Infineon Technologies India Private Limited
contribution to Telecom Regulatory Authority of India's (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 Shri Akhilesh Kumar Trivedi, Advisor (Network, Spectrum & Licensing):

Infineon Technologies India Pvt Ltd, an Infineon Technologies AG company, (collectively "Infineon") thanks the Telecom Regulatory Authority of India (TRAI) for issuing the "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.

Infineon Technologies AG is a global semiconductor manufacturer with a worldwide footprint of 58,600 employees, 69 research and development centres, and 17 manufacturing facilities. Infineon Technologies India Pvt ltd regional headquarters is in Bangalore, Karnataka. Infineon's mission is to make life easier, safer, and greener across a broad platform of daily activities. By way of illustration, Infineon develops unobtrusive, intuitive technology capable of delivering innovative solutions, including radar and 3D sensors that enable enhanced gesture control, reliable and sophisticated monitoring and tracking, and 3D augmented/virtual reality technologies. This means Infineon helps to connect the real and digital world, which allows users to interact seamlessly with objects in use every day. Infineon is also a leader in automotive safety and power semiconductors that contribute to a smarter, cleaner, and safer future. The company endeavours to make automobiles safer by providing sensor solutions to protect drivers and passengers inside the vehicle, and pedestrians and cyclists outside the vehicle. Infineon's applications also better safeguard public identities and data, and contribute to clean generation of electricity from solar and wind energy. In addition, Infineon provides microelectronics that improve the energy efficiency of industrial and consumer devices.

INFINEON'S EXPERIENCE IN RADAR DEVICE DEVELOPMENT & REGULATION

Infineon has a long history in radar device development and high-volume production. Radar devices at 77/79 gigahertz (GHz) for collision mitigation (CM), parking aid (PA) and at 24 GHz for blind spot detection (BSD), lane change assistance (LCA) and rear cross traffic alert (RCTA) have been developed and shipped to the market in very high volumes for many years. Infineon also has a long record of accomplishment in development and delivery of 60 GHz Radar devices and the respective system reference solutions to the consumer and automotive markets.

Since 2020 Infineon has supported radar regulatory activities at the Association of Radio Industries and Businesses (ARIB) in Japan (ARIB STD T73 V3.0[1]), and together with other leading companies like Google, Amazon, IEE, TI, Garmin, Vayyar, Qualcomm, Intel and META as WiGig representatives, the latest 60 GHz regulatory activities in America.

EXCECUTIVE SUMMARY

Infineon respectfully requests the Telecom Regulatory Authority of India (TRAI) to designate the 60 gigahertz (GHz) band as an open, licensed free band for short range devices, especially for field disturbance sensors/radar and high bandwidth communications. Additionally, we request that TRAI harmonize the use of the 57 – 71 GHz frequency band internationally.

The technical operating conditions for short-range devices in general, and for 60 GHz field disturbance sensors/radar devices in particular, have been a matter of regulatory activity in many jurisdictions. By verifying and adopting the terms for Radiolocation indicated in this letter, the TRAI can facilitate the deployment of many advanced and innovative radar applications and communications technologies to Indian citizens and enterprises generating new and critical applications for Indian society.

[1] https://www.arib.or.jp/english/std_tr/telecommunications/desc/std-t73.html

TABLE OF CONTENTS

TARGET USE CASES OF 60GHZ RADIOLOCATION

60 GHz Radar enables new applications affecting all market segments like consumer, industrial, automotive and smart homes. The following innovative radar applications are already available or in development:

- *Health and wellness monitoring (e.g., reading vital signs, detecting falls by the elderly)*
- *Sleep monitoring*[2][3]
- *Presence Sensing*
- *Interactive motion sensing, e.g. gesture sensing*[4] *in a wide range of potential contexts that will enhance accessibility and usability of various technologies but also gaming.*
- *Monitoring and surveillance*
- *Collision avoidance for robots (e.g., robot vacuum cleaner)*
- *Measuring speed of moving objects*
- *Fall detection (e.g., for elder care facilities/hospitals)*
- *Material and object classification*
- *Level metering and characterization of defects in materials (material quality analysis e.g. air pockets)*

For automotive applications, there are many useful 60 GHz radar use cases for improving the passenger comfort and security of a vehicle, including:

- *Life-saving motor vehicle applications e.g. LBC (left behind child) detection*[5]*, rear seat occupant detection*
- *Driver Monitoring for Vitals*
- *Passenger occupancy detection*
- *Theft and vandalism protection monitoring*
- *Door alert for obstacle detection*
- *Obstacle detection*
- *Door blocking control*
- *Smart trunk opener*
- *Gesture interactivity with vehicle*

All radar applications will sense movement of people and animals within a vehicle cabin to perform safety functions like detecting children or pets left behind in hot or cold cars. Leading automakers as members of the Alliance of Automobile Manufacturers and the Association of Global Automakers (now

[2] https://support.google.com/googlenest/answer/10357288?hl=en&co=GENIE.Platform%3DAndroid
[3] https://www.mobihealthnews.com/news/fcc-gives-amazon-greenlight-use-radar-monitoring-sleep
[4] See https://blog.research.google/2020/03/soli-radar-based-perception-and.html
[5] See https://www.continental.com/en/press/press-releases/20211013-cabin-sensing/

merged into the Alliance for Automotive Innovation[6]), entered into a voluntary agreement in September of 2019 for "Rear seat reminder systems" to become a standard by 2025 (See Alliance of Automobile Manufacturers, Inc., Association of Global Automakers, Inc.).[7] Infineon's radar (along with others) will allow automakers to keep that commitment.[8]

Further, a touchless control, or gesture-based system (automotive gesture recognition), that is based on 60 GHz radar sensors, will enable vehicle operators to fully focus on the road while being able to use simple motions to answer calls or operate navigation to reduce the probability of distraction-related accidents.[9] In addition, the 60 GHz radar sensors are able to detect macro and micro motions of occupants and interact with the body to sense certain aspects of an occupants' physical condition. By sensing certain critical aspects of the driver's physical condition, radar sensors will support drivers making prudent decisions while operating a vehicle, for example, due to fatigue, such as whether to take a break or change drivers. Moreover, these sensors can be used in occupancy sensing systems for seat belt reminder functions,[10] or systems that optimize airbag deployment based on seating position and occupant types (i.e. related to passenger size and indirectly to age – child or adult).[11] In short, appropriate sensing systems inside the car can reduce accidents and save lives.

U.S. Federal Communications Commission ("FCC") Chair Jessica Rosenworcel highlighted this new state of coexistence and the innovative applications it will produce, stating:

> ***"Welcome to the radar revolution'…All of this is possible—and our work here today is a big reason why. In this decision, we are updating our approach to the 60 GHz band. We are modernizing it so that it can be used to its full potential. That means expanding mobile operations for radar technology, increasing where and how it can be used. So get ready to see new augmented reality and virtual reality applications and a whole lot of other high-speed, data-intensive innovative activities in this band."***[12]

---

[6] See https://www.autosinnovate.org/press-release/auto-industry-trade-associations-unite-forming-unified-voice-on-critical-auto-policy-issues-and-championing-innovation/

[7] See "Leading Automakers' Commitment to Implement Rear Seat Reminder Systems" (Sept. 2019), available at https://autoalliance.org/wp-content/uploads/2019/09/Rear_Seat_Reminder_System_Voluntary_Agreement_September_4_2019-1.pdf

[8] https://www.fcc.gov/ecfs/document/10601238325349/1

[9] *See* Pankaj Singh, Electronic Design, "Automotive Gesture Recognition – The Next Level in Road Safety (Mar. 6, 2019), available at https://www.electronicdesign.com/markets/automotive/article/21807672/automotive-gesture-recognitionthe-next-level-in-road-safety.

[10] European Transport Safety Council, "Seatbelt reminders on every car seat from 2019" (Aug. 23, 2018), available at https://etsc.eu/seatbelt-reminders-on-every-new-car-seat-from-2019/.

[11] These sensors also enable automation of passenger comfort functions

[12] https://www.fcc.gov/document/fcc-empowers-short-range-radars-60-ghz-band/rosenworcel-statement-0

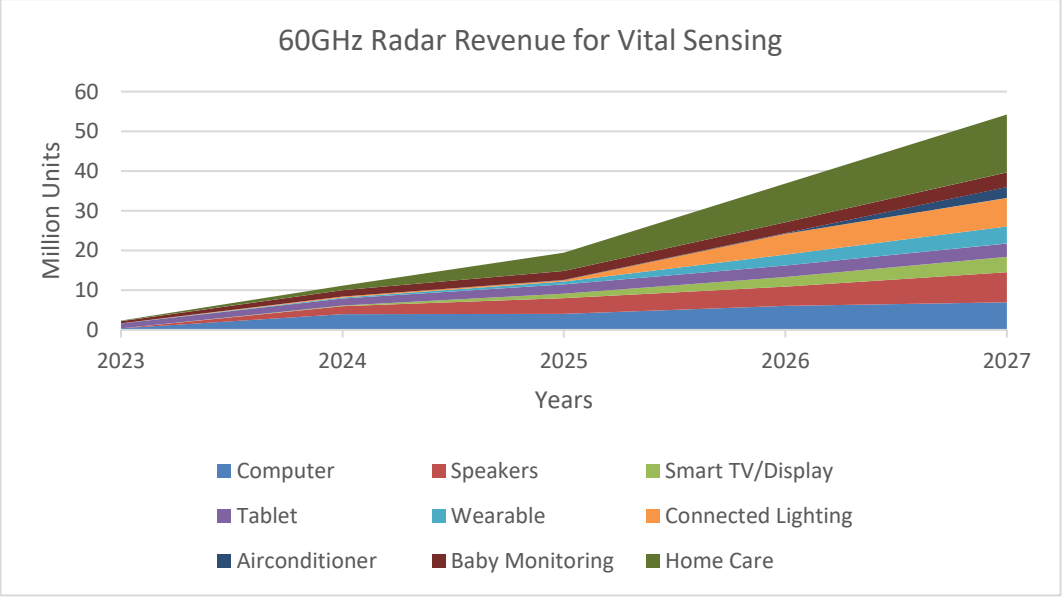
The manifold applications for radar sensors to improve the living standards of our society drives the use of the 57 GHz to 64 GHz band. Many countries have adopted clear rules for this band, and many others are considering action to harmonize the regulatory treatment of it. The most recent action adopted in the United States will allow coexistence between these critical radar applications and high bandwidth communications technology.

60 GHz RADAR MARKET

The global market for 60 GHz radar solutions is valued to $150 million in 2024; $100 million of that is expected for the smart home and Internet of Things (IoT) segment, and another $50 million for automotive applications. The global 60 GHz radar market is projected to reach $650 million by 2028, registering a compound annual growth rate (CAGR) of around 29% from 2024 to 2028 (Source: Infineon Market Model).

A rise in smart home and IoT adoption, especially in economically emerging nations, is a key factor that drives the growth of the global radar market. In addition, increased demand for high-end passenger cars, rise in concerns about vehicle & driver safety, and implementation of safety regulations contributes toward the growth of radar demand.

The following chart illustrates the market growth for 60 GHz vital sensing (million units) implemented as a new feature in different end-user applications.



The prominent factors that impact the radar market growth are increased demand for radar systems in automotive & smart home, IoT industry, advancement in radar technology (system on chip), and a harmonized worldwide radar regulation. Deployment of lightweight radars in aerial vehicles is expected to create lucrative opportunities for the market. Each of these factors is likely to have an impact on the growth of the global radar market.

REGULATION STATUS

Based on intensive interference tests and technical discussions between representatives from the Wireless Gigabit Alliance (WiGig Alliance) -- Qualcomm, Intel, META, and radar representatives -- Google LLC, Amazon, Continental, Texas Instruments, IEE, Garmin International, Vayyar and Infineon Technologies, an improved parameter set for 60 GHz operations was defined and eventually adopted by the FCC.[13]

A) FCC Final Rules for disturbance sensors/radars

In May of 2023 the U.S. FCC adopted new rules for unlicensed operation in the 60 GHz band. Below is an excerpt from the FCC:

Part 15 of Title 47 of the Code of Federal Regulations is amended as follows
PART 15 – RADIO FREQUENCY DEVICES[14]

The authority citation for part 15 continues to read as follows:

§ 15.255 Operation within the band 57-71 GHz.
Field disturbance sensors/radars shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:

[13] See https://www.fcc.gov/ecfs/document/102270237822648/1
[14] See https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-15/subpart-C/subject-group-ECFR2f2e5828339709e/section-15.255

(i) ***57.0–59.4 GHz:*** the peak EIRP level shall not exceed 20 dBm for indoor operation or 30 dBm for outdoor operation;

(ii) ***57.0–61.56 GHz:*** the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;

(iii) ***57.0–64.0 GHz:***

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

(B) The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors:

(*1*) As part of a temporary or permanently fixed application; or

(*2*) When being used in vehicular applications to perform specific tasks of moving something or someone, except for in-cabin applications;

(iv) A field disturbance sensor may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.

(v) ***61.0–61.5 GHz:*** For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) For pulsed field disturbance sensors/radars operating in the 57–64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window. In addition, the average integrated EIRP within the frequency band 61.5–64.0 GHz shall not exceed 5 dBm in any 0.3 µs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.

(4) The provisions in § 15.35(b) and (c) that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (c)(2) and (3) of this section.

B) European Conference of Postal and Telecommunications Administrations (CEPT) and European Telecommunications Standards Institute (ETSI) –
Regulation and Standardization of Short-Range Devices (SRDs) in European Countries

For SRDs (radars) operating within the 57-64 GHz band the regulation for Europe is defined under the CEPT Document: "COMMISSION IMPLEMENTING DECISION (EU) 2019/1345" from 2. August 2019. (Ref)[15] and under the CEPT document "ERC Recommendation 70-03, Subsequent amendments 10 June 2022, editorial update 17 February 2023"[16]. Technical information is listed under "ANNEX 1: NON-SPECIFIC SHORT-RANGE DEVICES" line n1 and "ANNEX 6: RADIODETERMINATION APPLICATIONS" which defines under line f4 and g3 the allowed parameters in particular for tank level probing.

The ETSI standard EN 305 550 V2.1.0.[17] with the title "Short Range Devices (SRDs); Radio equipment to be used in the 40 GHz to 246 GHz frequency range; Harmonized Standard for access to radio spectrum" defines in particular the 57 GHz – 64GHz band.

Reference:

EN 305 550 allows short range devices operating in the 57-64 GHz band and at +20 dBm average EIRP, a maximum (mean) +10 dBm transmitter conducted output power, and a mean power spectral density limit of +13 dBm/MHz EIRP. Infineon understands that EN 305 550 will shortly be revised to exclude a maximum power spectral density limit as unnecessary. Consistent with this standard, for non-specific short-range devices in the 57-64 GHz Band, EC Decision 2019/1345 sets a maximum +20 dBm (100 mW) EIRP limit for transmit power, a maximum transmit power of 10 dBm, and no power density limit.[18] Notably, nether of the Harmonized European Standards specifies a maximum duty cycle.

[15] See https://docdb.cept.org/document/845/amendments/397
[16] See https://docdb.cept.org/download/4298
[17] See https://www.etsi.org/deliver/etsi_en/305500_305599/305550/02.01.00_20/en_305550v020100a.pdf
[18] *See* EC Decision 2019/1345, line 74a, at L 212/69

SPECTRUM CHARACTERISTICS ENABLE "REASONABLE COEXISTENCE" AMONG USERS IN SHARED, UNLICENSED BANDS

The large number of identified radar applications in every market segment reflect the tremendous promise of the 60 GHz band, which possesses numerous unique characteristics favourable to facilitating innovation.

- Ample and significant deployment of multiple technological approaches.
- Substantial available bandwidth at high frequencies enables radar applications to yield fine spatial recognition and motion detection.
- The propagation characteristics at 60 GHz naturally limits coverage for both radar and communications applications to line-of-sight or to near-line-of-sight.
- Due to atmospheric absorption, 60 GHz spectrum exhibits significantly higher free-space path loss than lower and even higher adjacent frequency bands, as well as high attenuation through objects such as drywall, glass windows, etc.
- These atmospheric and real-world effects decrease the likelihood of interference between unlicensed applications, but also cast doubt on the effective use of this band for long-range licensed uses
- To effectively overcome these effects, high power consumption is required to cover larger distances which leads to a high carbon dioxide output.
- For short-range radar devices with a maximum target distance of below 20 meters air absorption is still insignificant.

Taken together, these distinctive features have sparked the imaginations of creators throughout the short-range wireless ecosystem, leading to widespread, significant, and sustained interest from a variety of industry stakeholders to develop new radar and communications systems and applications. This includes a host of current and anticipated radar use cases from lifesaving detection systems in cars, to health and wellness monitoring, and enhancements to device accessibility and usability.

Like other unlicensed spectrum bands, the 60 GHz band should allow the support of different technologies coexisting with each other, without a preferential treatment for a single technology. A host of current and prospective innovations should have the opportunity to capitalize on the 60 GHz band's favourable characteristics. To that end, the TRAI rules should not license the 60 GHz band to only one interest group or favour one unlicensed technology over any another. In particular, modified 60 GHz rules should be consistent with existing worldwide regulations to allow a worldwide harmonization and a reasonable spectrum sharing and coexistence for devices operating in unlicensed spectrum bands.

The concept of “reasonable coexistence” should be TRAI’s lodestar in adopting 60 GHz rules. A wide range of devices and use cases should be able to operate on 60 GHz airwaves within the band. As in other unlicensed bands, operators of these devices should not be able to reserve channels for their exclusive use or expect rules that have the same effect has many stakeholders interested to use this band for as the 57 GHz to 71 GHz band and particularly the 57 GHz to 64 GHz different radiolocation and communication applications.

REQUEST

Considering all the above, Infineon joins with many interested companies around the world that are innovating today in the 60 GHz band. Beyond the many radar use cases listed above, many more are unknowable at this time, but the trend line for use of this band for innovative applications continues upward. This diversity of devices and applications serves the public interest. Without unlicensed access to this band, the result could limit the Indian and multinational companies that are developing and doing R&D on global technologies. Delay in unlicensed access could result in late technological developments in important areas of sensing and communication.

Therefore, we request that the Telecommunications Standards Development Society India (TRAI) kindly to:

- Designate the frequency band 57 GHz to 64 GHz as an open, license-free band and do not license the frequency band to only one interest group like the telecommunications industry
- Review the changes above made by the FCC to Section 15.255 of the agency’s rules (47 C.F.R. § 15.255) through the Report and Order and adopt conforming changes as appropriate and applicable.

Respectfully Submitted,

Mamta Abichandani
Mobile: +91 9811168602
Email: Mamta.Abichandani@infineon.com
……..
Infineon Technologies India Pvt ltd.