:

* Wireless docking between devices like smartphones, laptops, projectors, and tablets
* Simultaneous streaming of multiple, ultra-high definition videos and movies
* More immersive gaming, augmented reality and virtual reality experiences
* Fast download of HD movies
* Convenient public kiosk services
* Easier handling of bandwidth intensive applications in the enterprise

**Question 91.** What is your assessment of the development outlook for these uses (Wi-Fi, IMT16)? Can you identify other uses that are likely to develop in this band [6425 – 7125 MHz (aka 6 GHz)]?

The upper segment of the 6GHz band (6425-7125MHz) is already designated or is a candidate for license exempt operation in many countries in all three regions Americas, EMEA and APAC. IEEE 802.11ax is completed and mature, Wi-Fi 6E certification started more than a year ago in Jan 2021 and many devices from of device manufacturers are certified and, in the markets, already. Various counties have developed regulatory certification programs for 6GHz enabled devices. Countries already started experiencing socioeconomic benefits of Wi-Fi 6E. While some countries and regions are still debating the results of WRC-23 and IMT studies for 6425 – 7125 MHz band, industry is marching toward enabling the second generation of Wi-Fi products based on IEEE 802.11be (i.e. Wi-Fi 7) in the band soon.

**Question 93.** Do you think the band is a good candidate for implementing dynamic spectrum sharing to handle the planned uses for it?

IEEE 802 LMSC believes that dynamic spectrum sharing mechanism similar to AFC System is the right choice for enabling Standard Power mode in extension band. AFC System certification planning is already under planning in US FCC and Canada ISED and Brazil Anatel are also going to preparation for enabling similar systems. Other countries such as S. Korea, Australia and Saudi Arabia are also considering.

**References:**

**[1]** Brussels, 9.3.2021, COM(2021) 118 final

**[2]** 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 Developed by the LAN/MAN Standards Committee of the IEEE Computer Society, IEEE Std 802.11™-2020, Approved 3 December 2020, <https://ieeexplore.ieee.org/document/9363693/>

**[3]** IEEE 802.11ax™-2021 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, February 2021

**[4]** Draft IEEE P802.11be or PAR?

Respectfully submitted

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