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Re: Consultation Paper on Assignment of the Microwave Spectrum in 6 GHz (lower), 7 GHz, 13 GHz, 15 GHz, 18 GHz, 21 GHz Bands, E-Band, and V-Band

Dear Shri Akhilesh Kumar Trivedi,

IEEE 802 LAN/MAN Standards Committee (LMSC) thanks the Telecom Regulatory Authority of India (TRAI) on its ongoing work in spectrum management. The consultation paper on assignment of the microwave spectrum in 6 GHz (lower), 7 GHz, 13 GHz, 15 GHz, 18 GHz, 21 GHz bands, E-Band, and V-Band is valuable to inform the public of the areas in which TRAI expects to focus and to solicit feedback that will provide the TRAI with the information necessary to proceed.

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 that other components of IEEE Organizational Units may have perspectives that differ from, or compete with, those of IEEE 802 LMSC¹.

Please find below the responses of IEEE 802 LMSC on the following questions: Q16, Q17, Q29, Q30, Q31, Q32, Q33, and Q34.

Q16. Considering that the Government has decided to delicense the 6 GHz (lower) band (5.925-6.425 GHz) for low power applications, whether there is any need to prescribe certain measures to provide necessary protection to incumbent users such as Fixed Microwave (backhaul) Services, Fixed Satellite Service (FSS) etc. operating in the 6 GHz (lower) band? If yes, which specific measures should be prescribed for this purpose? Kindly provide a detailed response with justifications.

IEEE 802 LMSC is highly supportive of the decision to delicense the lower 6 GHz band for low power applications. In our view, there is no need to prescribe certain measures to provide necessary protection to incumbent users, including but not limited to Fixed Microwave (backhaul) Services and Fixed Satellite Service (FSS), when operating indoors at low power indoor (LPI) or with very

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.

low power (VLP) in the 6 GHz (lower) band. A study conducted by Broadband India Forum² also supports our view.

Q17. Any other suggestions relevant to the assignment of spectrum in 6 GHz (lower), 7 GHz, 13 GHz, 15 GHz, 18 GHz, and 21 GHz bands may kindly be provided with detailed justifications.

In addition to LPI and VLP operation in the 6 GHz (lower) band, IEEE 802 LMSC recommends TRAI also enable standard power (SP) operation as well. SP enables Wi-Fi operation at higher power than both the LPI and VLP modes, to optimally utilize the 6 GHz spectrum. In order to enable SP operations effectively, IEEE 802 LMSC recommends TRAI to consider initiating proceedings to utilize an Automated Frequency Coordination (AFC) system in the 6 GHz (lower) band.

AFC technology is used to protect incumbent services during outdoor and indoor operations at SP level for Wi-Fi operation. IEEE 802 LMSC believes that an AFC system can provide effective automated spectrum sharing to enable essential Wi-Fi technology applications and use cases not only for outdoor operation but also indoor operation in the 6 GHz (lower) band.

The USA³ and Canada⁴ have already started certification of AFC systems. The certification process for AFC systems and devices is based on industry developed recommended compliance specifications^{5,6}. Many AFC controlled SP Access Points and Fixed Client devices are already certified in the USA and Canada.

IEEE 802 LMSC notes the presence of different types of incumbent services operating in 6 GHz (lower) band in India. Our understanding is that existing AFC systems are designed with flexibility built-in specifically to enable an AFC system to be customized based on local spectrum regulatory requirements. Therefore, with proper consideration of protection criteria for the existing incumbent services, we believe that AFC systems can properly implement the frequency coordination and maximum allowable power settings for AFC-enabled devices. As an example, in the USA, AFC systems determine frequency and channel availability and maximum permissible power levels for AFC devices considering incumbent fixed services and radio astronomy services.

AFC systems are designed to automatically calculate and make available, to AFC devices, available frequencies and corresponding permissible transmit power levels. AFC systems are required to use the updated incumbent system database to keep the calculations and frequency availability up to date as 6 GHz incumbent links are changed. This means that incumbent services are protected from harmful interference by AFC systems, and that any expansion of such incumbent services over time can be achieved without a need to redesign the AFC systems.

² See Broadband India Alliance: Frequency Sharing for RLAN for 6 GHz band in India, October 2021, https://broadbandindiaforum.in/wp-content/uploads/2021/11/Frequency-Sharing-for-RLANs-in-the-6GHz-band-in-India_Accessible.pdf [Last accessed: 21 June 2025]

³ See Federal Communications Commission: OET announces approval of seven 6 GHz band automated frequency coordination systems for commercial operation and seeks comment on C3 Spectra's proposed AFC system, <https://docs.fcc.gov/public/attachments/DA-24-166A1.pdf> [Last accessed: 21 June 2025].

⁴ See Innovation, Science and Economic Development Canada: List of designated Dynamic Spectrum Access System Administrators (DSASAs), Automated Frequency Coordination System Administrators (AFCSAs), issue 1 of DBS-06, <https://ISED-ISCED.CANADA.CA/site/certification-engineering-bureau/en/node/116> [Last accessed: 21 June 2025].

⁵ See Wi-Fi Alliance: 6 GHz AFC resources, <https://www.wi-fi.org/6-ghz-afc-resources> [Last accessed: 21 June 2025].

⁶ See Wireless Innovation Forum: Specifications, <https://6ghz.wirelessinnovation.org/baseline-standards> [Last accessed: 21 June 2025].

Q29. Whether it is feasible to allow low power indoor consumer device-to-consumer device usages on a license-exempt basis in the V-band in parallel to the use of the spectrum by telecom service providers for the establishment of terrestrial networks in a part or full V-band? Kindly provide a detailed response with justification and international scenario.

IEEE 802 LMSC believes that it is feasible to allow low power consumer devices to operate and co-exist with telecom services providers terrestrial networks in the V-band.

Given the atmospheric absorption in spectrum in question, V-band/extended V-band (i.e., 57 GHz to 64/66 GHz), the indoor operation of low power consumer devices (consumer device-to-consumer device) should not cause harmful interference to the operation of terrestrial networks. The indoor device operation is a point-to-point link using a narrow beam. Any spurious or unwanted emissions from the radiator/s would be absorbed by the walls/ceilings, and the atmosphere. Therefore, it is very unlikely that the low power indoor devices would cause interference to terrestrial networks.

For the above reasons, most major global regulators including the FCC, Ofcom, and ACMA as mentioned in paragraphs 3.67, 3.69, and 3.70 of the consultation paper allow license-exempt operation of low power devices along the high power terrestrial networks in this band.

Q30. In case it is decided to allow low power indoor consumer device-to-device usages on a license-exempt basis in the V band (57-64/66 GHz).

(a) Should it be permitted in the entire V-band or only in a portion of the V-band? If it should be permitted only in a portion of the V-band, please specify the frequency range.

IEEE 802 LMSC recommends that low power indoor consumer devices should be permitted to operate in the entire V-band (i.e., the extended V-band from 57 GHz to 66 GHz as mentioned in paragraph 3.15 of the consultation).

(b) In case it is decided to permit low power indoor consumer device-to-device usages on a license-exempt basis in the entire V-band, whether the 57-64 GHz range, or the 57-66 GHz range should be considered for such usages?

IEEE 802 LMSC recommends that low power indoor consumer devices be allowed to operate in the 57 GHz to 66 GHz spectrum (extended V-band) on a license-exempt basis.

This allocation would enable a growing number of applications that rely on the millimeter wave spectrum, and would also advance frequency sharing and co-existence between various technologies based on the family of IEEE 802 standards.

In addition to operation in the 57 GHz to 66 GHz range we requested, we recommend that TRAI allocate the entire 57 GHz to 71 GHz band for license-exempt operation of low power indoor devices. Most global regulators including the FCC, Ofcom, and ACMA have allocated the entire 57 GHz to 71 GHz band for such operation.

(c) What should be the carrier size/ channel bandwidth?

We recommend the carrier size/channel bandwidth following the channelization plans as provided in IEEE Std 802.11ad-2012⁷ and IEEE Std 802.11ay-2021⁸. An illustration of the channel bandwidth is shown in Figure 1 for reference.

Of note is that IEEE Std 802.11ay-2021 includes mechanisms for channel bonding and MU-MIMO technologies which results in higher transmission rates and range. Channel bonding allows up to four 2.16 GHz channels to be bonded together, which would result in much higher throughput. IEEE Std 802.11ay-2021 supports channel bonding along combined with other features such as higher number of spatial streams and higher QAM modulation results in an increase in the peak data rate from 7 Gb/s to 176 Gb/s.

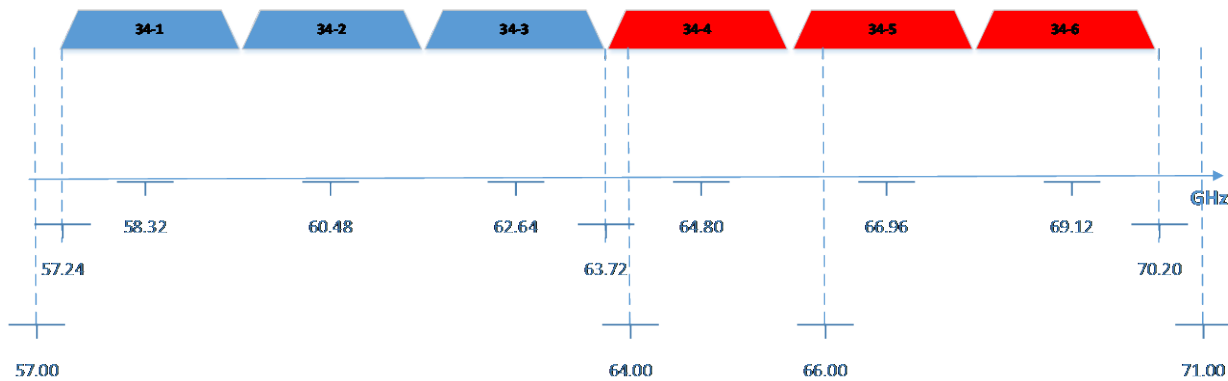


Figure 1: Channelization plan as provided in IEEE Std 802.11ad-2012 and IEEE Std 802.11ay-2021

(d) What should be the definition of indoor usages?

IEEE 802 LMSC agrees with Ofcom’s definition of “indoor”. Ofcom’s definition of indoor states:

“Indoor” means inside premises which: (i) have a ceiling or a roof; and (ii) except for any doors, windows or passageways, are wholly enclosed. For example, a tent or an open-air stadium would be considered outdoor settings.

(e) What technical parameters should be prescribed, including EIRP limits for low power indoor consumer device-to-device usages? Kindly provide a detailed response with justifications and international scenario.

IEEE 802 LMSC recommends that TRAI adopt technical rules for indoor devices to be consistent with the FCC Part 15.255 rules⁹. These technical parameters offer the most flexibility and are forwarding looking to enable future applications. Most major global regulators have adopted the same or similar rules.

⁷ “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 3: Enhancements for Very High Throughput in the 60 GHz Band,” in IEEE Std 802.11ad-2012 (Amendment to IEEE Std 802.11-2012, as amended by IEEE Std 802.11ae-2012 and IEEE Std 802.11aa-2012), vol., no., pp.1-628, 28 Dec. 2012, doi: 10.1109/IEEESTD.2012.6392842.

⁸ “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 2: Enhanced Throughput for Operation in License-exempt Bands above 45 GHz,” in IEEE Std 802.11ay-2021 (Amendment to IEEE Std 802.11-2020 as amendment by IEEE Std 802.11ax-2021), vol., no., pp.1-768, 28 July 2021, doi: 10.1109/IEEESTD.2021.9502046.

⁹ See Code of Federal Regulations, 47 CFR 15.255 -- Operation within the band 57-71 GHz, <https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-15/subpart-C/subject-group-ECFR2f2e5828339709e/section-15.255> [Last accessed: 21 June 2025].

Therefore, we recommend adopting rules that limit the average power density of any emission in this band to $9 \mu\text{W}/\text{cm}^2$ and the peak power density to $18 \mu\text{W}/\text{cm}^2$, measured at a distance of 3 meters from the radiating structure. These average and peak power density limits are equivalent to average and peak EIRP limits of 10 W (40 dBm) and 20 W (43 dBm), respectively. The rules also limit the peak transmitter conducted output power of 60 GHz license-exempt devices to 500 mW.

Q31. Whether there is a need for permitting “outdoor” usages of V band on a license-exempt basis? Kindly provide a detailed response with justification and international scenario.

IEEE 802 LMSC recommends that outdoor usage be permitted not only the entire extended V-band (57 GHz to 66 GHz) but also extended up to and including 71 GHz on a license-exempt basis.

The outdoor usage includes short-range point-to-point systems intended to extend the reach of fiber optic networks by providing service to adjacent structures, provide broadband backhaul links between cellular networks base stations, or interconnect buildings in campus environments.

Allowing license-exempt outdoor operation would provide an opportunity to unleash the 60 GHz band’s potential as a vehicle for truly competitive, very high-speed internet service and gigabit private network applications that can be offered to the public at highly economical price points while also furthering the availability of broadband connectivity to the consumer.

Most major global regulators have allowed license-exempt outdoor operation in the 57 GHz to 71 GHz frequency band.

Q32. If the response to the Q31 is in the affirmative, whether it is feasible to allow outdoor usages on a license-exempt basis in the V-band in parallel to the use of the spectrum by telecom service providers for the establishment of terrestrial networks in a part or full V-band? Kindly provide a detailed response with justification and international scenario.

IEEE 802 LMSC believes that both private and public networks can operate in parallel in the same band. Given the architecture of point-to-point implementations, we do not expect implementations by multiple users including the telecom service providers to cause harmful interference to each other or to other authorized users.

Q33. In case it is decided to allow outdoor usages on a license exempt basis in the V-band (57-64/ 66 GHz), -

(a) Should it be permitted in the entire V-band or only in a portion of the V-band? If it should be permitted only in a portion of the V-band, please specify the frequency range.

IEEE 802 LMSC recommends that license-exempt outdoor use to not only the entire extended V-band (57 GHz to 66 GHz) but also extended up to and including 71 GHz.

(b) In case it is decided to permit outdoor usages on a license-exempt basis in the entire V-band, whether the 57-64 GHz range, or the 57-66 GHz range should be considered for such usages?

IEEE 802 LMSC recommends that the maximum possible spectrum (i.e., 57 GHz to 66 GHz) be allocated for license-exempt outdoor use. We further recommend that the spectrum for both indoor and outdoor use be expanded up to and including 71 GHz for license-exempt use.

(c) What should be the carrier size/ channel bandwidth?

IEEE 802 LMSC recommends the carrier size and channel bandwidth to be the same as described in our response in Q30 (c).

(d) What technical parameters should be prescribed, including EIRP limits for low power indoor consumer device-to-device usages? Kindly provide a detailed response with justifications and international scenario.

IEEE 802 LMSC recommends TRAI adopt technical rules for outdoors to be consistent with the FCC Part 15.255 rules. These technical parameters offer most flexibility and are forwarding looking to enable future applications.

We recommend TRAI adopt an average EIRP limit of 82 dBm and a peak EIRP limit of 85 dBm, in each case minus 2 dB for every dB that the antenna gain is below 51 dBi, for 60 GHz devices using very high gain antennas that are located outdoors. We believe that the higher emission limits for antennas located outdoors will facilitate the use of longer range 60 GHz devices in wireless applications without causing harmful interference to authorized radio services in this band or disrupting the operations of other devices, including indoor Wireless Personal Area Networks (WPAN) systems that currently use this band. We believe that these rules will enhance the value of the 60 GHz band as a vehicle for delivering broadband, particularly the high capacity backhaul required for 5G wireless service and beyond. Further, it will afford 5G and other broadband providers greater operational flexibility at lower cost by allowing them to use license-exempt devices for backhaul, reserving licensed spectrum for other uses, thereby promoting spectrum efficiency.

Q34. Any other suggestions relevant to the assignment of the spectrum in E-band (71-76/ 81-86 GHz) and V-band (57-64/ 66 GHz) may kindly be made with detailed justifications.

IEEE 802 LMSC strongly recommends that TRAI expand the proposed license-exempt allocation from 57 GHz to 64/66 GHz range, to 57 GHz to 71 GHz range. The expanded spectrum would increase the number of 2.16 GHz channels from 3/4 to 6 channels, which would serve to deliver much higher throughput. Using channel bonding and higher QAM modulation based on the IEEE Std 802.11ay-2021 can increase the data rates from 7 Gb/s to 176 Gb/s. The resulting peak data rates in Wi-Fi CERTIFIED WiGig™ devices expands and enhances the Wi-Fi experience in applications including virtual reality, multimedia streaming, gaming, wireless docking, and enterprise applications that require high speed, data-intensive connections.

Regarding the E-band, IEEE 802 LMSC recommends that TRAI allow both governmental as well as non-governmental use of the spectrum. TRAI can consider establishing service rules to promote non-governmental development and use of the millimeter wave spectrum in the 71 GHz to 76 GHz and 81 GHz to 86 GHz bands on a shared basis with government operations. Further, we recommend TRAI to adopt a flexible and innovative regulatory framework for the 71 GHz to 86 GHz bands that allows for the issuance of an unlimited number of non-exclusive, nationwide licenses to non-governmental entities for commercial use to facilitate the provision of wireless

backhaul for 5G (and beyond), as well as the deployment of broadband services to aircraft and ships, while protecting incumbent wave spectrum for a myriad of innovative services by commercial industry. Taking advantage of the highly directional signal characteristics of these bands would permit the co-existence of multiple types of deployments.

In general, we recommend TRAI to consider the FCC's rule making *Report and Order*, FCC 03-248¹⁰, adopted on October 16, 2003, for reference.

Lastly, the IEEE 802.11 Working Group has begun work on IEEE P802.11bq¹¹ dedicated to enhancing the specification of millimeter Wave operation for WLAN connectivity, with the target of specifying frequency operation between 42.5 GHz and 71 GHz and defining integration with the multi-link operation framework specified by IEEE Std 802.11be-2024. The 40 GHz to 50 GHz bands may therefore be of relevance for the WLAN ecosystem and we recommend TRAI to investigate this option.

Conclusion

IEEE 802 LMSC thanks TRAI for the opportunity to provide this submission and respectfully requests to consider our responses provided in this document.

Respectfully submitted

By: /ss/.

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¹⁰ See <https://docs.fcc.gov/public/attachments/fcc-03-248a1.pdf> [Last accessed: 21 June 2025].

¹¹ See IEEE 802.11 Working Group: Status of IEEE 802.11 Integrated Millimeter Wave TG, https://www.ieee802.org/11/Reports/tgbq_update.htm [Last accessed: 21 June 2025].