

**CONSUMER PROTECTION ASSOCIATION
HIMMATNAGAR
DIST. : SABARKANTHA
GUJARAT**



**Comments
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**

Introduction ;

The open and de-licensed use of unused or limited used spectrum bands in the terahertz (THz) range offers several significant advantages, leading to various benefits and opportunities:

1. Promoting Innovation and Research:

Research Opportunities: Researchers and scientists can explore new technologies and applications within the THz range, driving innovation in fields such as communication, imaging, spectroscopy, and sensing.

Experimentation: De-licensing encourages experimentation, allowing researchers to test theories and prototype devices without the financial burden of acquiring licenses. This fosters breakthroughs in THz technology.

2. Encouraging Entrepreneurship:

Startup Ecosystem: De-licensing THz spectrum bands can stimulate the growth of startups and small businesses, encouraging entrepreneurs to develop THz-based products and services.

Lower Entry Barriers: By removing licensing costs, entrepreneurs have lower entry barriers, encouraging them to invest in innovative THz applications and explore market opportunities.

3. Facilitating Academic and Educational Initiatives:

Academic Research: Universities and research institutions can conduct experiments and develop educational programs focused on THz technologies, nurturing a skilled workforce for the future.

Educational Projects: Students can engage in practical projects, gaining hands-on experience in THz technology, which is essential for their professional development.

4. Supporting Prototyping and Proof of Concept:

Prototyping: De-licensing enables inventors and researchers to create prototypes and proof-of-concept devices, which are vital steps in technology development before commercialization.

Innovation Hubs: Establish innovation hubs and labs where inventors and innovators can collaborate, fostering creativity and accelerating the development of THz applications.

5. Encouraging Global Collaboration:

International Collaboration: De-licensing THz spectrum bands encourages international collaboration in research and development, enabling global partnerships and the exchange of knowledge and expertise.

Standardization Efforts: Collaborative international efforts can contribute to standardizing THz technologies, facilitating interoperability and a unified approach to THz applications.

6. Enabling Short-Term Demand Generation:

Short-Term Projects: De-licensing for a limited period can attract short-term projects, generating demand for THz spectrum utilization. This can lead to rapid development and experimentation within a defined timeframe.

Temporary Research Initiatives: Research initiatives and academic projects with specific timelines can benefit from this de-licensed period, promoting focused exploration of THz applications.

7. Technological Advancements:

Innovative Applications: De-licensing encourages the development of innovative applications in areas such as high-speed wireless communication, medical imaging, security screening, and industrial process monitoring.

Emerging Technologies: THz technology is essential for emerging fields like quantum computing and THz electronics. De-licensing accelerates progress in these cutting-edge areas.

8. Economic Growth and Job Creation:

Economic Impact: De-licensing stimulates economic growth by fostering technology-driven industries. Job creation occurs in research, development, manufacturing, and related services, contributing to the economy.

Market Expansion: THz-based products and services can enter the market more rapidly, expanding the technology sector and creating new market opportunities.

9. Encouraging Responsible Use:

Regulatory Compliance: While de-licensed, users are still expected to adhere to technical standards and interference mitigation protocols, ensuring responsible use of the spectrum.

Safety Protocols: De-licensed users must follow safety guidelines to protect human health and the environment, ensuring responsible experimentation and deployment.

In summary, the open and de-licensed use of unused or limited used spectrum bands in the terahertz range promotes innovation, entrepreneurship, education, and economic growth. It encourages research, development, and experimentation while fostering global collaboration and technological advancements, making it a powerful catalyst for progress in the THz technology landscape.

ISSUES FOR CONSULTATION

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.

Comments : **Yes.**

The open and de-licensed use of unused or limited-used spectrum bands in the Terahertz (THz) range can offer several benefits, especially in the context of advancing technology and fostering innovation. Here are some potential advantages of allowing open and de-licensed use of these spectrum bands:

1. Promoting Innovation and Research:

Experimentation: De-licensing encourages researchers, scientists, and innovators to experiment with new technologies and applications in the THz range without the constraints of licensing fees or regulations.

Technological Advancements: Open access to spectrum bands fosters the development of cutting-edge technologies, such as THz imaging, communication, and sensing, driving innovation in various sectors.

2. Encouraging Entrepreneurship:

Startups: De-licensing enables startups and entrepreneurs to explore novel business ideas without the financial burden of acquiring expensive licenses, facilitating the growth of innovative ventures.

Rapid Prototyping: Entrepreneurs can rapidly prototype and test THz-based products and services, accelerating the commercialization of new technologies.

3. Facilitating Education and Skill Development:

Academic Research: Students and researchers in educational institutions can engage in experiments and research projects related to THz technologies, enhancing the academic environment and knowledge base.

Skill Enhancement: Access to de-licensed spectrum bands encourages students to develop practical skills in THz technology, preparing a skilled workforce for future industries.

4. Supporting Wireless Communication:

High Data Rates: THz frequencies offer the potential for extremely high data rates in wireless communication, enabling faster and more efficient data transmission for various applications, including 6G and beyond.

Relieving Congestion: De-licensing THz spectrum bands can help alleviate congestion in lower frequency bands, especially in densely populated urban areas, improving overall network performance.

5. Enabling Sensing and Imaging Applications:

Medical Imaging: THz imaging can revolutionize medical diagnostics, enabling non-invasive imaging techniques that improve the accuracy of disease detection and diagnosis.

Security Applications: De-licensing THz bands can facilitate the development of advanced security systems, including high-resolution imaging for airport security and other public places.

6. Fostering International Collaboration:

Global Research Collaboration: Open access to THz spectrum bands encourages collaboration between researchers and institutions across the globe, fostering international partnerships and knowledge exchange.

Standardization Efforts: Collaboration on de-licensed spectrum usage can drive international efforts to establish standards for THz technologies, ensuring interoperability and compatibility.

7. Economic Growth and Job Creation:

Innovation Ecosystem: De-licensing fosters a vibrant innovation ecosystem, attracting investments, startups, and skilled professionals, leading to economic growth and job creation.

New Industries: Emerging THz-based industries, such as high-speed communication, imaging, and sensing, can create new job opportunities and contribute to economic diversification.

8. Community Connectivity and Digital Inclusion:

Rural Connectivity: THz technology can bridge the digital divide by providing high-speed internet access to remote and underserved areas, enhancing connectivity and promoting digital inclusion.

Disaster Response: THz communication systems can be deployed for rapid and reliable communication during natural disasters, enabling effective disaster response and relief efforts.

It's important to note that while de-licensing spectrum bands can offer significant benefits, it also requires careful management to prevent interference with existing services and ensure responsible use of the available spectrum resources. TRAI play a crucial role in establishing guidelines and standards to facilitate the open and de-licensed use of THz spectrum bands for maximum societal benefit.

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.

Comments :

Permitting license-exempt operations in the Terahertz (THz) range while protecting both passive and active services requires careful consideration of technical parameters and terms and conditions to prevent interference and ensure coexistence. Here are some essential terms and conditions, along with technical parameters, that TRAI may consider:

1. Technical Parameters:

Transmit Power Limits: Define maximum transmit power limits for license-exempt devices operating in the THz range to prevent harmful interference with passive and active services.

Frequency Range: Clearly specify the frequency bands available for license-exempt operations within the THz range to avoid conflicts with existing services.

Spectral Masks: Implement spectral masks to limit the out-of-band emissions, ensuring that license-exempt devices do not interfere with adjacent frequency bands.

Modulation Techniques: Prescribe specific modulation techniques that minimize interference and maximize spectrum efficiency.

Antenna Gain: Limit the antenna gain of license-exempt devices to control the directionality of the transmitted signals and reduce the risk of interference.

Duty Cycle: Define duty cycle limitations to prevent continuous transmission, ensuring fair spectrum access for all users.

Geographical Restrictions: Implement geographical restrictions or dynamic frequency selection mechanisms to avoid interference with neighboring regions or countries.

2. Interference Mitigation:

Dynamic Frequency Selection (DFS): Require license-exempt devices to incorporate DFS mechanisms, allowing them to detect and avoid active services automatically.

Spectrum Sensing: Implement spectrum sensing techniques to detect the presence of active services and adjust transmission accordingly.

Database Access: Create a central database of active services and coordinate license-exempt operations based on real-time information from the database.

Coexistence Protocols: Develop coexistence protocols that enable license-exempt devices to share spectrum resources and resolve conflicts without causing harmful interference.

3. Regulatory Oversight:

Certification Requirements: Mandate certification for license-exempt devices to ensure compliance with technical parameters and interference mitigation measures.

Monitoring and Enforcement: Establish a monitoring and enforcement framework to detect and address violations promptly.

Spectrum Management Authority: TRAI should Designate a regulatory body responsible for overseeing license-exempt operations, issuing certifications, and resolving interference issues.

4. Public Awareness and Education:

Awareness Campaigns: Conduct public awareness campaigns to educate users about the limitations of license-exempt operations and the importance of avoiding interference with active services.

Training Programs: Provide training programs for manufacturers, operators, and users of license-exempt devices to promote responsible spectrum use.

5. Coordination with International Standards:

Alignment with International Standards: Ensure that technical parameters and regulations align with international standards to facilitate global harmonization and interoperability of devices.

6. Research and Development:

Funding Research: Allocate funds for research and development initiatives focused on interference mitigation techniques, spectrum sharing technologies, and innovative modulation methods to enhance the efficiency of license-exempt operations.

7. Regular Review and Update:

Periodic Review: Conduct regular reviews of technical parameters and regulations to adapt to technological advancements and emerging interference challenges.

Flexibility: Maintain flexibility in regulations to accommodate evolving technologies and market demands while ensuring interference-free coexistence.

By carefully implementing these terms and conditions, TRAI can enable license-exempt operations in the THz range, fostering innovation and technological development while safeguarding the integrity of existing passive and active services. Coordination with international regulatory bodies and ongoing collaboration with industry stakeholders are essential to achieving successful and harmonious spectrum utilization in the THz frequency bands.

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.

Comments :

The need for permitting license-exempt operations in specific bands within the 95 GHz to 3 THz frequency range depends on various factors including technological advancements, research requirements, and regulatory goals. Here are some considerations regarding the need for allowing license-exempt operations in these frequency bands:

1. Encouraging Innovation and Research:

Prototyping and Testing: Researchers and innovators may require license-exempt access to prototype and test devices operating in the THz frequency range, enabling them to experiment with novel technologies.

Scientific Research: Scientists studying THz frequencies for various applications such as imaging, spectroscopy, and communication may benefit from license-exempt bands for research purposes.

2. Fostering Entrepreneurship and Startups:

Promoting Startup Ecosystem: Permitting license-exempt operations can encourage startups to develop THz-based products and services without the financial burden of acquiring licenses initially, fostering entrepreneurship.

Innovation Hubs: Designating specific license-exempt bands within the THz range can create innovation hubs where startups and small businesses can experiment with emerging technologies.

3. Supporting Education and Skill Development:

Educational Institutions: Universities and educational institutions may require license-exempt bands for educational purposes, enabling students to gain hands-on experience and skills in THz technology.

Training Programs: Training and certification programs in THz technology can benefit from license-exempt access for practical training sessions.

4. Emerging Technologies and Applications:

THz Communication: License-exempt bands can facilitate research and development in THz communication technologies, exploring high-bandwidth, short-range communication solutions.

Security and Sensing: THz frequencies are valuable for security applications like body scanning and material analysis. License-exempt access can promote innovation in these areas.

5. Encouraging Global Research Collaboration:

International Research Initiatives: License-exempt bands can facilitate collaborative research initiatives with international partners, allowing researchers to collaborate on global projects.

Standardization Efforts: Collaborative efforts for standardizing THz technologies can benefit from international research collaborations within license-exempt bands.

6. Flexible Research Environment:

Experimentation: Researchers often need a flexible environment for experimentation. License-exempt bands provide this flexibility, allowing for a wide range of experiments and technological explorations.

Interdisciplinary Research: Interdisciplinary research projects involving THz technology can benefit from license-exempt access, encouraging collaborations between different fields of study.

7. Public Safety and Disaster Management:

Emergency Communication: THz communication systems can be explored for emergency communication and disaster management, providing high-speed data transmission in critical situations.

First Responder Networks: Research and development in THz communication for first responder networks can benefit from license-exempt access for testing and validation.

While there are clear potential benefits, it's essential to strike a balance between encouraging innovation and ensuring that existing services are protected from harmful interference. TRAI needs to carefully

evaluate the demand for license-exempt operations in specific bands within the 95 GHz to 3 THz range, considering the potential impact on both the technological landscape and the existing spectrum users. Regulatory frameworks should be designed to foster innovation while guaranteeing responsible and interference-free use of the spectrum.

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.

Comments : **Yes.**

There is a need for permitting license-exempt operation in the 77-81 GHz band for automotive radar applications. This frequency band, often referred to as the 77 GHz band, is specifically allocated for automotive radar systems in many countries around the world. Automotive radar applications, particularly in the 77-81 GHz band, are essential for modern vehicle safety features and autonomous driving technologies. Here's why permitting license-exempt operation in this band is crucial:

1. Advanced Driver Assistance Systems (ADAS):

Collision Avoidance: Automotive radar systems operating in the 77-81 GHz band are integral components of ADAS, helping vehicles detect and avoid collisions by providing accurate distance and speed measurements.

Emergency Braking: Radar-based systems enable emergency braking systems, enhancing road safety by automatically applying brakes to prevent accidents.

2. Autonomous Driving:

Sensor Fusion: Radar sensors, along with other technologies like lidar and cameras, contribute to sensor fusion in autonomous vehicles, allowing them to perceive the environment and make decisions.

Object Detection: Radar systems are capable of detecting objects in various weather conditions, making them crucial for self-driving cars navigating complex environments.

3. Road Safety and Pedestrian Protection:

Pedestrian Detection: Radar-based systems assist in pedestrian detection, alerting drivers and triggering safety mechanisms to prevent accidents involving pedestrians.

Cross Traffic Alert: Radar sensors can detect cross traffic, improving safety at intersections and reducing the risk of collisions.

4. Adaptive Cruise Control (ACC):

ACC Systems: Radar sensors enable adaptive cruise control systems, allowing vehicles to automatically adjust their speed based on the distance from the vehicle in front, enhancing highway driving safety.

5. Enhanced Vehicle Communication:

V2V Communication: Vehicle-to-vehicle (V2V) communication using radar technology enhances communication between nearby vehicles, promoting cooperative driving and reducing traffic congestion.

6. Regulatory Alignment:

Global Standardization: Many countries have harmonized their regulations to allocate the 77-81 GHz band for automotive radar applications, ensuring interoperability and global standardization.

Regulatory Support: Regulatory bodies recognize the importance of this band for automotive safety, leading to allocations and permissions for radar use.

7. Industry Development:

Industry Investment: The automotive industry invests significantly in radar technology for vehicle safety, making it a pivotal component of the automotive sector's growth and technological advancements.

8. Economic Impact:

Job Creation: The development and deployment of radar-based automotive technologies create jobs in research, development, manufacturing, and maintenance, contributing to the economy.

Market Growth: Permitting license-exempt operation in the 77-81 GHz band encourages market growth and innovation, attracting investments from both established companies and startups.

Given the critical role of radar technology in automotive safety and the global consensus on its use in the 77-81 GHz band, permitting license-exempt operation is essential to ensure the continued development and widespread adoption of advanced automotive radar applications. This supports the automotive industry's efforts to enhance road safety and drive innovation in vehicle technologies.

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.

Comments :

Permitting license-exempt operations in the 77-81 GHz frequency band for automotive radar applications requires careful consideration of terms, conditions, and technical parameters to ensure efficient and interference-free use of the spectrum. Here are some essential terms and conditions, along with technical parameters, that TRAI may consider:

1. Technical Parameters:

Transmit Power Limits: Define maximum transmit power limits for license-exempt devices operating in the 77-81 GHz band to prevent harmful interference with other services and ensure safe operation within vehicles.

Antenna Gain: Limit the antenna gain of license-exempt devices to control the directionality of the transmitted signals and reduce the risk of interference with neighboring devices.

Beamwidth: Specify the beamwidth of radar signals to avoid excessive overlap between adjacent radar devices, minimizing interference in congested areas.

Modulation Techniques: Prescribe specific modulation techniques to maximize spectrum efficiency and ensure compatibility between different radar systems.

2. Frequency Management:

Channelization: Implement channelization to divide the frequency band into discrete channels, allowing multiple radar devices to operate simultaneously without interfering with each other.

Frequency Hopping: Utilize frequency hopping techniques to minimize interference and improve coexistence among radar devices, especially in dense urban environments and highway scenarios.

Interference Mitigation: Develop protocols and mechanisms for interference detection and mitigation, enabling radar devices to adjust their operating frequency or power level in response to interference.

3. Interference Avoidance:

Dynamic Frequency Selection (DFS): Require license-exempt devices to incorporate DFS mechanisms to detect and avoid interference with licensed services or other radar devices operating in the same band.

Spectrum Sensing: Implement spectrum sensing techniques to detect the presence of other radar devices or active services, allowing adaptive adjustments to avoid interference.

4. Regulatory Oversight:

Certification Requirements: Mandate certification for license-exempt radar devices to ensure compliance with technical parameters and interference mitigation measures.

Monitoring and Enforcement: Establish a monitoring and enforcement framework to detect and address violations promptly, ensuring that devices adhere to the specified technical standards.

5. Geographical Restrictions:

Geofencing: Implement geofencing mechanisms to restrict the operation of radar devices in sensitive areas, such as airports or military installations, where interference could have severe consequences.

6. Safety Considerations:

Collision Avoidance: Develop safety protocols to ensure that radar systems in vehicles prioritize collision avoidance capabilities, even in the presence of interference or adverse conditions.

Emergency Communication: Define procedures for radar devices to communicate emergency information, ensuring the continuous operation of essential safety features.

7. Education and Awareness:

Training and Education: Provide training programs and educational materials for manufacturers, installers, and users of radar devices, promoting responsible and effective use of the spectrum.

Public Awareness: Raise public awareness about radar technology and its benefits, encouraging responsible use and cooperation among users.

8. International Harmonization:

Alignment with International Standards: Ensure that technical parameters align with international standards, facilitating global harmonization and interoperability of radar devices across different regions.

By implementing these terms and conditions, TRAI can permit license-exempt operations in the 77-81 GHz frequency band for automotive radar applications while ensuring efficient use of the spectrum and avoiding harmful interference with other services and devices. Regular updates and collaboration with industry stakeholders are essential to adapting regulations to evolving technologies and market demands.

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

Comments : **Might be consider.**

Opening the frequency spectrum between 95 GHz to 3 THz for experiment and demonstration of equipment designed to operate above 95 GHz through a separate experimental license can offer several

advantages, fostering innovation and research in the terahertz (THz) frequency range. Here are some reasons why there might be a need to consider such an approach:

1. Encouraging Scientific Research:

THz Imaging: The THz range has potential applications in imaging, including medical imaging, material characterization, and security screening. Allowing experiments can drive advancements in these fields.

Spectroscopy: THz spectroscopy is valuable in studying molecular structures and materials. Experimental licenses can facilitate research in areas like chemistry, physics, and biology.

2. Technological Advancements:

Communication Technologies: THz frequencies offer high data rates and short wavelengths, making them suitable for high-speed, short-range communication systems. Experimental licenses can promote research in THz communication technologies.

Sensing and Detection: THz frequencies are sensitive to specific molecules and materials. Research in THz sensing and detection can benefit fields such as environmental monitoring and healthcare.

3. Supporting Innovation and Startups:

Startup Ecosystem: Allowing experiments in the THz range can encourage startups to develop innovative technologies. A dynamic startup ecosystem can emerge, leading to job creation and economic growth.

Proof of Concept: Startups often require experimental licenses to demonstrate proof of concept for potential investors and partners, driving interest and funding.

4. Educational Initiatives:

Academic Research: Universities and research institutions can conduct experiments to enhance academic research in various scientific disciplines. Students can gain practical experience, fostering a skilled workforce.

STEM Education: Experimental licenses can support educational initiatives in Science, Technology, Engineering, and Mathematics (STEM) fields, inspiring students and educators alike.

5. Emerging Technologies:

Quantum Computing: THz frequencies are explored in quantum computing research. Allowing experiments can contribute to the development of quantum technologies, which have transformative potential.

Terahertz Electronics: Experimental licenses can foster research in THz electronics, including THz transistors and integrated circuits, enabling the development of advanced electronic devices.

6. International Collaboration:

Global Research Collaboration: Opening the THz spectrum for experiments can facilitate international research collaborations. Researchers from different countries can collaborate on global projects, pooling expertise and resources.

7. Regulatory Flexibility:

Encouraging Innovation: Providing experimental licenses demonstrates regulatory flexibility, encouraging researchers and innovators to explore uncharted territories without immediate commercial constraints.

Safety Protocols: TRAI can implement safety protocols and guidelines to ensure responsible experimentation, preventing potential harm to humans and the environment.

However, while there are potential benefits, it's crucial to strike a balance between encouraging innovation and ensuring that experiments are conducted responsibly, without causing harmful interference to existing services or endangering public safety. Regulatory bodies need to carefully assess the demand for experimental licenses in the THz

spectrum, considering both the potential benefits and the potential risks, and develop appropriate guidelines and oversight mechanisms to support responsible experimentation. Collaboration with international regulatory bodies and ongoing dialogue with industry and research communities are essential for shaping effective regulatory frameworks in this frequency range.

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 - what should be the terms and conditions under such a license?

Comments :

Opening the frequency spectrum between 95 GHz to 3 THz for experiment and demonstration through a separate experimental license requires careful consideration of terms and conditions to ensure responsible and interference-free use of the spectrum. Here are some key terms and conditions that TRAI may consider under such a license:

1. License Eligibility:

Research and Educational Institutions: Limit the license eligibility to recognized research institutions, universities, and educational organizations engaged in scientific and technological research.

Private Companies and Startups: Allow private companies and startups to apply for the experimental license, provided they meet specific criteria related to research and innovation.

2. Technical Parameters:

Frequency Bands: Clearly define the specific frequency bands within the 95 GHz to 3 THz range available for experimental use.

Transmit Power Limits: Set maximum transmit power limits to prevent harmful interference with existing services and ensure safety.

Spectral Masks: Implement spectral masks to limit out-of-band emissions and prevent interference with adjacent frequency bands.

Antenna Characteristics: Specify antenna parameters such as gain, beamwidth, and polarization to control the directionality of transmissions.

3. Interference Mitigation:

Dynamic Frequency Selection (DFS): Require the implementation of DFS mechanisms to detect and avoid interference with licensed services and other experimental users.

Spectrum Sensing: Implement spectrum sensing techniques to detect the presence of active services and adjust transmission frequencies accordingly.

4. Geographical Restrictions:

Geofencing: Implement geofencing mechanisms to restrict experimentation within predefined geographic areas, ensuring localized use and avoiding interference in sensitive locations.

Coordination with TRAI: Require coordination with TRAI to ensure that experiments do not interfere with critical infrastructure or essential services.

5. Safety Protocols:

Human Exposure Limits: Establish guidelines and limits for human exposure to electromagnetic fields, ensuring that experiments adhere to safety standards.

Environmental Impact: Evaluate and mitigate potential environmental impact, ensuring that experimentation does not harm natural habitats or wildlife.

6. Reporting and Monitoring:

Regular Reporting: Require license holders to submit regular reports detailing their experimental activities, including technical parameters, outcomes, and any incidents of interference to TRAI.

Monitoring and Compliance: Implement a monitoring system to ensure compliance with license conditions and technical parameters, with penalties for violations.

7. Collaboration and Knowledge Sharing:

Industry Collaboration: Encourage collaboration between license holders and industry stakeholders, fostering knowledge exchange and potential commercialization of research findings.

Research Collaboration: Facilitate collaboration between license holders and academic institutions, promoting joint research projects and initiatives.

8. International Coordination:

Coordination with Other Countries: For cross-border experiments, establish coordination mechanisms with regulatory authorities in neighboring countries to prevent interference and ensure harmonized spectrum use.

9. Duration and Renewal:

License Duration: Specify the duration of the experimental license, allowing sufficient time for research and development activities.

Renewal Process: Outline the procedures for license renewal, including the criteria for renewal eligibility and the demonstration of responsible spectrum use.

10. Public Awareness and Transparency:

Public Disclosure: Ensure transparency by making non-sensitive experimental data and outcomes publicly accessible, promoting knowledge dissemination and awareness.

Stakeholder Consultation: Conduct consultations with stakeholders, including CAGs, local communities and environmental organizations, to address concerns and gather feedback.

11. Safety Nets and Emergency Protocols:

Emergency Protocols: Establish protocols for emergency shutdown in case of unexpected interference with essential services or critical infrastructure.

Conflict Resolution: Implement conflict resolution mechanisms to address disputes between experimental users or conflicts arising from spectrum use.

These terms and conditions, along with careful oversight and collaboration with relevant stakeholders, can help create a framework that supports responsible experimentation, innovation, and knowledge

sharing within the 95 GHz to 3 THz frequency range. Continuous evaluation and adaptation of these terms based on technological advancements and research findings are essential to ensure the effective and efficient use of the spectrum for experimental purposes.

Kindly provide inputs in respect of, inter alia, the following aspects for the proposed separate experimental license:

- i. Purpose of the license; : Mentioned above.**
- ii. Scope of the license : Mentioned above**
- iii. Eligibility conditions for entities seeking to acquire the license :**

Mentioned above.

- iv. Mode of applying for the license :**

The mode of applying for a license for the 95 GHz to 3 THz spectrum should be streamlined, efficient, and accessible to encourage innovation and research while ensuring regulatory oversight. Here are some considerations for the mode of applying for licenses in this frequency range:

1. Online Application Portal:

User-Friendly Platform: Develop a user-friendly online application portal where applicants can easily access information, submit applications, and track the status of their applications.

Guidance and FAQs: Provide comprehensive guidance documents and frequently asked questions (FAQs) on the portal to assist applicants in understanding the application process, technical requirements, and regulatory expectations.

2. Central Regulatory Authority:

Centralized Authority: Establish a centralized regulatory authority responsible for processing applications, conducting technical evaluations, and issuing licenses. Centralization ensures consistency and uniformity in the application process.

Dedicated Support Team: Have a dedicated support team within the regulatory authority to assist applicants, address queries, and provide clarifications during the application process.

3. Transparent and Timely Process:

Transparency: Ensure transparency in the application process by providing clear guidelines, timelines, and criteria for license approval. Applicants should understand the steps involved and the expected timeframe for processing their applications.

Regular Updates: Provide regular updates to applicants on the status of their applications. Communication regarding the progress of applications is essential to maintain trust and transparency.

4. Documentation Requirements:

Clear Documentation: Clearly outline the documentation requirements for license applications, including technical specifications, research proposals, safety protocols, and compliance plans. Detailed documentation ensures that applicants provide necessary information for evaluation.

Template Forms: Provide standardized template forms for applicants to fill out, ensuring that all required information is captured uniformly.

5. Technical Evaluation:

Technical Review Panel: Form a panel of technical experts within the TRAI to evaluate the technical aspects of applications. These experts should assess the feasibility, safety, and interference potential of proposed experiments.

Collaboration with Research Community: Collaborate with academic and industry experts to review technical aspects, ensuring a comprehensive evaluation process.

6. License Categories and Use Cases:

Flexible License Categories: Introduce flexible license categories based on the nature of experiments, such as academic research, startup initiatives, or commercial research and development.

Use Case Specific Licenses: Tailor licenses to specific use cases (e.g., medical imaging, communication, environmental sensing) to ensure that regulatory requirements align with the intended applications.

7. Application Review and Feedback:

Review Process: Conduct a thorough review of applications, taking into account technical feasibility, interference mitigation measures, and potential societal impact.

Feedback Mechanism: Provide feedback to applicants, especially if applications are rejected or require modifications. Clear feedback enables applicants to refine their proposals and reapply if necessary.

8. Appeals Process:

Appeals Mechanism: Establish an appeals process for applicants dissatisfied with the license decision. An independent body can handle appeals, ensuring a fair and impartial review of disputes.

By adopting these measures, the application process for the 95 GHz to 3 THz spectrum can be efficient, transparent, and supportive of

innovation, fostering a conducive environment for research and experimentation in this valuable frequency range.

v. Duration of the license :

The duration of a license for the 95 GHz to 3 THz spectrum should be carefully considered to balance the need for experimentation, research, and innovation with regulatory oversight and efficient use of the spectrum. Here are some factors to consider when determining the license duration:

1. Research and Development Timeframe:

Complexity of Experiments: Consider the complexity of experiments and the time required for meaningful research and development in the terahertz (THz) frequency range. Some experiments might require long-term observations and data collection.

Innovation Cycles: Recognize that innovation cycles in technology can vary. Longer license durations allow researchers to explore fundamental and long-term projects, encouraging in-depth exploration of THz applications.

2. Regulatory Oversight and Flexibility:

Regulatory Review Periods: Establish regular review periods during the license duration to assess compliance, interference issues, and

advancements in technology. These reviews can inform decisions about renewals, modifications, or extensions.

License Renewal Process: Specify a transparent and efficient license renewal process, allowing licensees to request extensions and demonstrating continued responsible use of the spectrum.

3. Encouraging Investment and Commercialization:

Startup Development: Consider the startup ecosystem. Longer license durations might encourage startups to invest in THz technology, providing them with a stable environment for product development and potential commercialization.

Commercial Deployment: If the goal is to facilitate commercial deployment, provide a sufficiently long license duration to incentivize companies to invest in research, development, and market readiness.

4. Emerging Technology Adoption:

Technology Maturation: Evaluate the maturity level of THz technologies. If THz applications are in early stages of development, longer license durations provide researchers with the necessary time to mature the technology before potential commercialization.

Incentivizing Investment: Longer license durations can incentivize companies to invest in THz technologies by providing them with a stable

regulatory environment for an extended period, fostering innovation and industry growth.

5. Public Interest and Benefit:

Societal Impact: Consider the potential societal impact of THz technologies. If THz applications have significant societal benefits, longer license durations might be justified to encourage research and development efforts aimed at addressing public needs, such as healthcare or environmental monitoring.

6. Balancing Spectrum Efficiency:

Spectrum Efficiency: Balance the need for innovation with spectrum efficiency. If there is high demand for the 95 GHz to 3 THz spectrum, consider a reasonable license duration that ensures efficient use of this valuable resource.

Considering these factors, a typical license duration for the 95 GHz to 3 THz spectrum might range from 5 to 10 years. However, this duration should be flexible and subject to regulatory reviews to ensure that the spectrum is utilized efficiently and in the public interest. TRAI should assess the progress, impact, and compliance of licensees during these review periods and make informed decisions about license renewals, modifications, or any necessary changes to the regulatory framework.

vi **Obligation under the license :** **Mentioned Above**

vii **Financial conditions including the license fees :**

6. Application Fees and Cost Structure:

Application Fees: Establish reasonable application fees to cover the cost of processing applications and conducting technical evaluations. Fees should be structured to encourage participation from research institutions, startups, and innovators.

Fee Waivers: Consider fee waivers or reductions for non-profit research institutions, educational organizations, and small startups to promote inclusivity and support grassroots innovation.

viii **Technical conditions and other terms and conditions for operations under the license :** **Mentioned above.**

ix **Mechanism to ensure protection to passive services in the frequency range between 95 GHz to 3 THz :**

Mentioned above.

and

X. **Any other (please specify). :** **No.**

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.

Comments :

Permitting licensees to market experimental devices designed to operate in the frequency range between 95 GHz to 3 THz via direct sale can foster innovation and facilitate the commercialization of emerging technologies. However, to ensure responsible and safe use of the spectrum, specific terms and conditions should be established. Here are considerations for associated terms and conditions:

1. Certification and Approval:

Regulatory Approval: Require experimental devices to undergo regulatory certification and approval before being marketed, ensuring compliance with technical standards and safety requirements.

Compliance Testing: Mandate thorough testing to confirm that devices meet specified technical parameters, including transmit power limits and spectral masks.

2. Consumer Awareness:

Labeling: Devices should be labeled clearly as experimental and should include information about the frequency range, transmit power, and any limitations.

User Manuals: Provide comprehensive user manuals detailing the safe and responsible operation of the devices, including guidelines on avoiding interference and adhering to local regulations.

3. Geographical Restrictions:

Geofencing: Implement geofencing mechanisms within devices to restrict their operation within authorized geographic areas, ensuring localized use and compliance with regional regulations.

Coordination with TRAI: Devices should be designed to coordinate with TRAI, enabling remote monitoring and enforcement capabilities if necessary.

4. Interference Mitigation:

Dynamic Frequency Selection (DFS): Include DFS capabilities in devices, enabling them to detect and avoid interference with licensed services and other experimental users.

Spectrum Sensing: Incorporate spectrum sensing techniques to detect nearby signals and adjust transmission frequencies to avoid interference.

5. Safety Protocols:

Human Exposure Limits: Devices must adhere to established human exposure limits, ensuring the safety of users and bystanders.

Emergency Shutdown: Include emergency shutdown mechanisms in devices to immediately cease transmission in critical situations, preventing harmful interference.

6. Reporting Obligations:

Incident Reporting: Licensees should report any incidents of interference promptly to regulatory authorities, enabling swift resolution and mitigation measures to the TRAI.

Compliance Reports: Provide periodic compliance reports detailing the devices' adherence to technical parameters and safety standards to the TRAI.

7. Consumer Support:

Customer Support: Establish a dedicated customer support system to assist users with technical queries, ensuring responsible use and troubleshooting assistance.

Software Updates: Devices should support firmware or software updates, allowing licensees to address issues and enhance interference mitigation capabilities.

8. Market Surveillance:

Regulatory Oversight: TRAI should conduct regular market surveillance to monitor the compliance of devices, ensuring that they meet the established standards and conditions.

Penalties for Non-Compliance: Define heavy penalties for licensees found in violation of regulatory standards, deterring non-compliance and ensuring adherence to regulations.

9. Stakeholder Collaboration:

Collaboration with Industry: Foster collaboration between TRAI and industry stakeholders to address emerging challenges and enhance regulatory frameworks as technologies evolve.

Public Consultation: Engage in public consultations to gather feedback from consumers, industry experts, and other stakeholders, ensuring a well-informed regulatory approach.

10. Transparency and Accountability:

Transparency: Ensure transparency in the marketing and sales process, allowing consumers to make informed decisions about purchasing experimental devices.

Accountability: Hold licensees accountable for the proper functioning and safety of the devices, encouraging responsible marketing practices.

