

VIEWS AND COMMENTS ON Consultation Paper on 8/2025

The Auction of Radio Frequency Spectrum in

The Frequency Bands Identified for

International Mobile Telecommunications (IMT)

Spectrum Allocation and Interference in the 1427-1518 MHz Band (Q22)

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The first issue focuses on a specific block of radio frequency, the 1427-1518 MHz range. The core concern here is twofold:

- * Undisclosed Issues: The regulator or body issuing the question is seeking information on any additional, unforeseen inputs or problems—such as technical interference, existing services, or future conflicts—that may not have been previously considered for this band.

- * Justified Suggestions: It is a direct request for detailed, evidence-based suggestions on how this particular spectrum band should be managed, assigned, or utilized to ensure efficient use and avoid problems. This band is internationally recognized for mobile telecommunications, making its allocation a critical economic and technical decision.

2. Review of India's Spectrum Auction Framework (Q23)

The second issue is a high-level review of the entire process by which mobile spectrum is sold to telecom operators in India. This is a fundamental policy question:

- * Need for Review: The question first asks whether the current method and design of spectrum auctions in India—which dictates how much spectrum costs and who gets it—is still appropriate and effective.

- * Proposed Reforms: If the answer is "yes," the query demands specific and detailed recommendations for changing the auction method (e.g., changing from a Simultaneous Multiple-Round Auction to a Combinatorial Clock Auction). These suggestions must be backed by justifications and referenced against international best practices, suggesting the current model might be outdated or suboptimal compared to global standards.

3. Comprehensive Economic, Technical, and Market Factors (Q24 - Incomplete)

The third question, though incomplete, is clearly a broad, catch-all request for any other relevant information that should influence policy decisions related to spectrum or the sector as a whole.

* Broad Scope: By mentioning "economic, technical, or market-related factors," the regulator is inviting stakeholders to provide a comprehensive view beyond just the specifics of spectrum bands or auction mechanics.

* Relevance: This is intended to capture macro-level concerns such as the financial health of the sector, the pace of 5G/6G deployment, the competitive landscape, the impact of new technologies, or consumer affordability, ensuring a holistic policy decision.

These are classic questions posed by the Telecom Regulatory Authority of India (TRAI) in a Consultation Paper on spectrum auction. Since I cannot provide official policy or recommendations (as that is the Authority's role after stakeholder consultation), I will provide an analysis of the common arguments, existing methodologies, and technical considerations relevant to each question.

Q29. Changes to Spectrum Valuation Models or Methodologies

Analysis and Common Suggestions

There is often a need for continuous refinement of spectrum valuation models to better reflect the current market, technological advancements (like 5G/6G), and specific band characteristics.

| Integrate Hybrid Models (e.g., DCF + Real Options) | Pure Discounted Cash Flow (DCF) can underestimate value by not accounting for future managerial flexibility and strategic options (e.g., waiting for new technology standards). Real Options Valuation (ROV) provides a more comprehensive value by considering the option-value of the spectrum license. |

| Enhance Benchmarking Normalization | While Benchmarking (Indexed Price from Previous Auctions) is quick, it often fails to account for crucial differences. Normalization factors should be refined beyond simple per-MHz-per-Population (MHz-Pop) to include: License Duration, Technology Neutrality, Spectrum Band Contiguity/Aggregation, and Macroeconomic/Currency Indexation specific to the telecom sector. |

| Introduce a Production Function Approach | This model values the spectrum based on its contribution to the final product (telecom services). It requires detailed modeling of the relationship between spectrum, network costs, and revenue, providing a bottom-up view that validates market and comparative prices. |

| Discontinue Sole Reliance on Indexed Prices | Sole reliance on indexing past auction prices can lead to a path-dependency problem, where the reserve price is an artifact of a

past market (which may have been bullish or bearish) rather than a reflection of the current economic or technological value. |

| Specific Modelling for mmWave | Valuation for high-frequency bands like 26 GHz must specifically model site density/cell size, backhaul cost, and the need for massive MIMO/beamforming, as the technical constraints are radically different from sub-3 GHz bands. |

Q30. Auction Determined Price and Spectral Efficiency for Existing Bands (800 MHz to 26 GHz)

Analysis: Spectral Efficiency as a Valuation Basis (The Ratio Method)

The concept of using the auction-determined price of one band to value another by applying a Spectral Efficiency Factor (SEF) is a widely debated method often used by regulators as a cross-check or a primary valuation tool in the absence of recent auction data for a specific band.

| Aspect | Rationale/Suggestion | Justification |

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| Should it serve as a basis? | Yes, but only as one of multiple inputs (a benchmarking cross-check), and not as the sole determination of the reserve price. | This method provides a market-validated starting point, especially for contiguous bands or bands with similar propagation characteristics, but must be adjusted for non-linear effects. |

| Which bands be related? | 1800 MHz is often used as a base reference (the ‘anchor band’). The following pairs are commonly related: (900 MHz to 1800 MHz), (800 MHz to 1800 MHz), and (2100 MHz to 1800 MHz). Low-band and mid-band 5G bands (like 3300 MHz) are often compared against other mid-band auction results globally. | Bands must be technologically comparable for the SEF to hold relevance (e.g., all for mobile broadband). Bands with similar technical features, like 1800 MHz and 2100 MHz, have closer relative values. |

| Efficiency Factor/Formula | The formula is typically: $\text{Price Band B} = \text{Price Band A} \times \frac{\text{SEF B}}{\text{SEF A}} \times \text{other market factors}$ The ratio of spectral efficiency is essentially the relative network cost (CAPEX/OPEX) required to provide the same capacity/coverage. | The factor should be derived from rigorous network planning/cost modelling that quantifies the number of base stations required in Band A versus Band B to achieve a target coverage or capacity. This results in the Cost-Parity Ratio. |

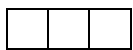
| Basis for the Factor | The core basis is the propagation physics (signal loss/coverage area) and equipment cost (radio/antenna complexity) for a given technology. Lower frequencies

(like 800/900 MHz) require fewer cell sites for coverage, making them more valuable per unit of spectrum than higher frequencies (like 2300/2500 MHz). | Example: A common SEF for 900 MHz relative to 1800 MHz may be around 1.5 to 2.0, meaning 1 MHz of 900 MHz is valued 1.5 \times to 2.0 \times the price of 1 MHz of 1800 MHz because it covers 1.5 \times to 2.0 \times the area with the same cell site density. |

Q31. Other Valuation Approaches for Existing Bands

Apart from the models mentioned (DCF, Benchmarking, Spectral Efficiency-based), the following approaches offer robust alternatives or supplements:

| Approach | Detailed Information | Justification |



| Alternative Cost / Cost Reduction Approach | This is a “bottom-up” model that determines the value of a specific spectrum block by calculating the net present value (NPV) of the savings a telecom operator would achieve on network CAPEX and OPEX by utilizing the new spectrum instead of relying solely on their existing holdings (e.g., avoiding cell site densification). | It provides a minimum economic value (the opportunity cost of not acquiring the spectrum) and is a strong input for setting the floor price or reserve price. |

| Game Theory / Auction Simulation Modelling | This involves running complex simulation models that forecast the bidding behavior of potential participants (using their estimated internal valuations) under different auction formats (e.g., Simultaneous Multi-Round Auction – SMRA). | It helps the Authority optimize the auction design (e.g., block size, reserve price, bid increments) to maximize competition and revenue while ensuring efficient allocation, but it does not determine the intrinsic value of the spectrum itself. |

| Financial Multiples / Comparables Analysis | Value is derived using industry-specific financial metrics. This involves valuing the spectrum based on how similar assets are reflected in the Enterprise Value (EV) of publicly traded telecom companies (e.g., EV/Subscriber or EV/EBITDA multiples, normalized for the spectrum portfolio). | It provides a direct link between spectrum holdings and the public market valuation of telecom companies, offering an external, holistic validation of the valuation exercise. |

Q32. Auction Determined Price and Spectral Efficiency for 6425–6725 MHz and 7025–7125 MHz Bands

Analysis: Application for Mid-to-High Frequency Bands (6/7 GHz)

Applying the spectral efficiency factor becomes more challenging for the mid-to-high bands like 6 GHz and 7 GHz, as their propagation characteristics and typical usage (often for backhaul or future IMT/5G/6G access) are distinct.

extreme caution, as the technical utility (backhaul vs. access) and international licensing status (licensed vs. unlicensed/Wi-Fi) may not be uniform. | The value of these bands is highly dependent on whether they are licensed for IMT (mobile access) or delicensed for Wi-Fi 6E/7 (unlicensed use), which radically changes their economic value. If licensed, their value is predominantly as high-capacity access spectrum. |

| Which bands be related? | If assigned for IMT/Access, they should be related to the nearest available high-capacity mid-band spectrum, such as the 3300 MHz – 3670 MHz (C-band). | These bands serve a similar purpose: providing high capacity in dense urban areas, even though their propagation is poorer than C-band, making the C-band auction price the most relevant benchmark. |

| Efficiency Factor/Formula | The factor must account for the significant difference in cell site coverage and indoor penetration compared to 3300 MHz. | The SEF will likely be less than 1 (e.g., $\mathbf{0.6}$ to $\mathbf{0.8}$) if compared to 3300 MHz, due to the shorter propagation range and greater loss at the higher frequencies, necessitating more cell sites for equivalent coverage. The Cost-Parity Ratio method is essential for deriving this factor. |

| Basis for the Factor | The basis is the technical deployment cost for a high-frequency network. The factor reflects the additional number of small cells or mini-macro sites required to cover the same area and provide the same capacity as the benchmark band (e.g., 3300 MHz). | If primarily used for backhaul, their valuation must instead be based on the alternative cost of fiber deployment or other microwave backhaul bands, completely bypassing the spectral efficiency relationship to mobile access bands. |