IEEE P802.11  
Radio Regulatory Technical Advisory Group (RR-TAG)

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| ISUS Document Draft | | | |
| Date: 2023-01-17 | | | |
| Author(s): | | | |
| Name | Affiliation | Address | email |
| Amelia Andersdotter | Sky Group/Comcast | Belgium | amelia.ieee@andersdotter.cc |

Abstract

This document contains a less skeletal draft for the IEEE Standards Association (SA) position statement “Intelligent Spectrum Allocation and Management” for review.

It is based on the Scope discussions outline on slide #12 in document 18-22-0084r2.'

**r1: new text** added from https://mentor.ieee.org/802.18/dcn/22/18-22-0120-07-0000-contribution-for-nkom-consultation.pdf and https://mentor.ieee.org/802.18/dcn/22/18-22-0152-07-0000-2022-dec-802-lmsc-response-to-japan-mic.pdf with some modifications (changing sentences to make better flows). **footnotes are still messy**. pieces kept from old statement are still marked with yellow highlight, but they've been reduced compared with previous version. **new section** with recommendations added just before history-headline.

**r2: replaced** "unlicensed" with "license-exempt"

**r3:** organised footnotes.

**r4:** with notes from 16 December 2022 meeting.

**r5:** with formatted version of new recommendation 2.

**r6:** annex with industry consortiums

**r7:** changes in current and future applications section courtesy of Hassan Yaghoobi.

**r8:** changes in the annex (add .11ah and WBA). replace mock titles of headings with real headings

r9: changes in the introduction (marked as accepted after no objections were made in the .18 session on 17 Jan 2023), "real" headings marked as accepted, changes in text of recommendation 2 marked as accepted to avoid further clutter, yellow highlights in introduction and co-existence sections removed, other changes **not** marked as accepted, recommendation 4 proposed to be removed,

IEEE Standards Association Position Statement

~~Intelligent~~ Spectrum Allocation and Management

**Introduction**

The IEEE Standards Association (IEEE-SA) Organizational Unit oversees the development of technical standards, some of which specify the key global technologies using license-exempt spectrum globally. The IEEE-SA technical standards volunteer participants are major contributors to the published standards incorporating industry leading wireless technologies. Participation in the development of IEEE standards is open to any interested party without restriction. IEEE-SA supports the position that spectrum allocation and management is needed for both licensed and license-exempt technologies to meet the explosive growth in the demand for wireless communication and sensing.

Participants in the IEEE 802.11 Wireless LAN (WLAN) Working Group and IEEE 802.15 Wireless Speciality Networks (WSN) Working Group develop wireless standards for license-exempt spectrum. While the former has reached wide fame under the brand-name Wi-Fi, the latter is sometimes grouped with Ultra-Wide Band (UWB) and is used by numerous consortiums supporting applications ranging from sensing, to agriculture, to car keys.

IEEE 802 wireless technologies are used in every market segment where there is a need for connectivity and communication, whether it is between humans and humans, humans and devices or devices and devices. WLAN and WSN provide flexible buildings blocks that can be easily combined to form larger systems, or be used inside of, as a complement to or side-by-side with already existing connectivity infrastructure.

**Main priorities for IEEE 802 wireless technologies in spectrum policy**

1. Spectrum policies, at both local, regional and global levels, should permit a multiplicity of uses and users, in so far as possible. Allocation and management strategies should be oriented towards shared spectrum, where many users are encouraged to co-exist and provide socially and economically beneficial services to communities. As spectrum is becoming increasingly scarce, policies towards flexible sharing and maximal efficient utilization of spectrum are not only critical but inevitable.

2. License-exempt shared spectrum technologies are an important part of both industrial and citizen-oriented networking ecosystems world-wide today. To further increase socioeconomic benefits offered by license-exempt technologies, to expand and scale existing services and further enable innovative applications and use-cases of tomorrow, more spectrum resources should be allocated on a licence-exempt basis.  
  
To protect fair sharing of scarce spectrum resources, technology neutrality principles, and potentially the exclusive access rights of incumbent spectrum owners, three levels of coexistence management are necessary in license-exempt shared spectrum allocations:

* To allow for multiple use of the same spectrum at a given location, spectrum resources are shared by same technology or even cross technology user devices in a fair fashion enabled by channel access mechanisms such as contention-based protocols.
* To enable various technologies to coexist in the same spectrum and to enable future evolution through new developments, the license-exempt shared spectrum is shared through appropriate means by different technologies such as those based on IEEE 802.11 and 802.15 and technologies developed by other organizations, like 3GPP.
* A license-exempt band may be allocated to an incumbent user. In these cases, the license-exempt regulatory requirements are designed in a way to protect the incumbent services from harmful interference. This provides a foundation for efficient spectrum utilization as it does not require re-farming of the spectrum and migration of incumbent services to other bands as spectrum is already scarce.

3. In terms of global spectrum management, we would like to specifically highlight that availability of the full 6 GHz band (i.e., 5925-7125 MHz) for license-exempt shared use is critical to IEEE 802 technologies to expand existing applications and services in support of ever increasing demand and to enable development and deployment of new applications and services in the coming years, and hence contribute further to the societal benefits.

**A proud history of standards development and success for the networked society**

add more stuff? delete above?

**Current and future state of IEEE 802 wireless technology development**

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 world-wide, with over 4 billion devices added annually[[1]](#footnote-1). The increasing use of IEEE 802.15 devices in the smartphone and consumer automotive spaces for location discovery and device ranging, puts forecasts at more than 1 billion UWB-enabled devices will be shipped annually worldwide by 2025[[2]](#footnote-2). IEEE 802 wireless technologies are deployed around the world. Today, these technologies are integral part of human life and changed the way world operates, communicates and conducts business, benefiting billions of people every day.  
  
Today, Wi-Fi networks are an essential part of the human connectivity deployed in residential, office, and industrial environments, in both public and private settings, and for both devices (such as printers or IoT) and people. Users in an array of industries including, health, education, transportation, leisure, and public services now relys on IEEE 802 and Wi-Fi technologies.

Technologies developed under the auspices of IEEE 802 also enable connectivity in underserved communities by efficiently using spectrum made available.   
  
IoT sensor networks are embedded in an increasing number of devices, from automotive vehicles, to industrial equipment to body implants, all improving user's capacity to deal with challenges ranging from manufacturing and safety to human health. These technologies all use license-exempt spectrum to co-exist not just within our own ecosystem but also pre-existing spectrum users.

IEEE 802, given its history of being a neutral and collaborative standards development organization, has long facilitated the development spectrum sharing technologies that are standardized across industry.   
  
Since 2021, IEEE 802.11 supports operation in the 6 GHz (5925-7125 MHz) band, and thousands of products based on this standard (Wi-Fi 6E) are already in the market globally are seeing significant adoption where regulations permit deployment. A new generation of IEEE 802.11 technologies currently under development will continue to enhance determinism, throughput, efficiency, reliability, and low latency and improve spectrum co-existence capacities by introducing wider channel bandwidths. contiguous bandwidths in the 6 GHz band accommodating multiple wide channel bandwidth is key in success of next generation IEEE 802.11 technologies to achieve the promised performance.

Meanwhile, the IEEE Std 802.15.4-2020[[3]](#footnote-5) standard supports operation in the upper 6 GHz (6425-7025 MHz and 7025-7125 MHz) bands and is expanding the use of location discovery and device ranging. With recent regulatory developments, UWB has come to be deployed in consumer devices such as smartphones and laptops, and increasingly in other consumer devices such as automobiles. IEEE Std 802.15.6-2012[[4]](#footnote-6), a standard for short range, wireless communication in the vicinity of, or inside, a uses the same bands and channels and is approved by national medical and/or regulatory authorities for applications including medical wireless body area network (BAN).

The IEEE Std 802.15.3d-2017 standard supports operations between 252 and 325 GHz and targets applications with several tens of Gbps. In this frequency band sharing with other passive services is a pre-requisite to use this frequency band for wireless communications. The future use of integrated sensing and communication applications in this frequency band will require the development of innovative spectrum management methods.

**IEEE 802 wireless technologies are developed and designed for co-existing**

IEEE 802 wireless technologies are designed not to cause any harmful interference with other incumbent users in bands where they operate. Our standards development process meets regulatory minimum requirements for interference mitigation and exceeds minimum requirements by actively working on robust co-existence mechanisms. Indeed, IEEE 802 is at the forefront of ensuring that a ubiquitous, wireless technological infrastructure can be shared by many technologies and actors. The technologies developed in IEEE 802 have fully implemented existing regulations, and have enabled regulations to change in ways that opened up more opportunities for social and economic welfare.

The IEEE 802.19 Wireless Coexistence Working Group completed work in sub-1GHz[[5]](#footnote-7) and for automotive use scenarios,[[6]](#footnote-8) as well as for individual standards amendments developed in the IEEE 802.11 and .15 Working Groups. Additional work is undertaken within the Working Groups, such as the Co-existence Standing Committee of IEEE 802.11 which follows co-existence studies at the ISO and ETSI levels.

IEEE 802.15 operates with very low risk of causing interference to other services, due to the extremely low transmit power levels, low activity factors, and other technical characteristics, which support high spectral reuse factors and effective sharing on the spectrum. IEEE 802.11 technologies make use of back-off mechanisms to ensure that a channel is clear before attempting transmission.

The increasing demands for wireless spectrum is facilitated by introducing flexibility into the use of lightly used spectrum. This includes spectrum that is being used sparsely on a geographic basis (i.e., only used in certain specific locations) or temporally.

As additional spectrum and bands are identified for new and expanded uses, IEEE 802 will continue (its tireless efforts) to enable robust coexistence and sharing with incumbent users.

**A solid vision for social and economic development through flexible spectrum management**

Technologies which are designed to use license-exempt or shared spectrum have made a tremendous positive impact on the world and will continue to benefit humanity profoundly in the years to come. In heavily regulated environment of spectrum management, these benefits can only be realized with a solid vision from regulators and governments to include as many users and entities as possible in a technical environment that provides a maximal amount of flexibility for those users and entities. The IEEE 802 wireless community provide the basic elements of one such eco-system, and we welcome others to contribute to and use our results.

**How can I find more information?**  
  
For more comprehensive information on specific use-cases and applications of IEEE 802 wireless technologies in the field, many industry consortia and business organisations exist that develop and describe deployment scenarios:

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| Name of organisation | Website | IEEE 802 relevancy | Activity Area |
| Wi-Fi Alliance (WFA) | https://www.wi-fi.org/ | IEEE 802.11 | Access network deployments in home and enterprise environments, certification of devices destined for these purposes with respect to interoperability, security and functionality. Marketing and industry research activities. |
| UWB Alliance | https://uwballiance.org/ | IEEE 802.15.4 | Marketing and industry research activities with a view to understanding the current and future uses of ultra-wide band technologies. |
| Car Connectivity Consortium (CCC) | https://carconnectivity.org/ | IEEE 802.15.4 | Communication between car and consumer electronics, certification of such devices with respect to interoperability and security. |
| Connectivity Standards Alliance (CSA-IOT) | https://csa-iot.org/ | IEEE 802.15.4 | Development of middleware and certification for home and industry use-cases with respect to interoperability, etc. |
| FiRa Consortium | https://www.firaconsortium.org/ | IEEE 802.15.4 | Development and certification of precise location technologies in consumer use-cases like payments, electricity measurements, locating devices, etc. |
| omlox | https://omlox.com/ | IEEE 802.15.4 | Development and certification of precise location technologies in professional use-cases like factories, logistics managements, etc. |
| Thread Group | https://www.threadgroup.org/ | IEEE 802.11  IEEE 802.15.4 | Internet of things connectivity protocols development, use-cases. |
| ‍Wireless Broadband Alliance (WBA) | https://wballiance.com/ | IEEE 802.11 | Develops best practices and recommendations for network operators that use IEEE 802 technologies in their networks. |
| Wi-SUN Alliance (Wi-SUN) | https://wi-sun.org/ | IEEE 802.15.4 | Development and certification of measurement technologies usable for weather monitoring, agriculture, asset managements, amongst others. |

The IEEE-SA has an important role to play in the development of intelligent spectrum allocation and management based upon transparent, standardized rules that also account for incumbent users.

*This statement was developed by the IEEE Standards Association and represents the considered judgement of a group of IEEE standards participants with expertise in the subject field. The position taken by the IEEE Standards Association does not necessarily reflect the views of IEEE or its other Organizational Units.*

**ABOUT IEEE**

The IEEE is the world’s largest professional association advancing innovation and technological excellence for the benefit of humanity. IEEE and its members inspire a global community to innovate for a better tomorrow through its highly-cited publications, conferences, technology standards, and professional and educational activities. IEEE is the trusted “voice” for engineering, computing, and technology information around the globe.

There are more than 420,000 IEEE members in more than 160 countries. IEEE publishes a third of the world’s technical literature in electrical engineering, computer science, and electronics, and is a leading developer of international standards that underpin many of today’s telecommunications, information technology, and power generation products and services.

***ABOUT THE IEEE STANDARDS ASSOCIATION***

*The IEEE Standards Association, a globally recognized standards-setting body within IEEE, develops consensus standards through an open process that engages industry and brings together a broad stakeholder community. IEEE standards set specifications and best practices based on current scientific and technological knowledge. The IEEE-SA has a portfolio of over 1,250 active standards and over 650 tandards under development. For more information visit http://standards.ieee.org.*

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2. FiRa Consortium: Unleashing the Potential of UWB: Regulatory considerations, August 2022. [Available online](https://www.firaconsortium.org/sites/default/files/2022-08/Unleashing-the-Potential-of-UWB-Regulatory-Considerations.pdf) [accessed: 12 December 2022] [↑](#footnote-ref-2)
3. “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. [↑](#footnote-ref-5)
4. “IEEE Standard for Local and metropolitan area networks - Part 15.6: Wireless Body Area Networks,” in IEEE Std 802.15.6-2012, vol., no., pp.1-271, 29 Feb. 2012, doi:10.1109/IEEESTD.2012.6161600. [↑](#footnote-ref-6)
5. "IEEE Recommended Practice for Local and Metropolitan Area Networks--Part 19: Coexistence Methods for IEEE 802.11 and IEEE 802.15.4 Based Systems Operating in the Sub-1 GHz Frequency Bands," in IEEE Std 802.19.3-2021 , vol., no., pp.1-79, 26 April 2021, doi: 10.1109/IEEESTD.2021.9416944. [↑](#footnote-ref-7)
6. Proceedings from Automotive Study Group in IEEE 802.19. [Available online](https://mentor.ieee.org/802.19/documents?is_group=Auto) [accessed: 2022-12-16] [↑](#footnote-ref-8)