DG/COAI/2023/567

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Mahanagar Doorsanchar Bhawan,
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Subject: COAI Response to the TRAI 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 Sir,

This is with reference to the TRAI 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" released on September 27, 2023.

In this regard, please find enclosed COAI Response to the Consultation Paper.

We hope that our submission will merit your kind consideration and support.

With Regards,

Yours faithfully,

Digitally signed
by Lt. Gen Dr. SP
Kochhar
Date: 2023.11.29
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COAI Response on 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

At the outset, we thank the Authority for providing us the opportunity to share the response to this 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."

A summary of our submission is as follows:

1. **No part of any of the spectrum bands including the spectrum bands under discussion in this CP should be considered for delicensing.**

2. **The Experimental and Technology trial licenses and Demonstration licenses prescribed by DoT in 2019 are sufficient for such requirements, even for the Tera Hertz frequencies.**

3. **There is no need for separate experimental license for any frequency band, including THz bands.**

Our Issue -Wise response is as below:

Q1. Whether there is a need for permitting license-exempt operations in 116-123 GHz, 174.8-182 GHz, 185-190 GHz, and 244-246 GHz frequency ranges? Please provide a detailed response with justification.

Q2. In case it is decided to permit license-exempt operations in 116-123 GHz, 174.8-182 GHz, 185-190 GHz, and 244-246 GHz frequency ranges, what should be the terms and conditions including technical parameters for permitting license-exempt operations in these bands, while protecting both passive and active services in and around these frequency ranges? Please provide a detailed response with justification.

Q3. 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.

COAI Response:

1. THz communications are envisioned as a key technology for 6G for 2030 and beyond. The very large available bandwidth at THz frequencies (tens of GHz and more, i.e., two orders of magnitude

more than that in the 5G systems) will drastically improve the performance of common network applications enabling Tera-IoT, Tera-IAB; whereas the very small wavelength of THz waves opens the door to the new world of nanoscale electromagnetic communications networks such as IoNT, and WiNoC.

2. Mobile Technology has advanced remarkably in the wake of transition from 4G to 5G in less than a decade and now in this era, where advent of 6G is being discussed, demand for high-frequency carriers like mmWave, has emerged and currently several international developments are in progress within these frequency bands.

3. The trends in the sub-THz and THz bands is discussed below along with remarkable national and international developments:

   a) **Advancements in THz spectrum utilization:** Advancements such as improved beamforming, ultra-massive MIMO antennas, reconfigurable intelligent surfaces (RIS), embedded AI/ML, and enhanced energy efficiency are opening the door to spectrum utilisation beyond 95 GHz. Ultra-high data rates and low latencies are being targeted by IMT-2030 (6G) which needs substantial contiguous spectrum. Frequencies ranging from 95 GHz to 3 THz hold immense potential. W band, D band (110 - 170 GHz) and H/J band (220 - 330 GHz) are being explored by OEMs for backhaul as these offer significant bandwidth for high throughput, low latency, high-resolution sensing and precise positioning. Also, ongoing research is focusing on innovative backhaul systems[1,2,3] in the D-Band, with active phase array antennas along with beam-steering.

   b) **Commercial prototypes in the THz bands:** ECC/REC/(18)01 for the D-Band (110 GHz to 170 GHz) and ECC/REC/(18)02 for the W-Band were published in 2018 by EU and upcoming ITU-R recommendations are aligned with ECCs. Also, commercial prototypes in the D-Band will be available in approximately 2-3 years (projected).

   c) **Evolution of the Backhaul Ecosystem:** The backhaul ecosystem is expected to evolve ahead of the low-power access equipment ecosystem. There is significant demand for backhaul capacity, in order to expedite the deployment of 5G in mmWave, where optical fiber deployment is cost-prohibitive or could lead to deployment delays.

   d) **Industry trials in D and W Band Spectrum:** The W-band alone (92–114 GHz) offers close to twice the amount of spectrum available in the E-band. In late 2020, in one of the first field trials by Ericsson[4] with pre-commercial W-band radios, it was shown that the W-band will offer similar

[1] www.graph-x-project.eu/
[2] www.h2020-dream.eu
[3] www.h2020-dragon.eu
[4] https://www.ericsson.com/en/news/2021/4/ericsson-trials-w-band-as-5g-backhaul-spectrum

performance to the E-band in terms of both hop length, availability and transport capacity. Vendors are also considering D-band[5] microwave backhaul links and have done some trials[6] .

Nokia Bell Labs has achieved a live microwave connection[7] using D-Band spectrum (130-175 GHz) - this spectrum offers significantly higher bandwidth compared to existing microwave bands and serves as an ultra-high-capacity backhaul solution in densely populated urban areas. The trial explores the potential of frequencies beyond 100 GHz to meet the growing capacity demands of mobile networks.

e) **Research in THz Bands**: The Working Party 5D (WP5D) of ITU-R and ISG THz group of ETSI are undertaking various studies to address the requirements of wireless communication in the THz bands. Furthermore, 3GPP is set to initiate work on THz communication in 2024 after these studies.

f) **IMT Deployment beyond 92 GHz:** The 'Document 5/131-E' dated 29th June 2023 from WP5D, titled *'Framework and overall objectives of the future development of IMT 2030 and beyond*' indicates the feasibility deploying IMT in bands above 92 GHz. Additional ITU WP5D studies have shown that extreme densification in IMT systems using frequencies above 92 GHz will significantly enhance user throughput and network capacity, by utilizing ultra-high bandwidths and massive multi-beam MIMO and will be able to support advanced services like immersive communications.

g) **Enhancement of User Throughput and Network Capacity**: According to Section 6.4.4 of the ITU draft report titled "*Updates to the Draft working document towards a preliminary draft new Report ITU-R M.[IMT. Above 100 GHz] Technical feasibility of IMT in bands above 100 GHz*", frequencies beyond 92 GHz offer the potential to significantly enhance user throughput and network capacity.

h) **'Bharat 6G Vision' of India**: The 'Bharat 6G Vision,' unveiled by the Hon'ble Prime Minister in March 2023, illustrates the importance of THz communication for high-speed indoor and outdoor applications as well as promotes extensive research in mmWave and THz communications. These studies are in their initial stages, and specific use cases are yet to be finalised. Standardisation efforts are also in pre-mature phases and there is no established device ecosystem for these frequency bands as of now. Also, one of the task force formed under The Bharat 6G, also recognize that the New Wireless Technology in the mm-Wave and TeraHertz bands is expected to provide multi-gigabit speed akin to optical systems.

[5] https://www.ericsson.com/en/reports-and-papers/microwave-outlook/articles/spectrum-in-a-dynamic-market
[6] https://www.ericsson.com/en/blog/2014/10/40-gbps-demonstrated-in-newly-developed-chipset-at-140-ghz
[7] https://www.nokia.com/about-us/news/releases/2022/04/13/nokia-demonstrates-live-d-band-microwave-backhaul-connection/

i) **Licensed Spectrum needs to be ensured for 6G and Future Applications:** In the near future**,** securing more licensed spectrum is crucial for maintaining demands of performance pertaining to 6G and its future applications. It is premature to delicense this spectrum. Any decision on the delicensing of new bands should be taken only after thoroughly conducted technical, demand and impact studies. Therefore, flexibility and potential alignment with international regulatory bodies should be maintained to build an adaptable ecosystem to benefit from global standardisation.

4. **Further, the consequences of delicensing spectrum are as below:**

   a) Irreversibility of Delicensing: Once a spectrum band is delicensed and the device ecosystem is established, reversal of the same becomes extremely challenging, disruptive, and often impractical as well as leveraging the spectrum bands becomes very difficult for future use cases such as IMT in the licensed telecom spectrum space due to the loss of regulatory oversight and control. Also, it may make extant investments and innovations obsolete. Further, reversing the decision may lead to legal and administrative challenges. **Therefore, delicensing should be avoided.**

   b) **Loss to Exchequer:** Delicensing at such an early stage, when the use cases for the THz bands are still evolving, may prevent the government from realising the full economic value of the spectrum, which is not in the best interests of the Indian economy.

5. Thus**, THz bands should not be delicensed in order to avoid irreversible consequences of delicensing and not to limit the deployment of IMT use cases when it is critically needed in India.**

6. **Rather, the policy goals regarding innovation and advancing research and development can be more effectively realised by granting experimental or demonstration licenses within these frequency bands to maintain flexibility in utilization of spectrum resources, consistent with the principles set forth in the guidelines for Experimental and Technology Trial Licenses, as well as for Demonstration Licenses, by DoT.**

Q4. Whether there is a need for permitting license-exempt operation in 77-81 GHz band for automotive radar applications? Please provide a detailed response with justification.

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Q5. In case it is decided to permit license-exempt operations in the 77-81 GHz band for automotive radar applications, what should be the terms and conditions including technical parameters for permitting licensed-exempt operations in this frequency band? Please provide detailed response with justification.

COAI Response:

1. The spectrum in the 76-77 GHz range is currently delicensed for short-range radar systems and there is no well-defined demand from the existing user group in India for additional spectrum within 77-81 GHz pertaining to the development of Advance Driver Assistance Systems (ADAS). The characteristics of the applications enabled by this band are well accommodated with the existing allocation.

2. The E-band (71-76/ 81-86 GHz), adjacent to the 77-81 GHz band is vital for mobile backhaul, and its importance is growing with the deployment of 5G and its upgrades. As a result, access to this band for backhaul operations will be crucial in the near future, and thus its operation should be kept free of harmful interference.

3. ITU has conducted a study[8] that has found potential adverse implications of using vehicular radars in the 76-81 range in E-band in some cases. The study identified practical scenarios which result in interference levels above the threshold and additional studies are recommended in order to investigate ways to optimize coexistence of both services.

4. Further, the 77-81 GHz frequency band, also known as the "77 GHz band," is primarily allocated for several types of applications in the field of radio communication and radar systems. It is important to recognise that the pursuit of a license-exempt approach for one specific user group within a shared spectrum could potentially have adverse implications for the broader community of users. The spectrum is a valuable and finite resource, and efficient allocation is crucial to ensuring equitable access and sustainable growth for all stakeholders.

5. **We reiterate our submissions that there is no case for license exempt use of any spectrum, further, license-exempt model exclusively for one user may inadvertently create an uneven playing field, impacting the potential for growth and innovation among other users and should be avoided**.

6. Furthermore, delicensing is an irreversible process with long-term implications. Reversal of such a decision can be complex and may inadvertently limit the opportunities for other licensed use cases, including IMT, which plays a pivotal role in the efficient utilisation of spectrum resources.

7. **Thus, we submit that the 77-81 GHz band should not be delicensed, rather, the existing regulatory framework should be maintained for continued proper and efficient utilisation of this spectrum.**

Q6. Whether there is a need to open the frequency spectrum between 95 GHz to 3 THz for experiment and demonstration of equipment designed to operate on any frequency above 95

[8] Compatibility between point-to-point applications in E-band between fixed services and automatic radar (itu.int)

GHz through a separate experimental license? Please provide a detailed response with justification.

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Q7. In case it is decided to open the frequency spectrum between 95 GHz to 3 THz for experiment and demonstration of equipment designed to operate on any frequency above 95 GHz through a separate experimental license –

(a) what should be the terms and conditions under such a license? Kindly provide inputs in respect of, inter alia, the following aspects for the proposed separate experimental license:

i. **Purpose of the license;**
ii. **Scope of the license;**
iii. **Eligibility conditions for entities seeking to acquire the license;**
iv. **Mode of applying for the license;**
v. **Duration of the license;**
vi. **Obligation under the license;**
vii. **Financial conditions including the license fees;**
viii. **Technical conditions and other terms and conditions for operations under the license;**
ix. **Mechanism to ensure protection to passive services in the frequency range between 95 GHz to 3 THz; and Any other (please specify).**

(b) whether the licensees should be permitted to market experimental devices designed to operate in the frequency range between 95 GHz to 3 THz via direct sale? If yes, what should be the associated terms and conditions? Please provide a detailed response with justification.

COAI Response:

1. It is pertinent to note that there is a wide requirement of emerging new radiocommunications technologies. To promote R&D activities for IMT services in the country, specifically for technologies beyond 5G, permitting experimental usage for such spectrum for small duration can be considered.

2. This will help to serve multiple purposes i.e., to increase awareness of various specific applications among users and stakeholders, stimulate local R&D ecosystem to develop innovative applications tailored to Indian needs, help local TSPs better understand technology and business models, encourage OEMs to better target various applications for local needs etc. This will facilitate innovation and relevant research activities in THz communication; for the same experimental licenses for the spectrum in 95 GHz to 3 THz may be given to interested organisations. **Delicensing a band just for experimental purposes does not serve the objective of R&D. Further, in the long term, the utility and application of the frequency bands should be clearly assessed.**

3. The THz range offers exciting possibilities, but it also presents challenges, such as limited propagation distances due to the absorption and scattering of THz waves in the atmosphere. Therefore, applications within this range are often short-range or focused on specific use cases such as data transfer, astronomy, imaging and sensing, semiconductor characterization, medicine and healthcare, remote sensing etc.

4. DoT on July 23, 2019, had notified detailed guidelines pertaining to Experimental and Technology trial licenses, as well as Demonstration licenses. These guidelines provide a robust framework for conducting experiments, trials and demonstrations utilizing the spectrum awarded under the license and can very well accommodate the R&D, experimentation, demonstration etc. aspects pertaining to the THz frequency bands. This will also maintain regulatory clarity and simplicity as no new framework is needed for the THz frequencies.

5. **Thus, we submit that there is no need for a separate experimental license for THz spectrum and the present DoT guidelines dated July 23, 2019, on Experimental and Technology trial licenses and Demonstration licenses are well-equipped to handle such requirements, including for the THz frequencies.**

6. Further, it is critical to ensure that the spirit of experimental licenses, focus on R&D and demonstration, is maintained. Otherwise, it will be tantamount to commercialisation and competition in the market, bypassing the legitimate routes of the licensed regime. For example, the 5G trials were conducted in an isolated and controlled environment by TSPs to test various use cases and network elements.

7. Further, based on TRAI's recommendations, the Government issued the guidelines for network testing before the launch of any services on a commercial basis. This meant that any service of a commercial nature had to be conducted under the proper licensing framework and the guidelines for the usage of spectrum on a commercial basis rather than under the garb of experimental licences. Such a sale, even on an experimental basis, would have resulted in the misuse of these licences and have distorted market conditions and the regulatory regime.

8. **Thus, it should not be permitted to market experimental devices designed to operate in the frequency range between 95 GHz to 3 THz via direct sale.**

Q8. Whether there are any other issues or inputs in respect of the frequency spectrum in Tera Hertz bands? If yes, please provide detailed comments with justification.

No comments**.**

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