November 18, 2025

To,

Shri Akhilesh Kumar Trivedi,
Advisor (Networks, Spectrum and Licensing),
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Tower F, NBCC World Trade Centre, Nauroji Nagar, New Delhi-110029

Re: Consultation Paper on the Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunications ("**Consultation Paper**")

Sub: Joint Submission on the Consultation Paper by Amazon, Apple, Broadcom Inc., Cisco Systems, Inc., Meta Platforms, Inc., Hewlett Packard Enterprise, and Intel Corporation

We, the undersigned companies—Amazon, Apple, Broadcom Inc., Cisco Systems, Inc., Meta Platforms, Inc., Hewlett Packard Enterprise, and Intel Corporation—extend our sincere appreciation to the Telecom Regulatory Authority of India ("**TRAI**") for the opportunity to provide our views on the Consultation Paper on 'Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunication'.

We appreciate TRAI's continued efforts to ensure efficient spectrum management and promote innovation and competition in India's digital ecosystem. We welcome this consultation and are pleased to provide our collective views and recommendations below.

Q1. What measures should be taken to enhance competition and mitigate over-supply of the spectrum in various frequency bands in the forthcoming auction? Please provide a detailed response with justifications.

At the outset, we respectfully state that enhancing competition while mitigating the risk of over-supply requires a calibrated spectrum policy that leverages both licensed and unlicensed frameworks, encourages efficient sharing, and confines IMT auction supply to bands with a mature device and infrastructure ecosystem.

Balanced spectrum policy to broaden participation and reduce barriers to entry

A balanced approach that advances both licensed and unlicensed spectrum access will support diverse use-cases and business models, thereby strengthening competition. IMT deployments in licensed 3GPP bands typically entail significant capital intensity and scale requirements, which limits participation to a few large operators. In contrast, unlicensed bands—such as the 5 GHz and 6 GHz ranges for Wi-Fi—enable open, innovation-led and rapid implementation by ISPs, start-ups, community networks, and enterprises. These complementary approaches lower barriers for market participation, expand consumer choice, and help avoid scenarios in which auctioned IMT spectrum remains underutilized due to limited demand and ecosystem readiness.

Promote spectrum sharing and dynamic access to maximise utilisation

We encourage TRAI to facilitate mechanisms that enable coexistence of multiple technologies within and across bands, including shared or dynamically accessed environments. Enabling fair and predictable coexistence between Wi-Fi and IMT—where technically appropriate—can increase spectral efficiency, stimulate competitive offerings across access technologies, and reduce the likelihood of idle capacity in auctioned holdings. Such measures should be underpinned by clear technical rules that protect incumbents and ensure equitable access.

Limit IMT auction supply to bands with a proven IMT ecosystem

To mitigate over-supply risk, IMT auction offerings should be confined to frequency ranges supported by a mature, globally harmonised IMT device and equipment ecosystem. Phasing supply in line with demonstrated commercial readiness helps align operator demand with realistic deployment timelines, thereby preserving competitive auction dynamics and reducing the prospect of unsold or under-utilised spectrum.

Role of unlicensed 6 GHz in strengthening competition and reducing under-utilisation risk

Expanding access to unlicensed spectrum—particularly across the full 6 GHz band (5925–7125 MHz)—can bolster broadband competition. The 6 GHz band enables multi-gigabit, low-latency Wi-Fi, and Standard Power Wi-Fi can effectively complement fibre by providing last-mile and in-building connectivity. This supports rapid, lower-cost deployments by ISPs, start-ups, community and enterprise networks without reliance on more costly licensed spectrum or specialised IMT equipment. Such outcomes directly address the twin concerns of over-supply and underutilization in auctioned bands by shifting appropriate traffic to cost-effective unlicensed solutions while preserving licensed spectrum for mobility-centric use cases.

The market experience of new fixed wireless and in-home broadband models in India underscores the capacity of unlicensed spectrum to deliver high-speed services at scale and lower cost.[1] Delicensing the entire 6 GHz band would catalyse further innovation, intensify competitive pressure across access technologies, and advance the objectives of Digital India by accelerating inclusive broadband rollout.

In summary, a policy mix that (i) advances both licensed and unlicensed access, (ii) enables technology coexistence through well-crafted sharing frameworks, and (iii) phases IMT auction supply to bands with established ecosystems, will best enhance competition while mitigating the risk of spectrum over-supply in the forthcoming auction.

[1] Ashutosh Kumar, ‘Reliance Jio turns to UBR to lower 5G FWA deployment costs, launches private network in Jamnagar’, The Economic Times, May 2, 2025, available at: https://telecom.economictimes.indiatimes.com/news/industry/reliance-jio-turns-to-ubr-to-lower-5g-fwa-deployment-costs-deploys-private-network-in-jamnagar/120820104.

Q14. 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? Kindly provide a detailed response with justifications.

We respectfully submit that the spectrum should not be put in the 6425–6725 MHz and 7025–7125 MHz ranges to auction for IMT in the forthcoming auction. This is because technical and commercial readiness for IMT in the 6 GHz band is not established. Early trials indicate material performance limitations, particularly for uplink and indoor reliability, which are critical to service quality in this spectrum range. Thus, proceeding with auctioning the upper 6 GHz band for IMT at this stage would be premature given the absence of demonstrated technical and commercial readiness for IMT deployments in the upper 6 GHz band, and the material risks of spectrum under-utilization and spectrum stall. Recent international experience underscores limited operator demand: Hong Kong's 6 GHz auction saw low participation, minimal bid premiums despite low reserve prices, and unsold spectrum, indicating that market appetite for IMT in this band remains weak.[22] To elaborate, Hong Kong conducted the world's first commercial auction for the upper 6 GHz band for IMT services, however, the auction concluded with notably weak market performance across several key metrics. For instance, only three of Hong Kong's four major mobile network operators participated in the bidding, with Hutchinson opting out entirely. The company cited the immaturity of the device and infrastructure ecosystem, limited global adoption for mobile services, lack of compelling use cases, and existing spectrum sufficiency as reasons for non-participation. Additionally, of the 400 MHz of spectrum offered for auction, only 300 MHz was sold and only at 5% above the reserve price.[3] This substantial amount of unsold spectrum indicates that even with historically low reserve prices, demand remained low.

A premature auction would impose a high opportunity cost relative to the immediate and well-substantiated public benefits of enabling unlicensed Wi-Fi across the full 6 GHz band. The global ecosystem for Wi-Fi 6E and Wi-Fi 7 is mature and expanding rapidly in jurisdictions that have opened the full 6 GHz band for unlicensed use, including the United States[4], Canada[5], South Korea[6], and Saudi

[22] See "Conclusion of auction of radio spectrum in 6/7 GHz band" from The Government of Hong Kong Special Administrative Region available at https://www.info.gov.hk/gia/general/202411/29/P2024112900425.htm.

[3] See Alexander Roytblat, Vice President, Regulatory Affairs, Wi-Fi Alliance, available at https://www.linkedin.com/posts/alexander-roytblat-b3b50367_hong-kong-raises-81-million-from-6-ghz-auction-activity-7269728207094882304-mqTD/.

[4] 'What is Wi-Fi 6 vs. Wi-Fi 6E vs. Wi-Fi 7?', Cisco, available at: https://www.cisco.com/site/us/en/learn/topics/networking/what-is-wifi-6-vs-wifi-6e.html; and 'No, US policy on 6 GHz Wi-Fi hasn't changed – and that's a good thing', RCR Wireless News, September 18, 2025, available at: https://www.rcrwireless.com/20250918/spectrum/us-policy-6-ghz-wi-fi.

[5] 'Decision on the Technical and Policy Framework for License-Exempt Use in the 6 GHz band', Gazette Notice No. SMSE-006-21, May 2021, available at: https://ised-isde.canada.ca/site/spectrum-management-telecommunications/en/spectrum-allocation/radio-local-area-network-rlan-6-ghz-band/decision-technical-and-policy-framework-licence-exempt-use-6-ghz-band.

[6] 'South Korea approves the 6 GHz band for unlicensed use', ELEOS Compliance, October 15, 2020, available at: https://www.eleoscompliance.com/en/article/south-korea-south-korea-approves-6ghz-band-for-unlicensed-use.

Arabia[7]. The U.K.[8], Europe[9], Australia[10], and Japan[11] are actively developing regulatory frameworks to support unlicensed use in the upper 6 GHz band. These developments demonstrate that unlicensed access catalyzes robust device ecosystems, drives consumer adoption, and accelerates broadband rollout.

Moreover, Wi-Fi technologies have been shown to coexist effectively with incumbents in the 6 GHz band under appropriate technical parameters. Experience in the United States indicates no reported harmful interference to broadcasting services sharing the band despite the deployment of millions of 6 GHz low-power indoor devices[12]. By contrast, IMT use in the upper 6 GHz band in India presents unresolved coexistence challenges that would likely take significant time to address, deferring any practical consumer benefit for years.

Q15. 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? Kindly provide a detailed response with justifications.

We do not recommend setting timelines for any future auction of the 6425–6725 MHz and 7025–7125 MHz ranges for IMT. TRAI, together with the Department of Telecommunications ("**DoT**"), should review the allocation of the upper 6 GHz band following the outcomes of WRC-27, including Agenda Item 1.7 concerning 7.125–8.4 GHz[13]. Aligning with WRC-27 will support international harmonization across the broader 6–8 GHz middle band and avoid premature, potentially non-harmonized decisions that could fragment the market and undermine India's long-term spectrum strategy.

In the interim, to prevent spectrum stall, any upper 6 GHz spectrum that would otherwise remain unused should be made available for unlicensed use. Immediate unlicensed access would deliver tangible, near-term benefits, including traffic offload from mobile networks, cost-effective last-mile alternatives

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[7] 'Saudi Arabia's CITC Designates 1200 MHz of Spectrum for License-Exempt Use and Paves Way for Wi-Fi 6E & Wi-Fi 7', Wireless Broadband Alliance, March 30, 2021, available at: https://wballiance.com/wba-celebrates-saudi-arabias-ground-breaking-designation-for-unlicensed-spectrum/.

[8] 'Ofcom launches consultation on wireless services in the Upper 6 GHz band', tech UK, February 17, 2025, available at: https://www.techuk.org/resource/ofcom-opens-consultation-on-wireless-services.html.

[9] 'Wi-Fi 6E in Europe: The Potential of the 6 GHz Band', Telecom Review Europe, February 24, 2025, available at: https://www.telecomrevieweurope.com/articles/reports-and-coverage/wi-fi-6e-in-europe-the-potential-of-the-6-ghz-band/.

[10] 'Future use of the upper 6 GHz band: Outcomes paper', Australian Communications and Media Authority, December 2024, available at: https://www.acma.gov.au/sites/default/files/2024-12/Outcomes%20paper%20-%20Future%20use%20of%20the%20upper%206%20GHz%20band_0.pdf.

[11] Dean Bubley, 'Where do we stand with the 6 GHz band? An updated (Analyst Angle)', RCR Wireless News, May 14, 2025, available at: https://www.rcrwireless.com/20250514/uncategorized/6-ghz-band-update#:~:text=Start%20with%20the%20lower%20part,%E2%80%9Chybrid%20sharing%E2%80%9D%20concept%20subsequently.

[12] Tevfik Yucek, Aspasia Paroutsas, 'Taking Wi-Fi to new heights: FCC's advancement of Standard Power and Automated Frequency Coordination', Qualcomm, February 24, 2024, available at: https://www.qualcomm.com/news/onq/2024/02/taking-wi-fi-to-new-heights-fcc-advances-standard-power-and-automated-frequency-coordination.

[13] 'The 6G Upgrade in the 7-8 GHZ Spectrum Range: Coverage, Capacity and Technology', A 5G Americas White paper, October 2024, available at: https://www.5gamericas.org/wp-content/uploads/2024/10/The-6G-Upgrade-in-the-7-8-GHz-Spectrum-Id.pdf#:~:text=In%20the%20preparation%20for%20the%20World%20Radiocommunication,%E2%80%93%208.400%20GHz%20and%2014.8%20%2D15.35%20GHz..

(including wireless-fiber/FWA models), faster commercial deployments, and broader participation by ISPs, startups, and community networks.

Thus, for the reasons mentioned above, we recommend that TRAI: (i) refrain from auctioning the 6425–6725 MHz and 7025–7125 MHz ranges for IMT in the forthcoming auction; (ii) not set any timelines for future IMT auctions in these ranges pending WRC-27 outcomes and clear evidence of technical and commercial readiness; and (iii) prioritize enabling unlicensed Wi-Fi across 5925–7125 MHz as soon as possible. To avoid spectrum stall, any spectrum not used for IMT should be promptly allocated to unlicensed use to realize immediate socio-economic benefits in support of India's digital ambitions.

Q16. 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? Kindly provide a detailed response with justifications.

International obligations

At the outset, we note that under ITU Appendix 30B, the 6725-7025 MHz band is designated for Fixed-Satellite Service ("**FSS**") feeder links (Earth-to-space). As an ITU Member State, India is obligated to protect both domestic and international satellite operations in this band in accordance with international treaty commitments. Any regulatory framework for the upper 6 GHz band must therefore ensure that FSS Earth-to-space uplinks—particularly high-availability feeder links—are protected from harmful interference arising from IMT base station operations in 6425–7125 MHz.

Technical considerations and WRC-23 outcomes

The coexistence between satellite uplinks and IMT systems in the upper 6 GHz band remains challenging from a technical and regulatory perspective. Following extensive ITU-R studies, the World Radiocommunication Conference 2023 ("**WRC-23**") adopted Resolution 220, which specifies an expected e.i.r.p. spectral-density mask versus elevation angle for IMT base stations operating in 6425–7125 MHz to ensure protection for FSS Earth-to-space uplinks. While this mask reflects a compromise reached in the study cycle, the WRC-23 decision rests on assumptions regarding deployment densities, antenna characteristics, and siting practices. India's national framework must therefore take account of India-specific network topologies, site densities, antenna patterns, and terrain/clutter characteristics rather than relying solely on global baseline assumptions.

Implementation gaps and absence of field evidence

Despite the WRC-23 outcome, there is currently no practical framework, field dataset, or regulatory methodology for implementing or enforcing these e.i.r.p. spectral-density limits in real-world IMT deployments. The coexistence scenario remains theoretical in key respects, including unresolved issues around base station density, aggregate interference modeling, and compliance verification at scale. Notably, no country has yet demonstrated successful large-scale coexistence between active FSS Earth-to-space uplink operations and dense IMT base station networks in this band. In the absence of

proven deployment and enforcement mechanisms, the risk of harmful interference to satellite uplinks cannot be discounted.

Risks of deferring determination to post-auction deployments

We do not agree that the determination of keep-out distances should be left to individual telecom service providers at the time of commercial deployment after an auction. Such an approach would create asymmetric incentives, lead to inconsistent practices across operators and geographies, and complicate ex-post enforcement. It would also undermine spectrum value by injecting uncertainty into business cases for both IMT and satellite stakeholders and by exposing all parties to material risk of interference disputes, remedial retrofits, and potential service disruptions. Allowing post-auction, operator-led determinations would shift essential public-interest protections to private parties without a harmonised methodology, which is neither efficient nor consistent with India's international protection obligations for FSS feeder links.

Given the foregoing, we submit that coexistence between IMT base stations and FSS Earth-to-space uplinks in the upper 6 GHz band remains highly uncertain, particularly in light of the high power levels contemplated for IMT and the sensitivity of satellite feeder links. Proceeding to auction or to field deployments before the feasibility of coexistence is conclusively established would expose the IMT and satellite sectors alike to substantial technical, regulatory, and investment risks.

Accordingly, we recommend that TRAI not proceed with pilot trials narrowly focused on deriving "keep-out distances" to facilitate an immediate auction. Rather, auction activity in this band should be deferred until credible coexistence studies—supported by India-specific assumptions and real-world measurement data—demonstrate that the expected e.i.r.p. spectral-density masks can be implemented, monitored, and enforced in practice at scale, while reliably protecting FSS feeder links. Such studies should culminate in a nationally harmonised, enforceable framework that addresses deployment densities, antenna characteristics, aggregate interference, certification, and compliance verification, thereby providing regulatory certainty to all stakeholders.

We remain available to engage constructively with TRAI and other stakeholders on the design of a rigorous, measurement-informed coexistence framework that aligns with India's obligations and ensures the long-term integrity of both satellite and terrestrial services in the upper 6 GHz band.

Q19. 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.

We appreciate the Authority's detailed examination of inter-operator interference mitigation for TDD-based systems. We respectfully submit that the approach adopted for the 3300 MHz and 26 GHz bands may not fully address the distinct interference concerns present in the upper 6 GHz band, particularly at the 6425 MHz boundary where unlicensed Wi-Fi operations adjoin prospective IMT use.

First, the asynchronous nature of TDD operation across different technologies heightens the risk of adjacent channel interference ("**ACI**") to Wi-Fi receivers operating near the 6425 MHz edge. Because

Wi-Fi and cellular uplink/downlink slots are not time-aligned, periods of Wi-Fi reception can temporally overlap with high-power IMT transmissions, raising the probability of blocking and desensitization in adjacent channels notwithstanding any inter-operator frame synchronisation within IMT networks.

Second, limitations in the front-end filtering of existing 6 GHz Wi-Fi devices exacerbate this risk. Most 6 GHz Wi-Fi receivers employ filters that extend up to 7125 MHz and provide little rejection of strong blockers just beyond the band edge. In common indoor scenarios—such as co-located small-cell deployments and Wi-Fi access points, or simultaneous Wi-Fi downlink and cellular uplink on user devices—the adjacent-channel power differential can be extreme, potentially exceeding 80 dB. Under such conditions, Wi-Fi receivers may saturate, leading to severe throughput degradation or complete loss of connectivity. The practical consequence is that channels adjacent to high-power IMT emissions may become unusable, reducing effective spectrum availability for unlicensed broadband.

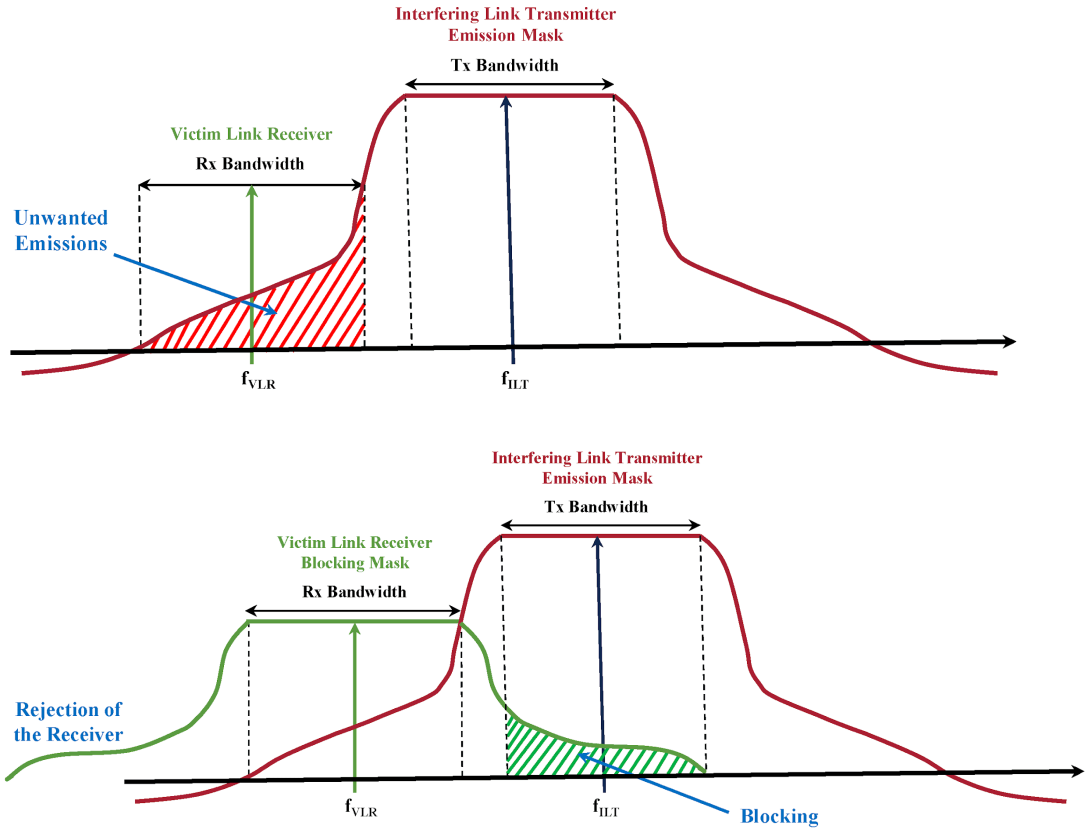


Illustration of interference due to unwanted emissions and receiver blocking

In light of these characteristics, provisions modelled on 3300 MHz and 26 GHz TDD coordination alone may be insufficient. We respectfully note the conclusion reflected in international consultations that guard band sizing between RLAN and potential wide-area broadband use in the upper 6 GHz band warrants further determination.[14] Consistent with that direction, and without proposing specific inter-operator TDD alignment measures for IMT, we submit that TRAI consider, as part of any framework for the upper 6

[14] Australian Communications and Media Authority, 'Outcomes paper: Future use of the upper 6 GHz band', December 2024, available at: https://www.acma.gov.au/consultations/2024-05/planning-options-upper-6-ghz-band.

GHz band, technical provisions addressing cross-technology ACI at the 6425 MHz boundary, taking into account device receiver performance and realistic deployment scenarios.

We remain available to support further technical examination of guard band needs and receiver blocking risks to ensure that any arrangements in the upper 6 GHz band safeguard the continued, reliable operation of adjacent Wi-Fi channels.

Q20. Are there any other inputs/ issues related to the auction of spectrum in the upper 6 GHz band for the forthcoming auction? Suggestions may be made with detailed justifications.

We respectfully submit that enabling unlicensed Wi-Fi access in the upper 6 GHz band need not preclude potential future International Mobile Telecommunications (IMT) use. International regulatory practice increasingly contemplates coexistence and phased frameworks that allow both technology ecosystems to mature while safeguarding long-term policy optionality.

In particular, the United Kingdom's Ofcom is considering a phased approach that would authorize near-term Wi-Fi access in the upper 6 GHz band while preserving the possibility of introducing IMT at a later stage. This reflects the reality that the Wi-Fi ecosystem is deployment-ready and capable of delivering immediate socio-economic benefits, whereas IMT use cases in this band remain nascent and may be reassessed as technology and demand evolve.

Globally discussed spectrum-sharing constructs include: (i) a priority spectrum split model, under which different sub-blocks are prioritized for Wi-Fi or mobile use; and (ii) an indoor/outdoor separation model, under which indoor use—given its low interference potential and high demand—is allocated for Wi-Fi, with outdoor use retained for possible future IMT.

We therefore encourage TRAI to consider a phased or hybrid framework that secures early public benefits through unlicensed use while maintaining strategic flexibility for potential IMT deployment over time.

Q32. Should the auction determined price of other bands by using spectral efficiency factor serve as a basis of valuation for 6425–6725 MHz and 7025–7125 MHz bands? If yes, which spectrum bands be related, what efficiency factor or formula should be used and what is the basis for the same? Please justify your suggestions.

Q33. Should the auction determined price of other countries in 6 GHz spectrum bands serve as a basis of valuation of 6425- 6725 MHz & 7025-7125 MHz bands in India? What methodology should be followed for using this auction determined price as a basis for valuation? Support your suggestions with justifications and country-wise auction data.

Q34. If the above approach is considered appropriate, should the international auction-determined prices be normalized to account for cross-country differences such as population, GDP, purchasing power parity (PPP), subscriber base, and other relevant factors? If so, should normalization be carried out by using the ratio of auction prices of 6 GHz spectrum bands vs other mid band/mmWave band within the same country to neutralize the impact of cross-country differences? Alternatively, please suggest any other suitable normalization methodology that may be adopted in this context.

Q35. Apart from the approaches highlighted above, which other valuation approaches may be adopted for the valuation of 6425-6725 MHz & 7025-7125 MHz bands? Please provide detailed information along with justifications.

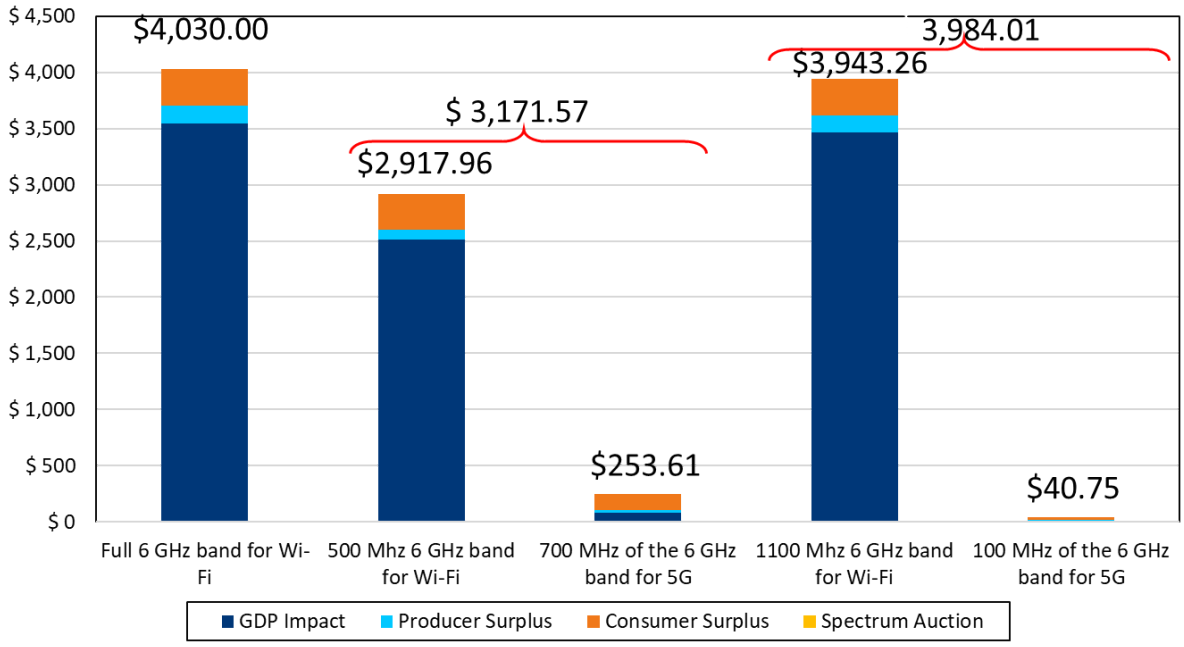
We respectfully submit our responses to questions 32 to 35 in the Consultation Paper below.

Conventional IMT valuation approaches—whether based on auction-determined prices in adjacent bands using spectral efficiency factors or on international 6 GHz auction benchmarks —are not fit-for-purpose for this band because they omit the material opportunity cost of foreclosing unlicensed use. Any benchmark-led method would therefore risk undervaluing public interest, given the demonstrable socio-economic benefits of unlicensed technologies in the 6 GHz range.

If TRAI nonetheless considers auction or spectral-efficiency benchmarks as reference points, they should be used only as secondary inputs within a broader welfare-maximizing framework. For international benchmarks, normalization for cross-country differences is necessary but not sufficient. While normalizations based on population, GDP, PPP, subscriber base, and intra-country price ratios across mid-band/mmWave may help mitigate comparability gaps, such techniques cannot capture India-specific consumer surplus, innovation spillovers, or broadband cost savings from unlicensed use. As such, normalized benchmarks should not be determinative for setting Indian valuations.

We recommend that TRAI adopt a social-welfare valuation approach that explicitly quantifies the opportunity cost of excluding unlicensed operations, including lost consumer surplus, reduced innovation potential, and foregone broadband cost efficiencies. In India's context, these effects are immediate and significant: enabling unlicensed use across the 6 GHz band would accelerate BharatNet backhaul, Fixed Wireless Access for rural broadband, and enterprise digitization at lower cost and with faster time-to-deploy than licensed alternatives. Recent economic assessments indicate that fully opening the 6 GHz band for unlicensed Wi-Fi could yield multi-trillion-dollar cumulative value over the coming decade, whereas failing to delicense the upper 6 GHz band would forfeit substantial national welfare.[15] TRAI's valuation framework should therefore holistically assess both licensed and unlicensed spectrum outcomes, ensuring that India's spectrum policy prioritizes total public benefit rather than short-term auction revenues.

[15] Dynamic Spectrum Alliance, 'Assessment of the Economic Value of the 6 GHz Spectrum Band in India', October 2024, available at: https://www.dynamicspectrumalliance.org/2024/nov/Assessing-the-economic-value-of-Wi-Fi-India-2034-2044.pdf.



Comparative economic value of the three regulatory alternatives

Respectfully submitted,

Amazon, Apple, Broadcom Inc., Cisco Systems, Inc., Meta Platforms, Inc., Hewlett Packard Enterprise, and Intel Corporation