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

Draft Response to India TRAI's consultation re TeraHertz				
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This contribution proposed a response to Telecom Regulatory Authority of India (TRAI)'s consultation "Consultation Paper on Open and De-licensed use of Unused or Limited Used Spectrum Bands for Demand Generation for Limited Period in Tera Hertz Range"

Electronic filing November 15, 2023

Re: Consultation Paper on Open and De-licensed use of Unused or Limited Used Spectrum Bands for Demand Generation for Limited Period in Tera Hertz Range

Dear Shri Akhilesh Kumar Trivedi, Advisor (Network, Spectrum & Licensing)

IEEE 802 LAN/MAN Standards Committee (IEEE 802 LMSC) thanks Telecom Regulatory Authority of India (TRAI) for issuing the consultation "Consultation Paper on Open and De-licensed use of Unused or Limited Used Spectrum Bands for Demand Generation for Limited Period in Tera Hertz Range" and for the opportunity to provide feedback.

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 about 400,000 members in over 160 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 world-wide. 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].

Please find below the comments of IEEE 802 LMSC on Question 3 "Whether there is a need for permitting license-exempt operations in any other bands in the 95 GHz to 3 THz frequency range? Please provide a detailed response with justification".

Recommend to permit license-exempt operations between 252 GHz and 450 GHz

IEEE 802 LMSC recommends TRAI to allow license-exempt operations between 252 GHz and 450 GHz.

IEEE 802 LMSC has been working on TeraHertz (THz) Communications since 2008, when an Interest Group (IG) THz was formed in the IEEE 802.15 Working Group for Wireless Specialty Network, followed by transitioning the Interest Group to the current IEEE 802.15 Standing Committee THz (SC THz). A project initiated as a result of the activities of the IEEE 802.15 IG THz group produced IEEE Std 802.15.3d™-2017 in 2017 - an amendment to IEEE Std 802.15.3™-2016, which defines physical layer (PHY) at the frequency range between 252 GHz and 325 GHz for switched point-to-point links and defines two PHY modes that enables data rates of up to 100 Gb/s using eight different channel bandwidths between 2.16 GHz and 69.12 GHz. Applications targeted with this standard comprise wireless backhaul/fronthaul links, wireless links

[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.

in data centers as well as short-range applications such as kiosk downloading, intra-device and close-proximity communication. In 2022, IEEE 802 LMSC initiated a project to revise IEEE Std 802.15.3™-2016, which includes the integration of amendment IEEE Std 802.15.3d™-2017 into the main standard IEEE Std 802.15.3™-2016 as well as an extension of the channel plan up 450 GHz covering the spectrum, that has been identified for the use of THz communications by the World Radiocommunications Conference (WRC) 2019 in Radio Regulation (RR) No. 5.564A. The 137 GHz of identified spectrum comprises the bands 275 GHz to 296 GHz, 306 GHz to 313 GHz, 318 GHz to 333 GHz, and 356 GHz to 450 GHz. The draft standard of this project, namely, IEEE Std 802.15.3™-2023, has been approved by the IEEE Standards Association and it will soon be published.

Use cases supported by IEEE Std 802.15.3-2023

The THz PHY of the standard defines a wireless switched point-to-point physical layer operating at PHY data rates of 100 Gb/s with fallback solutions at lower data rates. The standard provides low complexity, low cost, low power consumption, and high data rate wireless connectivity among devices. The supported data rates are expected to satisfy a set of consumer multimedia industry needs, and to support emerging wireless switched point-to-point applications. Five use cases supported by this standard are shown below and the detailed information is provided in the Application Requirement Document[2].

- Intra-device communication
- Close proximity P2P applications (e.g. kiosk downloading and file exchange)
- Wireless backhaul/fronthaul
- Data centers
- Touchless gate systems[3]

Technical requirements for the THz PHY in IEEE Std 802.15.3-2023

The requirements to define a wireless switched point-to-point physical layer operating at a nominal PHY data rate of 100 Gb/s with fallbacks to lower data rates as needed in terms of minimum data rates, required bit error rate (BER), and required transmission distances depending on the specific use cases are shown in Table 1. For specific configurations as defined in the standard, data rates even beyond 100 Gb/s are possible.

Table 1 Required performance for different use cases

Use case	Minimum Data Rate in Gb/s	Required BER after error correction	Required Transmission Distance (m)
Intra-Device Communication	1	10^{-12}	0.03
Close Proximity Communication	1	10^{-6}	0.1
Wireless Fronthauling[4]	10	10^{-12}	200
Wireless Backhauling	10	10^{-12}	500
Wireless Data Center	1	10^{-12}	100

[2] See https://mentor.ieee.org/802.15/dcn/14/15-14-0304-16-003d-applications-requirement-document-ard.docx

[3] This use case was standardized using 60 GHz band and published as IEEE Std 802.15.3e™-2017. See IEEE Xplore https://ieeexplore.ieee.org/document/7856917

[4] 10 Gb/s is the maximum data rate available today in CPRI. Hence, this shall be the minimum data rate targeted in the standard.

The standard also complies with regulatory requirements taking into account the specific situation for carrier frequencies beyond 275 GHz. However, IEEE 802 LMSC would recommend that devices based on the IEEE Std 802.15.3™-2023 be allowed to use the whole operational frequency range, 252 GHz to 450 GHz. The channel arrangement in the IEEE Std 802.15.3™-2023 is provided in the Channel Plan document[5]. Further information on technical requirements is provided in the Technical Requirement Document[6].

Conclusion

IEEE 802 LMSC thanks TRAI for the opportunity to provide this submission and commends the TRAI's leadership in opening THz bands for license-exempt operations. IEEE 802 LMSC respectfully requests TRAI to consider our requests in opening 252 GHz to 450 GHz frequency band for license-exempt operations.

Respectfully submitted

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[5] See https://mentor.ieee.org/802.15/dcn/22/15-22-0414-00-03ma-ieee802-15-3ma-channel-plan.xlsx
[6] See https://mentor.ieee.org/802.15/dcn/14/15-14-0309-20-003d-technical-requirements-document.docx