Dynamic Spectrum Alliance Limited
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Telecom Regulatory Authority of India (TRAI)
Tower F, NBCC World Trade Centre
Nauroji Nagar, New Delhi – 110029, India
advmn@trai.gov.in

Re: DSA response to TRAI on "The Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunications (IMT)" Public Consultation

Dear Sir/Madam

The Dynamic Spectrum Alliance[1] (DSA) welcomes the opportunity to submit its response to the Telecom Regulatory Authority of India (TRAI)'s Consultation Paper on the Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunications (IMT).

The DSA's comments focus primarily on the 6 GHz band, emphasizing its critical role in supporting next-generation Wi-Fi 6E and Wi-Fi 7 technologies and its potential to advance India's national broadband and connectivity goals under Digital India and BharatNet initiatives.

License-exempt access to the 6 GHz band offers unprecedented opportunity to expand affordable, high-capacity wireless broadband. In particular, Wi-Fi operations in this band are essential for in-building, community, enterprise, and last-mile connectivity. More than 75 countries[2] have already adopted licence-exempt policies for the 6 GHz band, contributing to a harmonized international market for devices, equipment, and services. This global momentum has catalysed a thriving ecosystem of Wi-Fi 6E and Wi-Fi 7 products, resulting in lower device costs, increased innovation, and faster adoption.

The DSA provides an evidence-based, forward-looking perspective supporting policy decisions that:

- Promote a balanced spectrum framework integrating licensed and licence-exempt access models;

[1] The DSA is a global, cross-industry, not for profit organization advocating for laws, regulations, and economic best practices that will lead to more efficient utilization of spectrum, fostering innovation and affordable connectivity for all. Our membership spans multinationals, small-and medium-sized enterprises, as well as academic, research and other organizations from around the world all working to create innovative solutions that will benefit consumers and businesses alike by making spectrum abundant through dynamic spectrum sharing. A full list of DSA members is available on the DSA's website at https://www.dynamicspectrumalliance.org/members.
[2] https://6ghz.info/#MAP

- Recommend avoiding premature IMT auctions in the upper 6 GHz band until global market and coexistence conditions mature;
- Align India's spectrum management strategy with international best practices that prioritize innovation, competition and citizen-centric connectivity outcomes.

The DSA supports TRAI in formulating a spectrum policy that ensures optimal use of this value public resource, strengthening India's leadership in inclusive digital transformation and positioning the country as a global leader in open spectrum innovation.

Sincerely,

Dr. Martin Suárez
President
Dynamic Spectrum Alliance

Q1. What measures should be taken to enhance competition and mitigate over-supply of the spectrum in various frequency bands in the forthcoming auction?

The DSA recommends that TRAI adopt a holistic and balanced spectrum policy that integrates both licensed and license-exempt spectrum frameworks effectively. Licensed 3GPP-based technologies often demand substantial capital investments, which can restrict market participation to a few large operators. In contrast, license-exempt spectrum in the 6 GHz band, widely used by Wi-Fi technologies at the international level, fosters open competition by lowering barriers to entry for smaller operators and startups and driving broadband innovation.

Expanding license-exempt spectrum access across the entire 6 GHz band (5925–7125 MHz) will significantly enhance competition in the broadband market. The 6 GHz band supports multi-gigabit speeds and low latency, making Wi-Fi an excellent complement to fibre networks by delivering affordable last-mile and in-building connectivity. This approach empowers ISPs, startups, and community networks to provide cost-effective broadband without the prohibitive costs of licensing and specialised equipment.

The DSA strongly encourages TRAI to:

- Protect and expand license-exempt spectrum access, especially throughout the full 6 GHz band, to unleash high-throughput, low-latency broadband services.
- Avoid oversupplying licensed spectrum where commercial ecosystem readiness and demand remain uncertain to prevent spectrum underutilisation and market concentration.
- Incorporate dynamic spectrum sharing and coexistence frameworks to maximise overall spectrum utilisation.
- Extend evaluation criteria beyond auction revenues to include longer-term socio-economic benefits derived from widespread and affordable connectivity enabled by license-exempt spectrum.

India's transformative success with Jio's AirFiber is a powerful example of how license-exempt spectrum can drive scalable, high-speed connectivity at lower cost. Opening the full 6 GHz band for license-exempt use stands to catalyse innovations nationwide, significantly advancing digital inclusion and consumer choice consistent with the objectives of Digital India.

Question 14. Whether the spectrum in 6425 – 6725 MHz and 7025 – 7125 MHz ranges in the upper 6 GHz band should be put to auction for IMT in the forthcoming auction?

Question 15. In case you are of the opinion that the spectrum in 6425 – 6725 MHz and 7025 – 7125 MHz ranges should not be put to auction in the forthcoming auction, what should be the timelines for auctioning of this spectrum for IMT?

The DSA recommends that the spectrum in the upper 6 GHz band (6425–6725 MHz and 7025–7125 MHz) should not be included in the forthcoming auction for IMT use. This recommendation is based on several important observations:

1. **Lack of Commercial Readiness and Ecosystem Maturity:** The IMT ecosystem in the upper 6 GHz band remains in its beginnings, with no mature device ecosystems, no user equipment available, and not even substantial commercial trials. Early studies and pilot deployments in other regions have revealed several operational challenges including poor indoor propagation, unreliable uplink performance, complex coordination with Fixed-Satellite Service (FSS) uplinks and no coexistence with FS.

   Furthermore, WRC-23 Resolution 220, which sets preliminary protection masks for FSS Earth-to-space links, has not yet been validated under field conditions. There is no robust coexistence model or empirical data demonstrating safe operation between high-power IMT base stations and sensitive satellite uplinks, leaving both services vulnerable to interference.

2. **Risks of Premature Auctioning:** Experience from jurisdictions such as Hong Kong's 2023 upper 6 GHz auction indicates that early auctions lead to limited operator participation, unsold spectrum blocks, and bids barely exceeding reserve prices—indicating weak commercial demand and technical uncertainty. Pursuing a similar course in India risks inefficient spectrum allocation, speculative hoarding, and underutilisation, which would delay significant broadband advancements and economic gains.

3. **Prioritization of License-exempt Wi-Fi Access:** The DSA recommends expanding license-exempt access across the entire 6 GHz band, recognizing its pivotal role in driving scalable broadband innovation, enabling cost-effective last-mile connectivity, and fostering vibrant market competition. The DSA further advocates for auction frameworks that explicitly safeguard Wi-Fi access including provisions to dedicate any unauctioned spectrum within the band to license-exempt use. This proactive approach to spectrum management ensures that license-exempt Wi-Fi can continue to flourish as a cornerstone of digital connectivity, supporting affordable access, socio-economic development, and nationwide digital inclusion. By striking a balanced allocation between licensed and license-exempt spectrum, India can maximise the utility of the 6 GHz band and build a resilient, inclusive, and innovation-driven broadband ecosystem that aligns with the goals of Digital India and BharatNet.

Regarding auction timing, the DSA suggests deferring any auction activity until after the World Radiocommunication Conference 2027 (WRC-27). This deferment period should be utilized for:

- Conducting comprehensive coexistence studies with incumbent satellite operators to validate real-world feasibility.

- Monitoring global policy and technological developments, particularly the outcomes of WRC-27 and decisions made by countries with similar spectrum environments.
- Allowing time to assess the existence of wide commercially available ecosystem conducive to IMT deployment in these bands.
- Undertaking thorough public consultation and stakeholder engagement to ensure spectrum policy reflects genuine market demand and maximises socio-economic benefits.

This prudent and data-driven approach will mitigate risks of premature spectrum allocation, prevent interference, and facilitate India's path to inclusive, innovation-powered broadband development leveraging the full potential of the upper 6 GHz spectrum.

Question 16. Considering that the satellite-based service (uplink) will coexist with IMT-based services in the upper 6 GHz band, whether pilot trials should be conducted to ascertain the keep-out distance of the IMT base stations for satellite uplink stations before the auction of the upper 6 GHz band, or should it be left to the telecom service providers to ascertain the keep-out distance of the IMT base stations for satellite uplink stations at the time of commercial deployment after the auction?

The DSA strongly recommends deferring any auction or commercial deployment in the upper 6 GHz band (6425–7125 MHz) until credible coexistence studies, validated through real-world measurement data, have been completed. Currently, there is no established technical framework or verified dataset that ensures reliable coexistence between IMT systems and Fixed-Satellite Service (FSS) Earth-to-space uplinks operating in this band.

WRC-23 Resolution 220 defines protection criteria, including equivalent isotropically radiated power (e.i.r.p.) spectral density masks versus elevation angle specifically for IMT base stations to safeguard FSS uplinks. However, these remain theoretical constructs lacking practical enforcement mechanisms or operational field validation. The coexistence scenario between dense IMT base station deployments and highly sensitive satellite uplinks is complicated by multiple unresolved factors, including:

- Aggregate interference from potentially large-scale urban and suburban IMT deployments.
- Variability in spatial and temporal emission characteristics due to diverse propagation environments.
- The absence of robust compliance verification methods to ensure adherence to prescribed emission masks within complex terrains.
- Practical enforcement challenges of keep-out zones and exclusion distances across heterogeneous and topographically varied regions.

Without empirical validation and operational experience, these parameters cannot be confidently integrated into licensing or spectrum planning frameworks.

Moreover, entrusting telecom operators to self-determine or enforce keep-out distances after spectrum assignment would introduce regulatory fragmentation, inconsistent protection standards, and heightened risks of harmful interference to critical satellite uplink services. Such an approach would also undermine broader international coordination efforts.

The DSA urges TRAI to defer any auction or spectrum assignment decision for the upper 6 GHz band until completion of technical coexistence studies in India. These will provide evidence-based coexistence frameworks and established operational enforcement mechanisms.

This cautious, data-driven strategy offers India an opportunity to harmonize with evolving international best practices, protect essential satellite services relied upon for broadcasting, backhaul, and emergency communications. Ultimately, such prudence will underpin technically sound, economically sustainable, and globally aligned spectrum policy decisions that foster a resilient and inclusive broadband ecosystem.

Question 19. To mitigate inter-operator interference due to TDD based configuration, whether the approach adopted for the 3300 MHz and 26 GHz bands should also be made applicable for the newly identified spectrum in the upper 6 GHz band? In case you are of the opinion that some other provisions are required to be established, suggestions may kindly be made with detailed justifications.

While the DSA does not make specific recommendations on mitigating inter-operator interference among IMT networks arising from TDD configuration misalignments, it is essential to highlight the significant adjacent-band interference risks that high-power IMT deployments above 6425 MHz could pose to Wi-Fi operations in the lower 6 GHz band (5925–6425 MHz)

1. **Nature of the Interference Problem:**

IMT systems proposed for the upper 6 GHz band are designed to operate in Time Division Duplex (TDD) mode, where uplink and downlink transmissions occur in alternating time slots defined by operator-specific frame configurations. Because these configurations are often unsynchronized across different networks, and because Wi-Fi operates asynchronously using a contention-based access mechanism (CSMA/CA), there exists a fundamental temporal mismatch between IMT and Wi-Fi transmissions.

This mismatch can lead to Adjacent Channel Interference (ACI) and blocking effects when high-power IMT transmissions overlap in time or frequency with nearby Wi-Fi receivers operating in adjacent channels. The problem is especially pronounced in environments where both technologies are deployed in close proximity—such as buildings, campuses, or public venues—without coordinated timing or spatial separation.

The transmit-power imbalance between the two systems further aggravates the interference risk. IMT base stations typically operate at substantially higher power levels than Wi-Fi access points and end-user devices, resulting in strong out-of-band emissions that can overwhelm nearby Wi-Fi receivers. In such cases, even when both systems comply with regulatory emission limits, the difference in signal strength can cause receiver desensitization or saturation, leading to degraded throughput, increased packet loss, and potential service disruption.

In practical deployment scenarios particularly in mixed indoor environments where small-cell IMT transmitters and Wi-Fi access points may coexist within the same physical space. These interference effects can significantly reduce Wi-Fi performance in channels adjacent to IMT bands, effectively diminishing the usable spectrum available for license-exempt broadband connectivity.

2. Device and Receiver Limitations

Current 6 GHz Wi-Fi technologies—including Wi-Fi 6E and Wi-Fi 7—are designed primarily for in-band coexistence and therefore exhibit limited front-end filtering performance beyond 6425 MHz. The radio-frequency (RF) filters integrated into these chipsets provide only moderate adjacent-channel rejection (ACR), optimised to manage interference among neighbouring Wi-Fi channels rather than to suppress strong emissions from high-power IMT transmitters operating immediately above the band.

As a result, even when IMT systems comply with prescribed out-of-band emission (OOBE) and adjacent-channel leakage ratio (ACLR) limits, residual interference energy can still enter the Wi-Fi receiver's front end. This unwanted signal power can overload the automatic gain control (AGC) circuitry, causing receiver desensitisation, reduced dynamic range, and instability in the physical-layer link. In practice, these effects manifest as packet loss, lower throughput, or complete connection drop-outs, particularly in high-density deployments or confined indoor environments where IMT and Wi-Fi equipment are located in close physical proximity.

Multiple technical studies—conducted under frameworks such as ETSI BRAN, IEEE 802.11 coexistence task groups, and national regulatory laboratory assessments—have observed that IMT out-of-band emissions in such conditions can materially degrade the Wi-Fi signal-to-interference-plus-noise ratio (SINR), making adjacent Wi-Fi channels operationally unusable within short ranges of an active IMT base station. These findings underscore the need for further coexistence validation, particularly to assess the real-world performance limits of commercial Wi-Fi receivers under adjacent-band IMT interference and to inform the development of appropriate mitigation and coordination mechanisms.

3. Real-World Deployment Scenarios

The interference threat is most acute in indoor mixed-use environments, such as enterprise buildings, shopping centres, airports, or smart campuses, where cellular small cells operating

above 6425 MHz may be deployed close to Wi-Fi access points serving the same coverage area. In such cases, owing to minimal physical separation, interference coupling through direct-path propagation or internal building reflections can exceed the Wi-Fi receiver's dynamic range, saturating front-end amplifiers and disrupting channel access mechanisms (CSMA/CA). This effectively reduces the usable license-exempt spectrum available for Wi-Fi, creating dead zones adjacent to the IMT allocation boundary and degrading broadband quality in both public and private networks.

4. Limitations of Applying Lower-Band Mitigation Models

Existing coexistence techniques developed for lower- or millimetre-wave bands (e.g. synchronisation alignment, guard bands, power control, and co-site filtering) cannot be directly applied to the upper 6 GHz context. The propagation characteristics and band adjacency between Wi-Fi and IMT in this frequency range are unique, with very narrow separation (less than 300 MHz) and overlapping indoor deployment zones.

Approaches effective in bands such as 3.3–3.8 GHz or 26 GHz—where physical separation and propagation attenuation are greater—are insufficient here. Without coordinated guard-band definition, enhanced emission masks, and possibly cross-technology synchronisation mechanisms, interference between asynchronous Wi-Fi and IMT systems will remain a critical coexistence challenge.

5. Need for Further Study and Regulatory Safeguards

Given these unresolved technical issues, the DSA recommends that further empirical coexistence studies be prioritised before any IMT authorisation in the upper 6 GHz band. These studies should include:

- Laboratory and field measurements quantifying Wi-Fi performance degradation under realistic IMT interference conditions.
- Receiver blocking and adjacent-channel rejection assessments across representative Wi-Fi chipset implementations.
- Simulation-based coexistence modeling using mixed-density deployment scenarios (indoor/outdoor, macro/small cell).
- Evaluation of mitigation strategies such as guard bands, adaptive filtering, dynamic frequency selection, and power coordination frameworks.

These findings should inform the development of band-specific coexistence frameworks, ensuring that upper 6 GHz IMT deployments do not compromise the performance and accessibility of licence-exempt Wi-Fi operations in the lower 6 GHz band—one of the most valuable spectrum resources for broadband innovation.

Question 20. Are there any other inputs/ issues related to the auction of spectrum in the upper 6 GHz band

The DSA emphasises that authorising Wi-Fi use in the upper 6 GHz band does not preclude future IMT deployments within the same spectrum. Instead, it represents a pragmatic and globally aligned approach that allows regulators to derive immediate public benefit from an already mature Wi-Fi ecosystem while maintaining flexibility for future mobile use as technology and demand evolve.

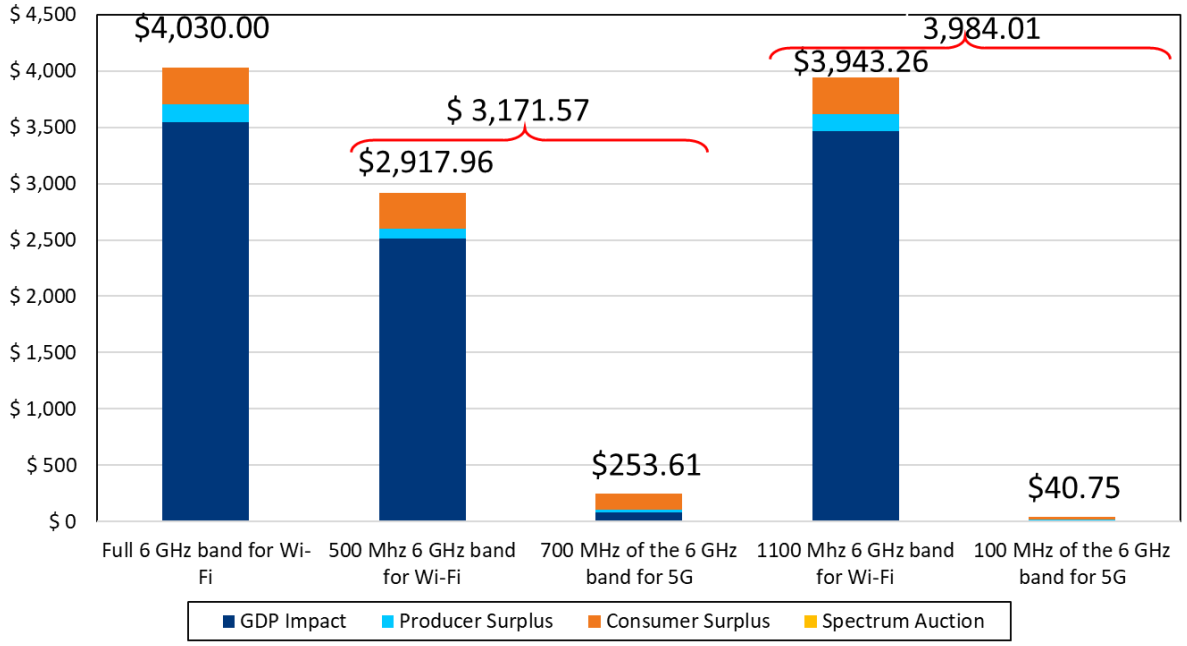
Globally, regulators are increasingly adopting phased or hybrid frameworks to balance innovation, efficiency, and long-term spectrum planning. For instance, Ofcom in the United Kingdom is considering a phased policy authorising near-term licence-exempt Wi-Fi operations in the upper 6 GHz band, with the possibility of introducing IMT services in later stages once coexistence mechanisms, ecosystem maturity, and market demand are validated. This forward-looking model reflects the complementary nature of Wi-Fi and IMT rather than a zero-sum approach to spectrum allocation. The DSA supports exploring similar models in India.

Question 32-35. Valuation of of 6425 – 6725 MHz & 7025 – 7125 MHz bands.

The DSA urges TRAI to comprehensively reflect the opportunity cost of limiting license-exempt access—such as Wi-Fi and other open wireless broadband technologies—in its valuation of the upper 6 GHz band for IMT. Traditional spectrum valuation methods focusing principally on auction benchmarks or spectral efficiency inadequately capture the substantial societal and economic benefits uniquely generated by license-exempt use.

Restricting the 6 GHz band exclusively to licensed mobile use risks significant losses in consumer surplus, innovation potential, and broadband cost-efficiency. In India's context, these opportunity costs are especially consequential given the country's digital inclusion goals.

A rigorous independent economic analysis commissioned by the DSA and conducted by Telecom Advisory Services estimated that full allocation of the entire 1200 MHz 6 GHz band for license-exempt Wi-Fi use could generate approximately US $4.03 trillion in cumulative economic value between 2024 and 2034. This includes tangible contributions to GDP, consumer savings, and producer benefits.



Moreover, unlike IMT networks, Wi-Fi benefits from immediate commercial readiness in this band. Wi-Fi could support critical services such as BharatNet rural connectivity projects, Fixed Wireless Access (FWA), and enterprise digital transformation—all without the complexities and capital intensity of licensed auctions.

Thus, the DSA strongly recommends that TRAI's valuation framework holistically assess both licensed and license-exempt spectrum outcomes, emphasising long-term socio-economic gains over narrow short-term auction revenues. Adopting such a comprehensive framework will align India's spectrum policy with global best practice, fostering accelerated broadband access, innovation, and inclusive digital growth.