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

Draft response to NTIA's consultation on the development of a national spectrum strategy				
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This document drafts a proposed response to US NTIA's consultation "Development of a national spectrum strategy".

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Re: Consultation "Development of a National Spectrum Strategy" / DOCKET NO. 230308-0068

Dear Ms. Stephanie Weine,

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks the National Telecommunications and Information Administration (NTIA) for issuing the consultation "Development of a National Spectrum Strategy" and for the opportunity to provide feedback on this topic.

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].

Current and future state of IEEE 802 wireless technology development

As the NTIA observes, access to spectrum is critical to continue positioning the U.S. as a world leader of advanced technology and enhance the U.S.'s national and economic security. Significant economic value is provided by IEEE 802-based systems today. Wi-Fi technology, based on the IEEE 802.11 standard, has an estimated 18 billion devices in use worldwide, with over 4 billion devices added annually [1]. The current deployments of IEEE 802.15 devices are found in markets ranging from consumer devices to industrial plants, automobiles to buildings and agriculture to space.[2] IEEE 802 wireless technologies are a critical part of the modern communications infrastructure, benefiting billions of people, governments, and businesses every day. Underserved communities stand to gain from IEEE 802 wireless technologies. They are used in community networks both to empower and provide an opportunity for education. IEEE 802 wireless technologies are in the forefront as an enabler of emerging applications such as augmented and virtual reality (AR/VR).

IEEE 802.11

Today, Wi-Fi networks based on IEEE 802.11 standards are found in residential, office, and industrial environments, in public and private settings. Users in an array of industries[3] rely on these cost-effective, energy-efficient technologies. Each new generation of IEEE 802.11

[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.

[2] The introduction of IEEE 802.15 UWB-enabled devices in smartphones and laptops puts forecasts at more than 1 billion devices shipped annually worldwide by 2025 (FiRA Consortium, August 2022).

[3] Leisure (gaming, multimedia, browsing), education, health, transportation, and public services are just a few examples.

technologies continues to improve efficiency, reliability, latency, throughput and determinism. IEEE 802.11 supports operation in several frequency bands [2], including the 6 GHz (5925 MHz to 7125 MHz) band, with significant deployments underway [3].

IEEE 802.15
Technologies based on IEEE 802.15 standards are embedded in an increasing number of devices. For some applications, such as cars or utilities, industry consortia exist to manage deployments. For other applications, proprietary protocols are used in conjunction with IEEE 802 standards. IEEE 802.15.4 can operate in many frequency ranges [2] and supports data communication, location discovery and device ranging. IEEE 802.15.6 is specialized for short range communication in the vicinity of, or inside, a human body. For high-speed, low-latency media transfers, IEEE 802.15.3 provides a specialty solution. IEEE 802.15.16 accommodates the needs of some utility networks.

IEEE 802.19
Many IEEE 802.15 standards, as well as the IEEE 802.11 standard, support operation on frequencies lower than 1 GHz. The IEEE 802.19 Wireless Coexistence Working Group published best practice coexistence mechanisms for sub-1 GHz technologies in 2021 [4].

IEEE 802 LMSC's response to Pillar #1 Question 1

Re: What relationship (if any) should our strategy have to the work of these entities?

IEEE 802 LMSC is a leading consensus-based industry standards body and we are a critical part of the ecosystem that enables full value from available spectrum. IEEE 802 LMSC wishes to be included in any future NTIA spectrum strategic effort so that we are able to inform the NTIA on spectrum requirements for next-generation networks and emerging technologies and standards under development.

IEEE 802 LMSC has been and continues to be a leader in developing wireless standards that are widely adopted. Some IEEE 802 wireless standards, e.g., IEEE 802.11 standard, are well known, while other standards, e.g., the IEEE 802.15 family of standards, are widely used in applications where the "branding" is not overt (examples include TV remote controls, lighting, windows, door locks, heating and air conditioning systems, alarm systems and remote medical monitoring). As examples of relevant work ongoing in IEEE 802 LMSC which should inform future policy, we have various ongoing projects that not only focus on higher throughput, but also improve upon the way spectrum is used to enable higher reuse, better coexistence, and greater energy efficiency. These projects enable further technological innovation that will provide value to federal and non-federal users.

Re: What are the spectrum requirements for next generation networks and emerging technologies and standards under development?

Within the upcoming 3 years, Wi-Fi 7 [15], operating in the 2.4 GHz, 5 GHz, and 6 GHz bands, are being developed based on the IEEE P802.11be project [9]. In order to achieve the target performance measures, IEEE P802.11be introduces advanced features including channel bandwidths of up to 320 MHz, 4K-quadrature amplitude modulation, multiple resource units to a single station, Multi-Link Operation (MLO), enhanced quality of service, improved Target Wake Time (for improved battery life for Internet of Things (IoT) or other applications), and improved

punctured transmission/subchannels to accommodate coexistence with incumbents more effectively and efficiently. IEEE P802.11be also specifies capacity to operate between 5925 MHz and 7250 MHz, and it is additionally designed to scale with dense deployments where multiple simultaneous sessions of similar or different applications on multiple Wi-Fi networks are coexisting with incumbent service operation.

In September 2022, the IEEE 802.11 Working Group established a project authorization request study group, namely Ultra High Reliability Study Group [10], that investigate physical layer and medium access control layer technologies to improve reliability of WLAN connectivity, reduce latency, increase manageability, increase throughput including at different signal-to-noise levels and reduce device level power consumption.

A study group dedicated towards the enhanced specification of mmWave (60 GHz) operation for WLAN connectivity, with the particular target of ensuring an ability to integrate such functionalities in the MLO framework specified by IEEE P802.11be, is expected to start from November 2023. Within the next 4 to 5 years, the 60 GHz band may therefore be of continued relevance for the WLAN ecosystem.

IEEE 802 LMSC's response to Pillar #1 Question 3

Re: What spectrum bands should be studied for potential repurposing for the services or missions of interest or concern to you over the short, medium, and long term?

IEEE 802 wireless technologies are primarily designed for use of shared and license-exempt operation and enable an ecosystem in which many independent entities can contribute and enable an ever-expanding communications infrastructure. IEEE 802 LMSC believes enabling license-exempt operation provides a robust foundation for flexible and future-proof policy making that is fit to promote urgent society interests such as economic development, environmental sustainability, and connectivity in underserved communities and technological neutrality.

The main priorities for IEEE 802 wireless technologies in spectrum policy are listed below:

[1] The increasing demands for wireless spectrum should be met by introducing flexibility into the use of lightly used spectrum. This includes spectrum that is being used sparsely on a geographic or temporal basis.

[2] Even though the U-NII-8 band ends at 7125 MHz, expanded availability of the 6 GHz band from 7125 MHz to 7250 MHz for license-exempt shared use (indoor and outdoor) is critical to IEEE 802 wireless technologies.

[3] Global convergence on policies for the sub-1 GHz bands is needed to enable wider deployment of technologies already developed by IEEE 802 LMSC.

License-exempt designations, whether accommodating license-exempt technologies as primary or secondary users of a frequency band, provide flexibility to the regulator and to technology developers in terms of changing and adapting features to the current needs of society and the economy. In addition, license-exempt technologies already have a proven track record of combining energy efficient spectrum use with higher capacity.

Availability of wider channel bandwidths, such as multiple, concurrent 320 MHz channels for IEEE P802.11be technologies in the 5925 MHz to 7250 MHz bands [16], enable higher throughput

and lower latency. Recent studies from regulatory and industry consortia also revealed that, with the support of multiple carriers and carrier aggregation, the access to large, contiguous frequency blocks can reduce energy consumption [11] [12]. In a similar fashion, broadcast Target Wake Time specified in IEEE Std 802.11ax-2021 [8] and marketed under Wi-Fi CERTIFIED 6 Release 2 [14], uses scheduling functions to improve throughput through coordinated transmissions that also improves energy efficiency potential by making it foreseeable when idling is possible without harming the service [13]. MLO will enable more adaptable, energy-efficient and robust connectivity than ever before.

Avoiding allocation of spectrum for technologies that rely on high transmission power in the range from 7250 MHz to 9500 MHz would allow low power technologies like UWB and other potential unlicensed technologies, e.g., Radio Local Area Network (RLAN), to achieve higher reliability. At the same time, if higher frequency bands are allocated to data-intensive applications, these applications could be further incentivized to move out of the sub-1 GHz and 2.4 GHz bands. Those bands could then be focused more on IoT applications and that would reduce the pressure on IoT applications in the sub-1 GHz and 2.4 GHz bands to increase transmit power to overcome interference.

IEEE 802 LMSC's response to Pillar #1 Question 9

Re: How should the U.S. think about international harmonization and allocation disparities in developing the National Spectrum Strategy?

Global convergence on policies for spectrum is needed to enable wider deployment of technologies already developed by IEEE 802 LMSC.

Expanded global availability of the 6 GHz band (5925 MHz to 7250 MHz) for license-exempt shared use (indoor and outdoor) is critical to IEEE 802 wireless technologies. The IEEE Std 802.11ax-2021 [8], the ongoing IEEE P802.11be project [9], IEEE Std 802.15.4z-2020 [6], and the ongoing P802.15.4ab project [7] for instance, introduce capability to operate in the entire 6 GHz band to meet the growing demand for connectivity and to achieve the performance required by new applications. Regulatory certainty is needed to further the benefits enjoyed by users of IEEE 802 wireless technologies around the world.

Global convergence on policies for the sub-1 GHz bands is needed to enable wider deployment of technologies already developed by IEEE 802. Standards-based systems operating in these bands make efficient and effective use of the spectrum. Allowing expanded use would further increase the economic and social value of sub-1 GHz spectrum.

IEEE 802 LMSC's response to Pillar #3 Question 2

Re: What policies should the National Spectrum Strategy identify to enable development of new and innovative uses of spectrum?

Rapid development of advanced communications technology and a diverse range of radio frequency spectrum uses are shaping the way the U.S. citizens stay connected. The appetite for advanced connectivity and the ubiquity of communications devices across all of U.S.'s economic, social, and public interest activities are key factors driving the demand for spectrum.

A core principle of IEEE 802 wireless standards is to enable spectrum sharing by using appropriate coexistence techniques. The coexistence technique or mechanism might change depending on the standards in use and the regulatory requirements.

The use of Ultra-Wideband (UWB), based on the IEEE 802.15.4 standard, is expanding rapidly, supporting a robust ecosystem delivering products providing significant value for numerous short-range sensing and ranging applications. IEEE Std 802.15.4-2020 [5] and IEEE Std 802.15.4z-2020 [6] are standards for precision ranging capable of using both the 6 GHz and 7 GHz frequency bands. In particular, the IEEE Std 802.15.4z-2020 secure ranging capability has boosted UWB adoption in first the automotive industry and later in mobile handsets. This is generating significant economic and social value, attracting further interest in developing future UWB standards, e.g. IEEE P802.15.4ab [7], which provides features to make greater use of the spectrum, and enable continued innovation in uses such as precise (centimeter accurate) location services, secure entry, in-vehicle use for presence detection and multimedia communications, and many others.

UWB operates at extremely low signal power and shares effectively. The extremely low transmit power makes interference with higher power services highly unlikely. To the best of our understanding, there has not been a reported incidence of UWB operating under the FCC Part 15 rules interfering with any licensed service. The signal and use characteristics of UWB enable very high spectral reuse, enabling dense deployment of devices, which in turn makes UWB a valuable compliment to other unlicensed technologies.

Ongoing work in IEEE 802 LMSC is developing more effective mutual coexistence strategies between UWB and RLAN. Within IEEE 802 LMSC and elsewhere in the industry, strategies for positive coexistence are being developed and tested. While IEEE 802 LMSC understands unlicensed services receive no protection, we ask that in developing and implementing the national spectrum strategic plan, the high value provided by existing unlicensed services be considered and measures taken to preserve the usability for unlicensed operation including UWB and RLAN. In particular there is concern that repurposing bands for expanded high-power use that are currently used for unlicensed services on a shared basis (e.g., 7 GHz to 8.5 GHz) may effectively make the band unusable for any but the licensed use, limiting diversity of use, which diminishes efficient use of the spectrum resources.

Conclusion

IEEE 802 LMSC thanks the NTIA for the opportunity to provide this submission and kindly requests the NTIA to take into account our responses in its decision towards the development and implementation of the US's national spectrum strategy.

Respectfully submitted

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