Consultation Paper No. 8/ 2025

भारतीय दूरसंचार विनियामक प्राधिकरण

Telecom Regulatory Authority of India

Consultation Paper on the Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunications (IMT)

New Delhi, India

30th September 2025

Tower F, NBCC World Trade Centre, Nauroji Nagar, New Delhi-110029

Written Comments on the Consultation Paper are invited from the stakeholders by 28.10.2025 and counter-comments by 11.11.2025. The Comments and counter-comments may be sent, preferably in electronic form, to Shri Akhilesh Kumar Trivedi, Advisor (Networks, Spectrum and Licensing), TRAI on the email ID advmn@trai.gov.in.

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CHAPTER I: INTRODUCTION AND BACKGROUND

A. Cellular Mobile Telephone Service

1.1 Though the concept of the cellular mobile telephone service was conceived in 1947 itself, it could not be put into practice for a long time. The concept included multiple low power transmitters and receivers spread throughout a region or highway in series of cells, with different frequencies used in adjacent cells but reused within a city or along a highway, and a way to switch the calls to adjacent cells as a vehicle moved down the road. The technology to implement such a scheme did not yet exist and the spectrum needed was not available. After many failed attempts by numerous companies, Motorola (a telecom equipment company in the USA) in 1973 succeeded and demonstrated a working prototype of cellular mobile telephone. It weighed 1.28 kg, and its rechargeable battery could last for 30 minutes of calling.

1.2 In October 1981, the Federal Communications Commission (FCC), USA announced that it would allocate two blocks of frequencies in the 800 MHz range to cellular telephony and would award two licenses in each market - one reserved for an incumbent wireline company, and one for a non-wireline competitor. In October 1983, AT&T opened the first modern cellular mobile telephone system in Chicago. This event marked the beginning of the cellular communication era.

1.3 The 1990s witnessed the digital revolution in cellular mobile communications. In 1990, AT&T Bell Labs developed a digital mobile phone capable of transmitting data. This innovation helped pave the way for the second generation (2G) cellular mobile technology. The first 2G cellular mobile network was launched in 1991 with Global System for

Mobile (GSM) technology in Finland. The shift from analog (1G) to digital (2G) improved capacity, enabled SMS and international roaming, and was soon enhanced by GPRS and EDGE for basic mobile data.

1.4 Parallelly, in 1985, the International Telecommunication Union (ITU) began developing a global standard to support harmonized mobile services, enabling roaming and efficient spectrum use. This led to the International Mobile Telecommunications (IMT) framework. By 2000, the ITU finalized the IMT 2000 (3G) standards offering higher speeds and seamless roaming. Building on this, the ITU defined IMT Advanced (4G) in 2008, requiring fully IP based networks and delivering true mobile broadband. The next milestone, IMT 2020 (5G), finalized between 2015–2020, enabled ultra-high speeds, massive IoT, low latency, and high reliability. At present, the ITU is developing IMT 2030 (6G), targeting even more ambitious goals such as integrated sensing, AI driven networks, and ubiquitous, ultra reliable low latency connections.

B. Cellular Mobile Telephone Service in India

1.5 In India, the first cellular mobile telephone service (CMTS) was launched in Calcutta (now Kolkata) in July 1995 using the GSM technology. This launch marked India's skip of the analog phase and leapfrog directly into the digital cellular technology. Around the year 2000, India adopted another 2G technology namely Code Division Multiple Access (CDMA) alongside GSM.

1.6 In the 1990s, the spectrum assigned to GSM operators was only in the 900 MHz band. As availability of the spectrum in the 900 MHz band was limited, the 1800 MHz band was also opened for GSM operators in the year 2001 to accommodate increasing subscriber demand and support

the entry of more telecom operators. Meanwhile, the spectrum in the 800 MHz band was made available to CDMA operators.

1.7 In the year 2008-2009, the state-owned companies (BSNL and MTNL) launched 3G networks using the WCDMA[1] technology using the spectrum in the 2100 MHz band. In the year 2010, BSNL launched WiMax[2] service using the BWA spectrum in the 2500 MHz band. In the year 2010, the Government of India conducted auctions for spectrum in the 2100 MHz band (for 3G) and the 2300 MHz band (for BWA). Many private telecom service providers obtained spectrum in those auctions. In November 2010, Tata Docomo, a private telecom service provider, launched 3G services in India using the spectrum in the 2100 MHz band. The first 4G service in India was launched by Bharti Airtel in the year 2012 by using the BWA spectrum in the 2300 MHz band and the LTE[3] technology. A decade later, in October 2022, Reliance Jio Infocomm Limited and Bharti Airtel Limited launched 5G services in India. Till date, three private operators have deployed their 5G networks in the country. At present, the spectrum in the 700 MHz, 3300 MHz, and 26 GHz bands is being used by the mobile operators to provide 5G services in India.

1.8 The Government of India conducted the first auction for spectrum in the year 2010. Till date, nine spectrum auctions have been conducted so far in India. The following table presents the frequency bands auctioned in these spectrum auctions.

[1] Wideband Code Division Multiple Access (WCDMA) is a type of cellular technology that was developed as a third-generation (3G) mobile communications standard.

[2] Worldwide Interoperability for Microwave Access (WiMax) was an early mobile broadband technology that was intended to provide 4G-like services.

[3] LTE (Long-Term Evolution) is a fourth-generation (4G) wireless standard that provides increased network capacity and speed for cellphones and other cellular devices compared with third-generation (3G) technology.

Table 1.1: Spectrum bands put in spectrum auctions since 2010

Year	Spectrum bands which were auctioned
2010	2100 MHz and 2300 MHz bands
2012	800 MHz and 1800 MHz bands
2013	800 MHz, 900 MHz, and 1800 MHz bands
2014	900 MHz and 1800 MHz bands
2015	800 MHz, 900 MHz, 1800 MHz, and 2100 MHz bands
2016	700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands
2021	700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands
2022	600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands
2024	800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands

C. Recent Important Developments in India

1.9 This section traces the recent developments related to the auction of the IMT spectrum, release of an updated frequency allocation plan, and enactment of a new telecommunications act in India.

(1) TRAI's Recommendations on the auction of Spectrum for IMT/ 5G (April 2022) and the Spectrum Auction of 2022

1.10 On 13.09.2021, the Department of Telecommunications (DoT), Ministry of Communications, Government of India sent a reference under the terms of clause 11(1)(a) of the TRAI Act, 1997 to the Telecom Regulatory Authority of India (hereinafter, also referred to as "TRAI", or "the Authority") and requested TRAI to provide recommendations, *inter-alia*, on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 526-698 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHZ, 3300-3670 MHz and 24.25-28.5 GHz bands for IMT/ 5G.

1.11 In response, TRAI, after following a comprehensive consultation with stakeholders, provided its recommendations on auction of spectrum in the frequency bands identified for IMT/ 5G dated 11.04.2022 (hereinafter, also referred to as "the Recommendations dated 11.04.2022"). Through these recommendations, TRAI provided specific recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 600 MHz band (612-703 MHz), 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3670 MHz and 24.25-28.5 GHz bands for IMT/ 5G.

1.12 The key recommendations given by TRAI through the Recommendations dated 11.04.2022 are given below:

(a) All available spectrum in existing bands viz. 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz and new spectrum bands viz. 600 MHz, 3300-3670 MHz and 24.25-28.5 GHz should be put to auction.

(b) Entire 40 MHz (paired) spectrum [612-652 MHz/ 663-703 MHz] should be put to auction in the forthcoming auction. For 600 MHz frequency range 612-703 MHz, Band Plan APT 600 (Option B1) should be adopted in India.

(c) DoT should carry out harmonization exercise in 800 MHz, 900 MHz and 1800 MHz bands immediately after conducting the auction so that frequencies assigned to telecom service providers (TSPs) are in contiguous manner.

(d) Spectrum cap of 40% on combined spectrum holding in sub-1 GHz bands; Spectrum cap of 40% on combined spectrum holding in 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands; Individual band specific cap of 40% for 3300-3670 MHz and 24.25-28.5 GHz spectrum bands; no overall cap across all bands.

(e) Roll-out conditions for 3300-3670 MHz and 24.25-28.5 GHz bands should be network deployment-based.

(f) Additional bands which have already been identified by the ITU for IMT services and additional bands under consideration in WRC-23 for IMT identification, be explored for possibility to make these bands available for IMT services at the earliest and DoT should come out with a spectrum roadmap for opening of new bands for IMT to meet the future demand.

(g) At least, a 5-year roadmap on spectrum likely to be made available for IMT in each year and likely date/ month of auction should be made public. Such a spectrum roadmap will provide certainty, enable the bidders to take informed decisions and may also encourage new entrants.

1.13 Through the Recommendations dated 11.04.2022, TRAI recommended frequency band-wise, LSA-wise reserve prices of spectrum per MHz for the upcoming spectrum auction. With respect to the spectrum auctions to be held in future, TRAI recommended as below:

"6.42 As there will be regular conduct of spectrum auctions on annual basis (or at shorter intervals), the Authority recommends that

(I) For existing bands (including for the bands being put to auction for the first time in the forthcoming auction), a fresh spectrum valuation exercise be conducted once every three years; a suitable reference be made to the Authority by Government for this purpose.

(II) For auctions conducted in the interim period between periodic valuation exercises conducted once every three years,
(1) for LSAs where the spectrum put to auction in a previous auction is sold, the auction determined prices (duly indexed using applicable MCLR if more than one year has elapsed since the previous auction) should be used for arriving at the reserve prices for the next auction;
(2) for LSAs, where spectrum remains unsold in previous auctions, past recommended reserve price (without indexation) should be used.

(III) For new spectrum bands, to be put to auction for first time, a reference be sent to the Authority, as per established procedure as and when these bands are proposed to be put to auction.

(IV) However, if required, DoT may seek fresh reserve prices from the Authority for the existing bands, providing a full and reasoned justification for the same."

1.14 Based on the Recommendations dated 11.04.2022, DoT conducted the auction of spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in July/ August 2022. In that auction, three bands viz. 600 MHz band, 3300 MHz band and 26 GHz band were put to auction for the first time. 72,098 MHz of spectrum with a value of Rs.4,31,604.95 crore at reserve price

was put to auction. Out of this, 51,236 MHz (71% of the total) was sold with bids amounting to Rs.1,50,173 crore in the auction.

(2) National Frequency Allocation Plan - 2022

1.15 On 26.10.2022, DoT released the National Frequency Allocation Plan - 2022 (NFAP-2022). The NFAP-2022 was drawn up using the ITU Radio Regulations-2020 (RR-2020) as the foundational text. The NFAP-2022 provides a broad regulatory framework, identifying which frequency bands are available for cellular mobile service, Wi-fi, sound and television broadcasting, defence and security communications, satellite communications and satellite-broadcasting in India. Apart from the footnotes of the ITU RR, The NFAP-2022 contains "India footnotes", which provides India specific provisions governing the use of spectrum.

1.16 The footnote IND16 of the NFAP-2022 provides a list of frequency bands, or parts thereof, which had been identified for the implementation of International Mobile Telecommunications (IMT) at the time of the release of NFAP-2022, as outlined below:

Table 1.2: IMT bands as per the IND 16 of the NFAP-2022

S. No.	IMT Bands as mentioned in RR
1	450-455 MHz
2	455-456 MHz
3	456-459 MHz
4	459-460 MHz
5	460-470 MHz

S. No.	IMT Bands as mentioned in RR
6	470-585 MHz
7	585-610 MHz
8	610-890 MHz
9	890-942 MHz
10	942-960 MHz
11	1427-1429 MHz
12	1429-1452 MHz
13	1452-1492 MHz
14	1492-1518 MHz
15	1710-1930 MHz
16	1930-1970 MHz
17	1970-1980 MHz
18	1980-2010 MHz
19	2010-2025 MHz
20	2025-2110 MHz
21	2110-2120 MHz
22	2120-2160 MHz
23	2160-2170 MHz

S. No.	IMT Bands as mentioned in RR
24	2170-2200 MHz
25	2300-2450 MHz
26	2500-2520 MHz
27	2520-2535 MHz
28	2535-2655 MHz
29	2655-2670 MHz
30	2670-2690 MHz
31	3300-3400 MHz
32	3400-3500 MHz
33	3500-3600 MHz
34	3600-3670 MHz
35	24.25-27.5 GHz
36	27.5-28.5 GHz
37	37-43.5 GHz
38	47.2-48.2 GHz
39	66-71 GHz

1.17 IND16 of the NFAP-2022 provides the following notes for the frequency bands, or parts thereof, identified for IMT in India:

(a) **Note 1:** New assignments to the broadcasting service may not be made in 470-582 MHz range. The frequency range 526-582 MHz may be used for mobile service/ IMT in coordination with the broadcasting service.

(b) **Note 2:** The frequency range 582-617 MHz may be used primarily by mobile service/ IMT and rural point to point links.

(c) **Note 3:** The frequency range 617-698 MHz may be used for IMT except that certain point to point links, subject to population being less, may be protected initially at few locations. Such sporadic non-IMT users shall vacate the band in near future.

(d) **Note 4:** The frequency band 3300-3400 MHz may be used for implementation of IMT except that initially some usages towards high seas beyond 50 kms from the coast and some links in very less populated areas may be permitted for non-IMT usages. Such non-IMT usages shall be shifted to other bands in near future.

(e) **Note 5:** The frequency range 3400-3425 MHz may be used for implementation of IMT except that in six DoS (Department of Space) locations at Thiruvanthapuram, Hassan, Bhopal, Jodhpur, Shillong and A&N Islands, a suitable keep-off distance shall be maintained by the IMT stations.

(f) **Note 6:** The frequency range 3600-3670 MHz may be used for implementation of IMT. The Satellite services may use the C band frequencies beyond 3670 MHz after leaving a guard band of 10 MHz.

(g) **Note 7 (i):** The frequency range 24.25-27.5 GHz may be used for implementation of IMT except that in 25.5-27 GHz frequency range the IMT stations will be required to maintain a keep-off distance of 2.7 kms around five DoS locations at Delhi, Shadnagar, Khambaliya, Hut Bay and Tirunelveli.

(h) **Note 7 (ii):** The frequency range 27.5-28.5 GHz may be allowed for shared use by IMT and Satellite services subject to feasibility.

(i) **Note 8:** While considering the bands 37-43.5 GHz, 47.2-48.2 GHz and 66-71 GHz for the implementation of International Mobile Telecommunications (IMT), the requirements of Satellite based and other services to which these bands might have been allocated in the RR, may be taken due care of.

(3) The Telecommunications Act, 2023

1.18 In December 2023, the Indian Parliament enacted a new statute namely, 'The Telecommunications Act, 2023'. The Act amends and consolidates the law relating to development, expansion and operation of telecommunication services and telecommunication networks, assignment of spectrum, and for matters connected therewith or incidental thereto.

1.19 Section 4 of the Telecommunications Act, 2023 provides an overarching policy framework for assignment of frequency spectrum. For a ready reference, Section 4 of the Telecommunications Act, 2023 is reproduced below:

"4. (1) The Central Government, being the owner of the spectrum on behalf of the people, shall assign the spectrum in accordance with Act, and may notify a National Frequency Allocation Plan from time to time.

(2) Any person intending to use spectrum shall require an assignment from the Central Government.

(3) The Central Government may prescribe such terms and conditions as may be applicable, for such assignment of spectrum, including the frequency range, methodology for pricing, price, fees and charges, payment mechanism, duration and procedure for the same.

(4) The Central Government shall assign spectrum for telecommunication through auction except for entries listed in the First Schedule for which assignment shall be done by administrative process.

Explanation. – For the purposes of this sub-section, -

(a) "administrative process" means assignment of spectrum without holding an auction.

(b) "auction" means a bid process for assignment of spectrum.

(5) (a) The Central Government may, by notification, amend the First Schedule for assignment of spectrum—(i) in order to serve public interest; or (ii) in order to perform government function; or (iii) in cases where auction of spectrum is not the preferred mode of assignment due to technical or economic reasons. (b) The notification referred to in clause (a) shall be laid before each House of Parliament.

(6) The Central Government, if it determines that it is necessary in the public interest so to do, may exempt,— (a) from the requirement of assignment under sub-section (2), in such manner as may be prescribed; and (b) by notification, specific usages within specified frequencies and parameters, from the requirements of sub-section (2).

(7) Any exemption with respect to use of spectrum granted under the Indian Telegraph Act, 1885 (13 of 1885) and the Indian Wireless Telegraphy Act, 1933 (17 of 1933) prior to the appointed day, shall continue under this Act, unless otherwise notified by the Central Government.

(8) Any spectrum assigned through the administrative process prior to the appointed day, shall continue to be valid on the terms and conditions on which it had been assigned, for a period of five years from the appointed day, or the date of expiry of such assignment, whichever is earlier.

(9) Any spectrum assigned through auction prior to the appointed day, shall continue to be valid on the terms and conditions on which it had been assigned."

1.20 Importantly, the Subsection (4) of Section 4 of the Telecommunications Act, 2023, provides that spectrum for telecommunication shall be assigned through auction except for entries listed in the first schedule for which assignment shall be done by administrative process. The First Schedule of the Telecommunications Act, 2023 is reproduced below:

"THE FIRST SCHEDULE

…

ASSIGNMENT OF SPECTRUM THROUGH ADMINISTRATIVE PROCESS

1. *National security and defence.*
2. *Law enforcement and crime prevention.*
3. *Public broadcasting services.*
4. *Disaster management, safeguarding life and property.*
5. *Promoting scientific research, resource development, and exploration.*
6. *Safety and operation of roads, railways, metro, regional rail, inland waterways, airports, ports, pipelines, shipping, and other transport systems.*
7. *Conservation of natural resources and wildlife.*
8. *Meteorological department and weather forecasting.*
9. *Internationally recognised dedicated bands for amateur stations, navigation, telemetry, and other like usages.*
10. *Use by Central Government, State Governments, or their entities or other authorised entities for safety and operations of mines, ports and oil exploration and such other activities where the use of spectrum is primarily for supporting the safety and operations.*
11. *Public Mobile Radio Trunking Services.*
12. *Radio backhaul for telecommunication services.*

    Explanation —The term "radio backhaul" shall mean the use of radio frequency only to interconnect telecommunication

equipment, other than the customer equipment in telecommunication networks.

13. *Community Radio Stations.*
14. *In-flight and maritime connectivity.*
15. *Space research and application, launch vehicle operations and ground station for satellite control.*
16. *Certain satellite-based services such as: Teleports, Television channels, Direct To Home, Headend In The Sky, Digital Satellite News Gathering, Very Small Aperture Terminal, Global Mobile Personal Communication by Satellites, National Long Distance, International Long Distance, Mobile Satellite Service in L and S bands.*
17. *Use by Central Government, State Governments or their authorised agencies for telecommunication services.*
18. *Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Limited (MTNL).*
19. *Testing, trial, experimental, demonstration purposes for enabling implementation of new technologies, including for creation of one or more Regulatory Sandboxes."*

(4) TRAI's recommendations on auction of IMT spectrum (September 2023, and April 2024) and the spectrum auction of June 2024

1.21 Through a reference dated 02.08.2023, DoT sought TRAI's recommendations for the auction of spectrum in certain frequency bands identified for IMT viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz and 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz bands. In this regard, TRAI, through its response dated 01.09.2023 to DoT, stated, *inter-alia*, as below:

"10. …, the Authority reiterates its recommendation at para 6.42 (II) of the Recommendations on 'Auction of Spectrum in frequency bands identified for IMT/ 5G' dated 11.04.2022 on the reserve price. All available spectrum in the existing bands viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz in the referred LSAs may be put to auction with the same band plan, block size and associated conditions.

11. As per the para 6.42 (III) of the TRAI's Recommendations dated 11.04.2022, the Authority will initiate a consultation process for providing recommendations for the new referred bands viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz.

12. The Government may put to auction the spectrum in the existing bands viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz without waiting for the Authority's recommendations for the new bands viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz."

1.22 In April 2024, TRAI issued a consultation paper on 'Auction of Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz bands identified for IMT'. After a detailed consultation with stakeholders, TRAI, on 04.02.2025, sent its recommendations on the frequency spectrum in the 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands to DoT.

1.23 Based on the TRAI's response dated 01.09.2023, the Government conducted auction of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands in the month of June 2024. In the auction, 10,522.35 MHz of spectrum with a value of Rs.96,238.45 crore at reserve price was put to auction. Out of this, 141.40 MHz was sold with bid amounting to Rs.11,340.79 crore.

D. DoT's Reference Dated 15.05.2025

1.24 DoT, through the letter No. L-14006/01/2025-IMT dated 15.05.2025 (**Annexure-1.1**) sent a reference under the terms of clause 11(1)(a) of the TRAI Act, 1997 and requested TRAI to provide recommendations for the auction of radio frequency (RF) spectrum in the frequency bands identified for International Mobile Telecommunications (IMT). The relevant extract from the afore-mentioned letter dated 15.05.2025 is reproduced below:

"In response to DoT's reference dated 02-08-2023 on auction of RF spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz and 37 – 37.5 GHz, 37.5 – 40 GHz and 42.5 – 43.5 GHz bands, TRAI had provided its recommendations on 01-09-2023. Based on the TRAI recommendations dated 01-09-2023, the Government conducted auction of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands during June, 2024.

1.1 During this auction, a total of 10522.35 MHz spectrum in different band-LSA combinations worth Rs. 96238.45 crores (at Reserve Price) were made available for bidding. A total quantum of 141.40 MHz of spectrum worth Rs. 11340.79 crores were sold during this auction. Moreover, no bids were received in the 800 MHz, 2300 MHz, 3300 MHz and 26 MHz bands.

1.2 Further, as per the earlier TRAI recommendation, a comprehensive report analysing the outcomes of the above auction was also communicated to TRAI on 08-01-2025. Copy of the same is attached as Annexure – I.

2. The following developments took place after the last reference to TRAI, for the auctions held during June 2024:

Administratively assigned spectrum released by TSPs:

2.1 M/s BSNL was assigned 02 MHz of paired spectrum in the 1800 MHz band in Kerala, Tamil Nadu and Odisha LSAs on 16-11-2023 and its right to use expired on 30-06-2024. Hence, this spectrum is now available for bidding in the next auction.

2.1.1 Also some of the Telecom Service Providers (TSPs) whose service licenses will be expiring during the year 2026-2027 are holding administratively assigned spectrum. Such spectrum will be available for bidding post expiry of these service licenses. The LSA-wise details of all such spectrum are attached as Annexure – II.

Spectrum reserved for M/s BSNL:

2.2. As per the approval of the Union Cabinet, the Department has reserved some spectrum to BSNL in some LSAs in various frequency bands. Details of such spectrum reserved for BSNL is attached as Annexure – III.

Spectrum available due to Re-farming/ vacation:

2.3 Based on the proposal of DoT on the re-farming/ vacation of spectrum, the Union Cabinet has taken the following decisions:

2.3.1 A total of 687 MHz of spectrum is to be re-farmed for IMT based services as tabulated below:

Sl. No.	*Frequency band (MHz)*	*Quantum of spectrum for re-farming (MHz)*	*Timeline/ Status for vacation of spectrum by existing users for IMT based services*
1	*6725-7025#*	*300*	*31-12-2030*
2	*6425-6725#*	*300*	*Immediately*
3	*2500-2690**	*20*	*Implemented*
4	*1427-1518*	*67*	*31-12-2026*
TOTAL		*687*	

#Protection with geographical separation will be provided to the feeder link and space operation of the existing/ future satellite operations of Department of Space, at certain locations. The details of such locations as shared by the Department of Space is enclosed as Annexure – IV.

** The 20 MHz of spectrum in the 2500 – 2690 MHz band has been re-farmed and allocated for IMT based services.*

2.3.2 Additionally, it was also decided that the frequency band from 27.5-28.5 GHz shall be used for satellite-based services in place of IMT/ 5G.

Indian Railways request for additional spectrum.

2.4 5 MHz of paired spectrum is presently assigned to Indian Railways (IR) for their safety and security networks. Besides this, IR has sought additional 5 MHz of paired spectrum in the 700 MHz band for national roll out of their indigenously developed Automatic Train Protection

system. In this regard, TRAI had provided its recommendations on 20-12-2024, which is presently under examination in the DoT.

Auction of spectrum in 37- 40 GHz band:

2.5 Based on the DoT reference, TRAI gave its recommendations on 04-02-2025 for the auction of RF spectrum in the 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands, which is under consideration in the Department.

Auction of spectrum in 600 MHz band:

2.6 In the auction held in 2024, 600 MHz (612-652/ 663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. In the ITU Radio Regulations also, this band has not been identified at the regional or global level for International Mobile Telecommunication. It was also decided that fresh consultations with TRAI may be taken before putting up this band for auction.

2.6.1 In view of the above, there is a need to re-examine and seek fresh recommendations for the auction of spectrum in the 600 MHz band.

3. Further, it may be noted that out of the total 700 MHz spectrum in the 6 GHz frequency band (6425-7125 MHz), only 400 MHz spectrum in two fragmented chunks at 6425-6725 MHz (300 MHz) and 7025-7125 MHz (100 MHz) are immediately available for auction and the remaining 300 MHz in the frequency band 6725-7025 MHz will be available by December 2030.

3.1 Presently, the IMT ecosystem in the 6 GHz band is at a nascent stage and very few countries like China, South Korea, UAE, and Saudi Arabia, have assigned this band for IMT based services.

3.2 In view of the above, appropriate time for the auction of this band is required to be explored considering the less developed ecosystem and availability of only 400 MHz spectrum in a fragmented manner.

4. The Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed the following, among others: "Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply."

5. Considering the above-mentioned facts, the LSA-wise quantum of the spectrum available with the Government in the existing and new IMT bands, excluding the spectrum reserved for BSNL and spectrum released due to expiry of the service licenses during 2026-2027 are attached as Annexure-V. The details of the spectrum released due to expiry of the service licenses during 2026-2027 are attached as Annexure-II.

5.1 Any other spectrum, which might be available due to any re-farming etc. in these bands before the start of the auction, will also be made part of the auction process.

6. Further, as part of the reforms in the telecom sector, the Government has decided to hold spectrum auctions in the last quarter of every financial year.

7. In view of the above, under the terms of clause 11 (1)(a) of TRAI Act, 1997, as amended by TRAI Amendment Act 2000, TRAI is requested to:

(a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

(b) explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz & 7025-7125 MHz bands. Accordingly, provide recommendations on timing of auction, applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands.

(c) re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band.

(d) provide any other recommendations deemed fit for the purpose of spectrum auction in these frequency bands, including the regulatory/ technical requirements as enunciated in the relevant provisions of the latest NFAP/ Radio Regulations of the ITU.

7.1 Further, while providing its recommendations, TRAI may also take into account the observations of Department of Economic Affairs as mentioned in para 4 above."

1.25 Hereinafter, the afore-mentioned letter dated 15.05.2025 will also be referred to as "the Reference dated 15.05.2025".

1.26 TRAI examined the Reference dated 15.05.2025, and through a letter dated 19.06.2025, sought certain additional information/ clarifications from DoT. In response, DoT, through a letter dated 14.08.2025 (**Annexure 1.2**), provided the requisite information/ clarification. The salient points of the DoT's response letter dated 14.08.2025 are given below:

(a) With respect to 67 MHz of spectrum in the 1427-1518 MHz range to be refarmed for IMT by 31.12.2026, TRAI had requested DoT to provide (i) the reasons for not including this spectrum for the forthcoming auction, (ii) the details of the exact frequencies in this range that would be made available for IMT, and (iii) the expected timelines to put the spectrum to auction. In response, DoT informed as below:

"Out of the total 91 MHz spectrum in the 1427-1518 MHz band, 67 MHz has been identified for IMT, while 24 MHz is reserved for assignment to a government user. This band will be refarmed for IMT-based services only after 2026 and band plan is also not finalised, therefore, it is not included in the upcoming auction. Hence, TRAI is requested to recommend a possible band plan for the 67 MHz spectrum between 1427-1518 MHz considering the need to assign a continuous 24 MHz block to the Government user."
[Emphasis added]

(b) With respect to the TRAI's request for the information on the outcome of the analysis and keep-out distance determined by DoT for IMT/ terrestrial services, as recommended by the Department of Space (DoS) for the 6 GHz band, DoT informed as below:

"In the 6 GHz band, satellite-based services (uplink) are coexisting with IMT-based services. The determination of keep-out distances for satellite uplink stations shall be worked out by the TSPs in coordination with the DoS, based on the technical specifications of the base transceiver stations (BTS). At present, the technical details of IMT base stations operating in the 6 GHz band are not available. Once any technical analysis is carried out by the TSPs and DoS, the outcome will be duly communicated to TRAI."

(c) With respect to the TRAI's request for the clarification on the assignment of spectrum in the 6425-6725 MHz range to any other users apart from DoS, along with the protection requirements of such systems, DoT provided the following information:

"No protection is required for terrestrial users operating in this band. The incumbent users in this band will be relocated to another frequency range."

1.27 Hereinafter, the afore-mentioned letter dated 14.08.2025 will also be referred to as "the Letter dated 14.08.2025".

1.28 In short, Through the Reference dated 15.05.2025, DoT has requested TRAI to provide recommendations for the auction of 600 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands. DoT has also requested TRAI to explore the possibility of auction and timing of auction for 6425-6725 MHz and 7025-7125 MHz bands. Besides, through the Letter dated 14.08.2025, DoT has requested TRAI to recommend the band plan for the 67 MHz spectrum between 1427-1518 MHz. These aspects will be examined in detail in Chapter II and Chapter III of this consultation paper. As a prelude, the following section provides the background information on the relevant frequency bands.

E. Background Information on the Relevant Frequency Bands For IMT

(1) The 600 MHz band

1.29 In the year 2021, DoT had sought TRAI's recommendations for the auction of frequency spectrum in the 600 MHz band for IMT for the first time. Based on the Recommendations dated 11.04.2022, the

Government put 40 MHz (paired) spectrum [612-652 MHz/ 663-703 MHz] in the 600 MHz band (3GPP band plan n105) in the spectrum auction of 2022. However, no bids were received for this spectrum in the spectrum auction. Thus, 40 MHz (paired) spectrum in the 600 MHz band would be available for the forthcoming auction.

1.30 Through the Reference dated 15.05.2025, DoT has informed that "*[i]n the auction held in 2024, 600 MHz (612-652/ 663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. In the ITU Radio Regulations also, this band has not been identified at the regional or global level for International Mobile Telecommunication."* Further, DoT has requested TRAI to "*re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band*".

1.31 The international scenario and ecosystem for IMT in the 600 MHz band will be examined in detail in Chapter II of this consultation paper.

(2) The 700 MHz band

1.32 In the year 2015, DoT sought TRAI's recommendations for the auction of frequency spectrum in the 700 MHz band for IMT for the first time. Based on the TRAI's recommendations dated 27.01.2016, the 700 MHz band (3GPP band 28) was opened for IMT with the FDD configuration in the year 2016. 10 MHz (paired) spectrum in 700 MHz was assigned for the Government use in each LSA, and the remaining 35 MHz (paired) in each LSA was put to auction in the spectrum auction held in October 2016. However, the entire spectrum remained unsold in that auction.

1.33 Thereafter, in October 2019, considering the importance for Indian Railways to have the latest standards of train signaling system in order to improve the passenger safety as well as to improve the operational efficiency, TRAI recommended that out of the 35 MHz (paired) spectrum available in the 700 MHz band, 5 MHz (paired) spectrum may be allotted to Indian Railways for implementing European Train Control System (ETCS) Level-2, Mission-Critical Push-To-Talk (MCPTT) + Voice, Internet of Things (IoT) based asset monitoring services, passenger information display system and live feed of video surveillance of few coaches at a time. Accordingly, in the subsequent spectrum auction conducted in March 2021, 30 MHz (paired) spectrum in 700 MHz band was put to auction in each LSA. However, entire spectrum remained unsold.

1.34 In the subsequent spectrum auction held in July/ August 2022, 10 MHz (paired) spectrum was sold in each LSA. Thereafter, in the year 2023, DoT provisionally assigned 5 MHz (paired) spectrum in 700 MHz band to NCRTC. Further, 10 MHz (paired) spectrum was reserved for the public sector unit (PSU) mobile operator.

1.35 The following table exhibits the present spectrum utilization of the 700 MHz band.

Table 1.3: Present Utilization of the 700 MHz Band

S. No.	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Quantum of spectrum (MHz)	TSP/ User
1.	703 - 713	758 - 768	10	Government User
2.	713 - 718	768 - 773	5	Indian Railways
3.	718 - 723	773 - 778	5	NCRTC/ RRTS

S. No.	Uplink Frequency (MHz)	Downlink Frequency (MHz)	Quantum of spectrum (MHz)	TSP/ User
4.	723 - 733	778 - 788	10	Reliance Jio
5.	733 - 738	788 - 793	5	Vacant
6.	738 - 748	793 - 803	10	BSNL

1.36 For the vacant 5 MHz (paired) spectrum, DoT, through the Reference dated 15.05.2025, has mentioned that *"IR has sought additional 5 MHz of paired spectrum in the 700 MHz band for national roll out of their indigenously developed Automatic Train Protection system. In this regard, TRAI had provided its recommendations on 20-12-2024, which is presently under examination in the DoT."* Through the Reference dated 15.05.2025, DoT has not sought TRAI's recommendations w.r.t. the 700 MHz band.

(3) The 800 MHz, 900 MHz, 1800 MHz Bands

1.37 Earlier, the spectrum in the 800 MHz band (3GPP band 5), 900 MHz band (3GPP band 8) and 1800 MHz band (3GPP band 3) was primarily being used for providing circuit-switched voice telephony services by using 2G technologies (CDMA and GSM) in India. At present, these bands are predominantly being used to deliver high speed data services using the 4G technology (LTE).

1.38 Since the year 2012, eight auctions have been held for the assignment of spectrum in various frequency bands for IMT including 800 MHz, 900 MHz and 1800 MHz bands. The amount of spectrum auctioned, and the

amount of spectrum sold in the 800 MHz, 900 MHz, and 1800 MHz bands since the year 2012 are given in the following table:

Table 1.4: Spectrum auctioned and sold in 800 MHz, 900 MHz, and 1800 MHz bands since 2012

S. No.	Year	Spectrum band	Amount of spectrum put to auction	Amount of spectrum sold
1.	2012	1800 MHz	295 MHz	127.5 MHz
		800 MHz	95 MHz	No bidder
2.	2013	900 MHz	46 MHz (Delhi, Mumbai and Kolkata)	No bidder
		1800 MHz	57.5 MHz (Delhi, Mumbai, Karnataka and Rajasthan)	No bidder
		800 MHz	95 MHz	30 MHz
3.	2014	900 MHz	46 MHz (Delhi, Mumbai and Kolkata)	46 MHz
		1800 MHz	385 MHz	307.2 MHz
4.	2015	800 MHz	108.75 MHz	86.25 MHz
		900 MHz	177.8 MHz	168 MHz
		1800 MHz	99.2 MHz	93.8 MHz
5.	2016	800 MHz	73.75 MHz (in 19 LSAs)	15 MHz (in 4 LSAs)

S. No.	Year	Spectrum band	Amount of spectrum put to auction	Amount of spectrum sold
		900 MHz	9.4 MHz (Bihar, Gujarat, UP-East, UP-West)	No bidder
		1800 MHz	221.6 MHz (All LSAs except Tamil Nadu)	174.8 MHz (in 19 LSAs)
6.	2021	800 MHz	230 MHz (in all LSAs)	150 MHz (in 19 LSAs)
		900 MHz	98.8 MHz (in 19 LSAs)	38.4 MHz (in 9 LSAs)
		1800 MHz	355 MHz (in all LSAs)	152.2 MHz (in 21 LSAs)
7.	2022	800 MHz	136 MHz (in all LSAs)	20 MHz (in 4 LSAs)
		900 MHz	74 MHz (in 18 LSAs)	12.8 MHz (in 3 LSAs)
		1800 MHz	267 MHz (in all LSAs)	88.4 MHz (in 10 LSAs)
8.	2024	800 MHz	118.75 MHz (in 19 LSAs)	No bidder
		900 MHz	117.2 MHz (in all LSAs)	60.8 MHz (in 14 LSAs)
		1800 MHz	221.4 MHz (in all LSAs)	50.6 MHz (in 10 LSAs)

1.39 The spectrum that remained unsold in the spectrum auction held in June 2024 along with the administratively assigned spectrum in the 1800 MHz band, which may be released due to the expiry of licenses in the year 2026-27, would be available for the forthcoming auction.

(4) The 2100 MHz Band

1.40 In the year 2010, the 2100 MHz spectrum band (3GPP band 1) was opened in India for deploying 3G networks. However, lately, service providers have started to migrate from 3G services to 4G services.

1.41 The first auction of the spectrum in the 2100 MHz band was held in the year 2010. In this auction, three blocks [each block of 5 MHz (paired)] of spectrum in the 2100 MHz band in 17 LSAs and four blocks in the remaining five LSAs were awarded. In addition, the Government alloted one block of 5 MHz (paired) spectrum in all 22 LSAs to the PSU operators at the winning price achieved in the respective LSAs.

1.42 The second auction of the spectrum in the 2100 MHz band was held in March 2015 along with other frequency bands. In that auction, one block of 5 MHz (paired) spectrum in the 2100 MHz band was made available in the 17 LSAs in which three blocks of spectrum in 2100 MHz band had been auctioned in the year 2010. Meanwhile, the Defence Ministry agreed, in principle, for the swapping of 15 MHz (paired) spectrum in the 2100 MHz band with the 1900 MHz band in all LSAs. Therefore, additional three blocks of 5 MHz (paired) in the 2100 MHz band became available for the commercial assignment. These new blocks were included in the spectrum auction held in the year 2016.

1.43 Till date, a total of 40 MHz (paired) spectrum has been made available in the 2100 MHz band for commercial mobile services. Six spectrum

auctions have been conducted for the 2100 MHz band so far. A summary of the spectrum awarded in the 2100 MHz band through various auctions is given in the following table:

Table 1.5: Spectrum auctioned and sold in the 2100 MHz band since 2010

S. No.	Year	Amount of spectrum put to auction	Amount of spectrum sold
1	2010	355 MHz (15 MHz in 17 LSAs, 20 MHz in 4 LSAs)	355 MHz
2	2015	85 MHz (5 MHz in 17 LSAs)	70 MHz
3	2016	360 MHz (in 22 LSAs)	85 MHz (in 12 LSAs)
4	2021	175 MHz (in 19 LSAs)	15 MHz (in 3 LSAs)
5	2022	160 MHz (in 19 LSAs)	35 MHz (in 7 LSAs)
6	2024	125 MHz (in 15 LSAs)	20 MHz (in 4 LSAs)

1.44 The spectrum that remained unsold in the spectrum auction held in June 2024 would be available for the forthcoming auction.

(5) The 2300 MHz band

1.45 For the spectrum in the 2300 MHz band, 3GPP band 40 has been adopted in India. At present, this band is being used to offer high speed data services using LTE technology. The spectrum in the 2300 MHz band was assigned for the first time for commercial use through an auction

conducted in the year 2010. In that auction, the Government put two blocks [each block of 20 MHz (unpaired)] in the 2300 MHz band in each of the 22 LSAs. The entire spectrum which was put for bidding was sold in that auction.

1.46 Subsequently, more frequency spectrum was made available in the 2300 MHz band. In total, 80 MHz spectrum has been made available in the 2300 MHz band for commercial mobile services. Till date, five spectrum auctions have been conducted for the spectrum in the 2300 MHz band. A summary of the spectrum awarded in the 2300 MHz band through various auctions held so far is given in the following table:

Table 1.6: Spectrum auctioned and sold in the 2300 MHz band since 2010

S. No.	Year	Amount of spectrum put to auction	Amount of spectrum sold
1	2010	880 MHz (40 MHz in each LSA)	880 MHz
2	2016	320 MHz (20 MHz in 16 LSAs)	320 MHz
3	2021	560 MHz (40 MHz in 6 LSAs, 20 MHz in 16 LSAs)	500 MHz (in 22 LSAs)
4	2022	60 MHz (10 MHz in 6 LSAs)	No bidder
5	2024	60 MHz (10 MHz in 6 LSAs)	No bidder

1.47 The spectrum that remained unsold in the spectrum auction held in June 2024 would be available for the forthcoming auction.

(6) The 2500 MHz band

1.48 For the spectrum in the 2500 MHz band, 3GPP band 41 has been adopted in India. At present, this band is being used to offer high speed data services using the 4G technology.

1.49 In the year 2009, the Government allotted one block of 20 MHz (unpaired) spectrum in the 2500 MHz band in Delhi and Mumbai LSAs to MTNL and in the remaining 20 LSAs to BSNL, for which they had to pay to the Government at the winning price for the spectrum in the 2300 MHz band achieved in the 2010 auctions.

1.50 Later, MTNL surrendered its spectrum in this band in both the LSAs (Delhi and Mumbai), while BSNL surrendered its spectrum in six LSAs (Kolkata, Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu, and Karnataka).

1.51 The spectrum in the 2500 MHz band was put to auction for the first time in the auction held in October 2016. In that auction, a total of 600 MHz spectrum in the 2500 MHz band was put to auction (20 MHz in all 22 LSAs *plus* 20 MHz in 8 LSAs surrendered by MTNL/ BSNL), out of which, 370 MHz spectrum was sold in 20 LSAs.

1.52 In the year 2023, the Government decided to allot additional 20 MHz of spectrum in the 2500 MHz band in the Andhra Pradesh, Karnataka, Kolkata, Tamil Nadu, Delhi and Mumbai LSAs and 10 MHz of spectrum in Gujarat and Maharashtra LSAs to the PSU operators for the roll out of 4G services.

1.53 Till date, four spectrum auctions have been conducted for the 2500 MHz band. A summary of the spectrum awarded in the 2500 MHz spectrum through various auctions held so far is given in the following table:

Table 1.7: Spectrum auctioned and sold in the 2500 MHz band since 2016

S. No.	Year	Amount of spectrum put to auction	Amount of spectrum sold
1	2016	600 MHz (40 MHz in 8 LSAs, 20 MHz in 14 LSAs)	370 MHz (in 20 LSAs)
2	2021	230 MHz (40 MHz in 2 LSAs, 30 MHz in 1 LSA, 20 MHz in 3 LSAs, 10 MHz in 6 LSAs)	No bidder
3	2022	230 MHz (40 MHz in 2 LSAs, 30 MHz in 1 LSA, 20 MHz in 3 LSAs, 10 MHz in 6 LSAs)	20 MHz (in 2 LSAs)
4	2024	70 MHz (20 MHz in 2 LSAs, 10 MHz in 3 LSAs)	10 MHz (in 1 LSA)

1.54 Through the Reference dated 15.05.2025, DoT has informed, *inter-alia*, that 20 MHz spectrum (in each LSA) in the 2500 MHz band has been refarmed and allocated for IMT based services. In total, in the 2500 MHz, 60 MHz spectrum (in each LSA) has been made available for IMT.

(7) The 3300 MHz band

1.55 In India, for the spectrum in the 3300 MHz band, 3GPP band n77/ n78 have been adopted. The spectrum in the 3300 MHz band was put to auction for IMT services for the first time in India in the spectrum auction

conducted in July/ August 2022. At that time, 40 MHz spectrum was reserved for the PSU operator. In the spectrum auction held in July/ August 2022, 7260 MHz (330 MHz in each LSA) spectrum was put to auction, out of which 5490 MHz (in 22 LSAs) was sold.

1.56 Subsequently, it was decided to reserve an additional 30 MHz in the 3300 MHz band in each LSA for the PSU operator. The residual spectrum in the 3300 MHz band was put to auction in the spectrum auction held in June 2024. However, no bids were received in that auction. Thus, the spectrum in the 3300 MHz band that remained unsold in the spectrum auction held in June 2024, would be available for the forthcoming auction.

(8) The 6425-6725 MHz and 7025-7125 MHz ranges

1.57 Through the Reference dated 15.05.2025, DoT has requested the Authority to explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz and 6725-7125 MHz bands.

1.58 The 6 GHz band (5925–7125 MHz) is a mid-band frequency range that has garnered significant attention for its potential use in Wi-Fi and International Mobile Telecommunications (IMT), primarily for further roll out of 5G, 5G-Advanced and future 6G systems. In India, the 6 GHz band (5925–7125 MHz range) has been segregated into two parts viz. the lower 6 GHz band (5925-6425 MHz), and the upper 6 GHz band (6425-7125 MHz). In terrestrial networks in India, the lower 6 GHz band is, at present, being used for provisioning microwave backhaul links. Recently, TRAI has, based on a reference from DoT, issued a consultation paper[4] dated 28.05.2025 *inter-alia*, for the assignment of spectrum in the lower

[4] Consultation Paper on Assignment of the Microwave Spectrum in 6 GHz (lower), 7 GHz, 13 GHz, 15 GHz, 18 GHz, 21 GHz Bands, E-Band, and V-Band, dated 28.05.2025. The Consultation Paper is available at the following URL: https://www.trai.gov.in/sites/default/files/2025-05/CP_28052025.pdf

6 GHz band. Further, DoT, through a letter dated 08.05.2025, has informed TRAI that it "*has decided to de-license the lower 6 GHz band (5925-6425 MHz) for low power applications. Relevant rules are under consideration in the Department for notification*." In this regard, DoT, on 16.05.2025, has circulated draft rules by the name (draft) "Use of Low Power and Very Low Power Wireless Access System including Radio Local Area Network in Lower 6 GHz band (Exemption from Licensing Requirement) Rules, 2025"[5] for public consultation.

1.59 The newly identified 6425-6725 MHz and 6725-7125 MHz bands form part of the upper 6 GHz band (6425-7125 MHz range). In June 2025, the 3GPP standardized the upper 6 GHz band (6425-7125 MHz range) for IMT and assigned the frequency band number 'n104' for 5G-NR to this band. The 3GPP has defined the Time Division Duplex (TDD) configuration for this band.[6]

1.60 With respect to the upper 6 GHz band, the GSMA, in its paper[7] on 'Spectrum Policy Trends 2025' (February 2025), has noted that "*Hong Kong recently concluded the world's first IMT auction of the upper 6 GHz band, and the UAE is assigning the full upper 6 GHz to its operators. Meanwhile, Sri Lanka, Indonesia, Thailand, Bangladesh and Cambodia have added it to their spectrum roadmaps and India is also progressing the use of 6 GHz for mobile. In 2024, Australia, Brazil, Chile and Mexico moved away from dedicating the entire band for unlicensed use and identified the upper part of the band to IMT in the countries' table of frequency allocations. In 2025, many more nations will make 6 GHz*

[5] https://dot.gov.in/sites/default/files/Gazette%20Notification%20Draft%206GHz%20Delicensing%20Rules.pdf

[6] Source: https://www.yolegroup.com/industry-news/3gpp-officially-completed-the-specification-of-the-upper-6ghz-licensed-band-for-5g

[7] Source: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/GSMA-Spectrum-Policy-Trends-2025-1.pdf

available for IMT. Countries across APAC, the Gulf region and Latin America will help accelerate these regional trends."

1.61 On examination of the international scenario, it has been observed that there is a strong momentum for the use of the upper 6 GHz band for IMT.

(9) The 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands

1.62 With respect to the frequency bands 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz, DoT has mentioned that "*based on the DoT reference, TRAI gave its recommendations on 04.02.2025 for the auction of RF spectrum in the 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands, which is under consideration in the Department".* Accordingly, these frequency bands have not been deliberated in this consultation paper.

(10) The 26 GHz band

1.63 In 2021, DoT through its reference informed, *inter-alia*, about the identification of the 24.25-28.5 GHz range for IMT and sought the recommendations of TRAI for the auction of spectrum in the 24.25-28.5 GHz range for IMT/ 5G. In this regard, TRAI, through the Recommendations dated 11.04.2022, recommended the terms and conditions for the assignment of spectrum in the 24.25-28.5 GHz range through auction. Based on these recommendations, the spectrum in the 24.25-27.5 GHz range was put in the spectrum auction held in July/ August 2022. Notably, the frequency spectrum range 27.5-28.5 GHz was not put in that auction.

1.64 For the spectrum in the 26 GHz band (24.25-27.5 GHz range), the 3GPP band n257 has been adopted in India. From the total available spectrum

of 3.25 GHz in each LSA in the 26 GHz band, 400 MHz spectrum in each LSA was reserved for the PSU operator and 2850 MHz in each LSA was put to auction in the spectrum auction held in July/ August 2022. Out of the total 62700 MHz (2850 MHz in each of the 22 LSAs), 45350 MHz was sold in that auction.

1.65 Subsequently, it was decided to reserve an additional 400 MHz for the already reserved 400 MHz in the 26 GHz band in all LSAs except Kerala for the PSU operator. In Kerala LSA, 250 MHz in addition to the already reserved 400 MHz in 26 GHz band was reserved for the PSU operator. The residual spectrum was put to auction in the spectrum auction held in 2024. However, no bids were received.

1.66 Through the present reference dated 15.05.2025, DoT has informed that it has been decided that the frequency range 27.5-28.5 GHz shall be used for satellite-based services in place of IMT/ 5G.

F. The Present Consultation Paper

1.67 In this background, this consultation paper is being issued for soliciting comments from the stakeholders on auction of radio frequency spectrum in the frequency bands identified for IMT. This chapter provides the introduction and background information on the reference received from DoT. Chapter II examines the issues related to the auction of spectrum. Chapter III examines the issues related to valuation and reserve price of spectrum. Chapter IV summarizes the issues for consultation.

CHAPTER II: AUCTION RELATED ISSUES

2.1 Through the Reference dated 15.05.2025, DoT has requested TRAI to -

(a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

(b) explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz and 7025-7125 MHz bands. Accordingly, provide recommendations on timing of auction, applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands.

(c) re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band.

(d) provide any other recommendations deemed fit for the purpose of spectrum auction in these frequency bands, including the regulatory/ technical requirements as enunciated in the relevant provisions of the latest NFAP/ Radio Regulations of the ITU.

2.2 Further, through the Letter dated 14.08.2025, DoT has requested TRAI to recommend band plan for the 67 MHz spectrum between 1427-1518 MHz range considering the need to assign a contiguous 24 MHz block to the Government user.

2.3 At present, the Government of India, through DoT, assigns the right to use the spectrum in certain specified frequency band by means of auction in various Licensed Service Areas (LSA)[8]. For the auction of

[8] Licensed Service Area (LSA) for access service is Telecom Circle/ Metro Area. At present, there are 22 LSAs in the country.

spectrum in the specified frequency bands, DoT issues a Notice Inviting Application (NIA) to invite applications from prospective bidders who meet the eligibility criteria for participating in the auction. NIA is a comprehensive document which stipulates, *inter-alia*, the methodology of auction, eligibility criteria to participate in the auction, frequency bands to be auctioned with the amount of spectrum available for bidding, validity period of right to use of spectrum, band plan, block size, minimum bid quantity, spectrum cap, roll-out obligations, reserve price etc. for each frequency band.

2.4 Through this chapter, the aspects related to the availability of spectrum, amount of spectrum to be put to auction, eligibility conditions to participate in this auction, validity period of right to use of spectrum, band plan, block size, minimum bid quantity of spectrum, spectrum cap, roll out obligations etc. will be examined for the frequency bands under consideration for the forthcoming auction. The aspects related to valuation and reserve price will be examined in Chapter III of this consultation paper.

2.5 In this consultation paper, the term 'existing bands' refers to the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands. These bands are already in use for IMT in India. The other bands under consideration viz. the 600 MHz band, 1427-1518 MHz, 6425-6725 MHz and 7025-7125 MHz bands are yet to be assigned to telecom service providers for IMT in India.

2.6 The plan of this chapter is as below:

(i) Section-A: The aspects related to the auction of the existing bands

(ii) Section-B: The aspects related to the auction of the 600 MHz band

(iii) Section-C: The aspects related to the auction for the newly identified 6425-6725 MHz and 7025-7125 MHz bands

(iv) Section-D: The aspects related to the band plan for the 67 GHz spectrum between 1427-1518 MHz

(v) Section-E: The aspects related to the methodology for the auction of spectrum

A. Aspects related to the auction of the existing bands

(1) Availability of the spectrum in the existing bands

2.7 This sub-section provides broad-level information on the availability of the spectrum in each of the existing bands, viz. the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

The 800 MHz Band (Uplink: 824-844 MHz, Downlink: 869-889 MHz)

2.8 India has adopted FDD configuration based 3GPP band 5 for the 800 MHz band. This band consists of 20 MHz (paired) spectrum. The 824-844 MHz range is for the uplink, and the 869-889 MHz range is for the downlink. 5 MHz (paired) spectrum in the 800 MHz band has been assigned to the Government in three LSAs viz. Assam, Jammu & Kashmir and North East. The remaining spectrum in the 800 MHz band in all LSAs has been earmarked for IMT.

2.9 In the last spectrum auction held in June 2024, a total of 118.75 MHz (paired) spectrum was put to auction in the 800 MHz band in 19 LSAs; however, no bid was received. Therefore, the entire spectrum, which was put to auction in June 2024, would be available for the forthcoming auction.

2.10 The LSA-wise availability of the spectrum in the 800 MHz band is given in the following table:

Table 2.1: Availability of the spectrum in the 800 MHz band (paired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	20	10	10
Assam	15	15	-
Bihar	20	10	10
Delhi	20	13.75	6.25
Gujarat	20	16.25	3.75
Haryana	20	16.25	3.75
Himachal Pradesh	20	12.5	7.5
Jammu & Kashmir	15	12.5	2.5
Karnataka	20	13.75	6.25
Kerala	20	13.75	6.25
Kolkata	20	15	5
Madhya Pradesh	20	15	5
Maharashtra	20	15	5
Mumbai	20	15	5
North East	15	15	-
Odisha	20	11.25	8.75
Punjab	20	12.5	7.5
Rajasthan	20	15	5
Tamilnadu	20	13.75	6.25
Uttar Pradesh (East)	20	10	10
Uttar Pradesh (West)	20	20	-
West Bengal	20	15	5
Total	**425**	**306.25**	**118.75**

The 900 MHz Band (Uplink: 890-915 MHz, Downlink: 935-960 MHz)

2.11 India has adopted FDD configuration based 3GPP band 8 for the 900 MHz band. This band consists of 25 MHz (paired) spectrum. The 890-915 MHz range is for the uplink, and the 935-960 MHz range is for the downlink. For the mitigation of interference with the bands adjacent to the 900 MHz band, a guard band of 0.1 MHz (i.e. 100 KHz) has been left out at both ends. As a result, the assignable spectrum in the 900 MHz band is in the 890.1-914.9 MHz range (uplink) and the 935.1-959.9 MHz range (downlink). In effect, the total assignable spectrum in the 900 MHz band is 24.8 MHz (paired).

2.12 As per the information provided by DoT through the Letter dated 14.08.2025, in the 900 MHz band, 1.6 MHz (paired) has been assigned to Indian Railways in 14 LSAs viz. Assam, Bihar, Delhi, Gujarat, Haryana, Kolkata, Madhya Pradesh, Maharashtra, Mumbai, Punjab, Rajasthan, UP (East), UP (West) and West Bengal. The remaining spectrum in the 900 MHz band has been earmarked for IMT.

2.13 In the spectrum auction held in June 2024, a total of 117.2 MHz (paired) spectrum was put to auction in the 900 MHz band in 22 LSAs, out of which, 60.8 MHz (paired) spectrum in 14 LSAs could be sold in the auction. The entire spectrum that remained unsold (56.4 MHz) would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 900 MHz band is given in the following table:

Table 2.2: Availability of the spectrum in the 900 MHz Band (paired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	24.8	22.8	2
Assam	23.2	21.4	1.8
Bihar	23.2	18.4	4.8
Delhi	23.2	22.4	0.8
Gujarat	23.2	21.6	1.6
Haryana	23.2	18.6	4.6
Himachal Pradesh	24.8	21.4	3.4
Jammu & Kashmir	24.8	21.4	3.4
Karnataka	24.8	22.4	2.4
Kerala	24.8	23.4	1.4
Kolkata	23.2	20.6	2.6
Madhya Pradesh	23.2	18.8	4.4
Maharashtra	23.2	20.4	2.8
Mumbai	23.2	22.4	0.8
North East	24.8	21.4	3.4
Odisha	24.8	21.4	3.4
Punjab	23.2	23.2	-
Rajasthan	23.2	23.2	-
Tamilnadu	24.8	18.8	6
Uttar Pradesh (East)	23.2	23.2	-
Uttar Pradesh (West)	23.2	16.4	6.8*
West Bengal	23.2	23.2	
Total	**523.2**	**466.8**	**56.4**

* Available in two non-contiguous chunks of 1.2 MHz and 5.6 MHz

The 1800 MHz Band (Uplink: 1710-1785 MHz, Downlink: 1805-1880 MHz)

2.14 India has adopted FDD configuration based 3GPP band 3 for the 1800 MHz band. This band consists of 75 MHz (paired) spectrum. The 1710-1785 MHz range is for the uplink, and the 1805-1880 MHz range is for the downlink. For the mitigation of interference with bands adjacent to the 1800 MHz band, a guard band of 0.1 MHz (i.e. 100 KHz) has been left out at both ends. As a result, the assignable spectrum in the 1800 MHz band is in the 1710.1-1784.9 MHz range (uplink) and the 1805.1-1879.9 MHz range (downlink). In effect, the total assignable spectrum in the 1800 MHz band is 74.8 MHz (paired). As per the information provided by DoT through the Letter dated 14.08.2025, in the 1800 MHz band, 20 MHz (paired) spectrum has been assigned to the Government in all LSAs except Haryana, Kerala, Kolkata, Mumbai and Odisha. In Haryana, Kolkata and Mumbai LSAs, 10 MHz (paired) spectrum has been assigned to the Government in the 1800 MHz band. In Kerala and Odisha LSAs, 5 MHz (paired) spectrum has been assigned to the Government in the 1800 MHz band. The remaining spectrum in the 1800 MHz band in all LSAs has been earmarked for IMT.

2.15 In the spectrum auction held in June 2024, a total of 221.4 MHz (paired) spectrum was put to auction in the 1800 MHz band in all 22 LSAs, out of which, 50.6 MHz (paired) spectrum was sold in 10 LSAs and 170.8 MHz (paired) spectrum in 21 LSAs remained unsold. Besides, administratively assigned 88.2 MHz (paired) spectrum in 16 LSAs would be released due to expiry of service licenses in December 2026/ March 2027; this spectrum would also be available for the forthcoming auction. DoT has clarified that "*these spectrum blocks, if sold in the auction, will be assigned only after expiry of such service licenses*" The LSA-wise

availability of the spectrum in the 1800 MHz band is given in the following table:

Table 2.3: Availability of the spectrum in the 1800 MHz Band (paired in MHz)

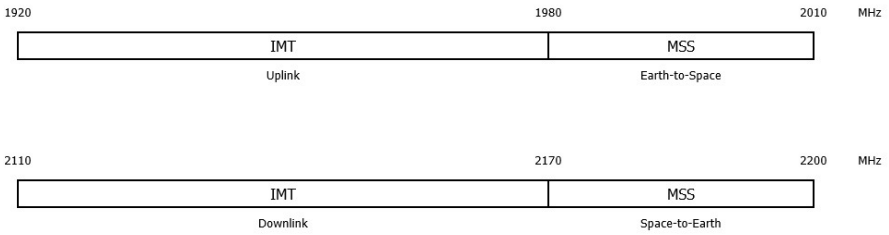
LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum	Administratively assigned spectrum getting released due to the expiry of licenses during 2026-2027	Total Available Spectrum
	A	B	C = A-B	D	E = C+D
Andhra Pradesh	54.8	45.8	9	4.4	13.4
Assam	54.8	50.2	4.6	4.4	9
Bihar	54.8	54.8	-	8.8	8.8
Delhi	54.8	43.8	11	6.2	17.2
Gujarat	54.8	50.8	4	-	4
Haryana	64.8	41.4	23.4	-	23.4
Himachal Pradesh	54.8	41.6	13.2	4.4	17.6
Jammu & Kashmir	54.8	48.8	6	4.4	10.4
Karnataka	54.8	50	4.8	4.4	9.2
Kerala	69.8	44.4	25.4	4.4	29.8
Kolkata	64.8	51.2	13.6	6.2	19.8
Madhya Pradesh	54.8	54.8	-	4.4	4.4
Maharashtra	54.8	52.4	2.4	-	2.4
Mumbai	64.8	46.4	18.4	10.6	29
North East	54.8	52.6	2.2	4.4	6.6
Odisha	69.8	62	7.8	4.4	12.2
Punjab	54.8	50	4.8	4.4	9.2
Rajasthan	54.8	52.8	2	6.2	8.2
Tamilnadu	54.8	51.4	3.4	-	3.4
UP (East)	54.8	54.8	-	6.2	6.2
UP (West)	54.8	40	14.8	-	14.8
West Bengal	54.8	54.8	-	-	-
Total	**1265.6**	**1094.8**	**170.8**	**88.2**	**259**

2.16 On examination of the information provided by DoT on the frequency-wise spectrum assignment in the 1800 MHz band, it has been observed that in Andhra Pradesh, Delhi, Haryana, Jammu & Kashmir, Karnataka, Kerala, Mumbai, and North East LSAs, vacant spectrum is not available in a contiguous manner. In case, harmonization exercise is carried out in the 1800 MHz band, the spectrum efficiency can be improved by making spectrum assigned to each spectrum assignee as well as the vacant spectrum, contiguous. In Haryana LSA, of the total vacant spectrum of 23.4 MHz (comprising of two chunks of 10 MHz and 13.4 MHz), the 10 MHz chunk is not available in Sirsa and Fatehbad.

The 2100 MHz Band (Uplink: 1920-1980 MHz, Downlink: 2110-2170 MHz)

2.17 India has adopted FDD configuration based 3GPP band 1 for the 2100 MHz band. This band consists of 60 MHz (paired) spectrum. The 1920-1980 MHz range is for the uplink, and the 2110-2170 MHz range is for the downlink. For the mitigation of interference with the adjacent band at the upper edge of the band[9], a guard band of 1 MHz spectrum has been left out. As a result, the assignable spectrum in the 2100 MHz band is in the 1920-1979 MHz range for the uplink, and the 2110-2169 MHz range for the downlink. In effect, the total assignable spectrum in the 2100 MHz band is 59 MHz (paired). As per the information provided by

[9] S-band for Mobile Satellite Service (MSS) occupies the spectrum adjacent to the upper edge of the 2100 MHz band. The frequency ranges of the S-band are 1980-2010 MHz (Earth-to-space), and 2170-2200 MHz (space-to-Earth). The following figure depicts the juxtaposition of the 2100 MHz band and the S-band.



The guard bands in the 2100 MHz band: 1979-1980 MHz, and 2169-2170 MHz

DoT through the Letter dated 14.08.2025, 19 MHz (paired) in the 2100 MHz band has been assigned to the Government in all LSAs. The remaining 40 MHz (paired) spectrum in the 2100 MHz band has been earmarked for IMT in all LSAs.

2.18 In the spectrum auction held in June 2024, a total of 125 MHz (paired) spectrum was put to auction in the 2100 MHz band in 15 LSAs. Out of this spectrum, a total of 20 MHz spectrum was sold in four LSAs. The remaining (unsold) spectrum would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 2100 MHz band is given in the following table:

Table 2.4: Availability of the spectrum in the 2100 MHz band (paired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	40	25	15
Assam	40	40	-
Bihar	40	40	-
Delhi	40	30	10*
Gujarat	40	35	5
Haryana	40	40	-
Himachal Pradesh	40	25	15*
Jammu & Kashmir	40	40	-
Karnataka	40	35	5
Kerala	40	40	-
Kolkata	40	30	10
Madhya Pradesh	40	30	10*
Maharashtra	40	35	5

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Mumbai	40	30	10
North East	40	40	-
Odisha	40	30	10
Punjab	40	35	5
Rajasthan	40	40	-
Tamilnadu	40	40	-
Uttar Pradesh (East)	40	40	-
Uttar Pradesh (West)	40	35	5
West Bengal	40	40	-
Total	**880**	**775**	**105**

* Available in two non-contiguous chunks

The 2300 MHz Band (2300-2400 MHz)

2.19 India has adopted TDD configuration based 3GPP band 40 for the 2300 MHz band. This band consists of 100 MHz (unpaired) of spectrum. 20 MHz (unpaired) spectrum in the 2300 MHz band has been assigned to the Government in all LSAs. The remaining 80 MHz (unpaired) spectrum in the 2300 MHz band has been earmarked for IMT in all LSAs.

2.20 In the spectrum auction held in June 2024, a total of 60 MHz (unpaired) spectrum was put to auction in the 2300 MHz band in 6 LSAs. However, no bid was received in that auction. Therefore, the entire spectrum, which was put to auction in June 2024, would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 2300 MHz band is given in the following table:

Table 2.5: Availability of the spectrum in the 2300 MHz band (unpaired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	80	70	10
Assam	80	80	-
Bihar	80	80	-
Delhi	80	70	10
Gujarat	80	80	-
Haryana	80	80	-
Himachal Pradesh	80	80	-
Jammu & Kashmir	80	80	-
Karnataka	80	70	10
Kerala	80	80	-
Kolkata	80	70	10
Madhya Pradesh	80	80	-
Maharashtra	80	80	-
Mumbai	80	70	10
North East	80	80	-
Odisha	80	80	-
Punjab	80	80	-
Rajasthan	80	80	-
Tamilnadu	80	70	10
Uttar Pradesh (East)	80	80	-
Uttar Pradesh (West)	80	80	-
West Bengal	80	80	-
Total	**1760**	**1700**	**60**

The 2500 MHz Band (2535-2555 MHz and 2615-2655 MHz)

2.21 India has adopted TDD configuration based 3GPP band 41 for the 2500 MHz band. In this band, 60 MHz (unpaired) spectrum in the 2535-2555 MHz and 2615-2655 MHz ranges has been made available for IMT in India.

2.22 In the spectrum auction held in June 2024, a total of 70 MHz (unpaired) spectrum in 5 LSAs was put to auction in the 2500 MHz band. Out of this spectrum, only 10 MHz in one LSA could be sold. Besides, DoT, through the Reference dated 15.05.2025, has informed that an additional 20 MHz in each LSA has been re-farmed for IMT services. Therefore, the spectrum that remained unsold in the spectrum auction of June 2024, along with the additional spectrum made available through the re-farming exercise, would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 2500 MHz band is given in the following table:

Table 2.6: Availability of the spectrum in the 2500 MHz band (unpaired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	60	40	20
Assam	60	40	20
Bihar	60	40	20
Delhi	60	40	20
Gujarat	60	40	20*
Haryana	60	40	20

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
Himachal Pradesh	60	30	30
Jammu & Kashmir	60	30	30
Karnataka	60	20	40
Kerala	60	40	20
Kolkata	60	40	20
Madhya Pradesh	60	40	20
Maharashtra	60	40	20*
Mumbai	60	40	20
North East	60	40	20
Odisha	60	40	20
Punjab	60	40	20
Rajasthan	60	40	20
Tamilnadu	60	20	40
Uttar Pradesh (East)	60	40	20
Uttar Pradesh (West)	60	40	20
West Bengal	60	40	20
Total	**1320**	**820**	**500**

* Available in two non-contiguous chunks of 10 MHz each

The 3300 MHz Band (3300-3670 MHz)

2.23 India has adopted TDD configuration based 3GPP band n77/ n78 for the 3300 MHz band. In the 3300 MHz band, 370 MHz (unpaired) spectrum in the 3300-3670 MHz range has been earmarked for IMT in each LSA.

2.24 In the spectrum auction held in June 2024, a total of 1110 MHz (unpaired) spectrum in 22 LSAs was put to auction in the 3300 MHz band. However, no bid was received in that auction. Therefore, the entire spectrum in the 3300 MHz band, which was put to auction in June 2024, would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 3300 MHz band is given in the following table:

Table 2.7: Availability of the spectrum in the 3300 MHz band (unpaired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers*	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	370	320	50
Assam	370	270	100
Bihar	370	320	50
Delhi	370	320	50
Gujarat	370	320	50
Haryana	370	320	50
Himachal Pradesh	370	300	70
Jammu & Kashmir	370	300	70
Karnataka	370	350	20
Kerala	370	350	20
Kolkata	370	320	50
Madhya Pradesh	370	350	20
Maharashtra	370	320	50
Mumbai	370	320	50
North East	370	300	70
Odisha	370	270	100
Punjab	370	320	50

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers*	Total Vacant Spectrum
	A	B	C = A-B
Rajasthan	370	350	20
Tamilnadu	370	320	50
Uttar Pradesh (East)	370	320	50
Uttar Pradesh (West)	370	350	20
West Bengal	370	320	50
Total	**8140**	**7030**	**1110**

***** Includes 70 MHz spectrum reserved for BSNL 5G in all LSAs

The 26 GHz band (24.25 to 27.5 GHz)

2.25 India has adopted TDD configuration based 3GPP band 258 for the 26 GHz band. In the 26 GHz band, 3.25 GHz (unpaired) spectrum in the 24.25 to 27.5 GHz range has been earmarked for IMT in each LSA.

2.26 In the spectrum auction held in June 2024, a total of 8700 MHz (unpaired) spectrum in 21 LSAs was put to auction in the 26 GHz band. However, no bid was received in that auction. Therefore, the entire spectrum in the 26 GHz band, which was put to auction in June 2024, would be available for the forthcoming auction. The LSA-wise availability of the spectrum in the 26 GHz band is given in the following table:

Table 2.8: Availability of the spectrum in the 26 GHz band (unpaired in MHz)

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers*	Total Vacant Spectrum
	A	B	C = A-B
Andhra Pradesh	3250	2850	400
Assam	3250	2600	650
Bihar	3250	2600	650
Delhi	3250	2800	450
Gujarat	3250	3150	100
Haryana	3250	3000	250
Himachal Pradesh	3250	2600	650
Jammu & Kashmir	3250	2600	650
Karnataka	3250	2850	400
Kerala	3250	3250	-
Kolkata	3250	2800	450
Madhya Pradesh	3250	3000	250
Maharashtra	3250	3000	250
Mumbai	3250	2900	350
North East	3250	2600	650
Odisha	3250	2600	650
Punjab	3250	2900	350
Rajasthan	3250	2950	300
Tamilnadu	3250	2950	300
Uttar Pradesh (East)	3250	2850	400
Uttar Pradesh (West)	3250	2950	300
West Bengal	3250	3000	250
Total	**71500**	**62800**	**8700**

* Includes 800 MHz reserved in 21 LSAs except Kerala where 650 MHz is reserved for BSNL 5G.

(2) Amount of spectrum to be put to auction in the existing bands

2.27 In the previous sub-section, information on the LSA-wise availability of the spectrum in the existing bands has been provided. Further, DoT in para 5.1 of the Reference dated 15.05.2025 has mentioned that any other spectrum, which might be available due to any re-farming etc. in these bands before the start of the auction, will also be made part of the auction process.

2.28 At this stage, it needs to be deliberated as to whether the entire available spectrum in the existing bands should be put to auction. In this regard, it is important to note that DoT, in the Reference dated 15.05.2025, has mentioned as below:

"4. The Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed the following, among others: "Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply.

…

7.1 Further, while providing its recommendations, TRAI may also take into account the observations of Department of Economic Affairs as mentioned in para 4 above."

2.29 Apparently, the concern of the Department of Economic Affairs is to ensure effective competition in the auction process. This issue requires detailed analysis, which will be made based on the comments of stakeholders in this consultation paper. At this stage, a preliminary examination of the aspects brought out by the Department of Economic Affairs is given below:

Demand and Supply Dynamics

2.30 The supply side for spectrum in the auction process is governed primarily by the availability of the spectrum in the globally harmonized frequency bands for IMT. The demand for spectrum is driven by market forces and influenced by several economic and technological factors. The lesson that emerges from the varied auction experiences globally is that the auction results depend upon the particular contexts in which they take place. A large number of factors, some are policy induced and others, exogenous and circumstantial, tend to impact the results.

2.31 Since the year 2022, the Government has conducted two auctions for access spectrum- one in July/ August 2022 and the other in June 2024. The following paragraphs provide a brief description of these auctions.

2.32 In both auctions, only access service providers were permitted to participate in the auction. In the spectrum auction held in July/ August 2022, four bidders took part in the auction. A new entity viz. M/s Adani Data Networks Limited apart from three existing access service providers viz. M/s Bharti Airtel Limited, M/s Reliance Jio Infocomm Limited, and M/s Vodafone Idea Limited submitted their bids in the auction. After the auction of July/ August 2022, the PSU operator was granted spectrum in a few frequency bands through administrative process. In the spectrum auction held in June 2024, three bidders viz. M/s Bharti Airtel Limited, M/s Reliance Jio Infocomm Limited, and M/s Vodafone Idea Limited took part in the auction. After the auction of June 2024, the PSU operator was granted spectrum in a few bands through administrative process.

2.33 In the spectrum auction held in July/ August 2022, the spectrum across 10 frequency bands viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz were put

to auction. The LSA-wise, frequency band-wise number of bidders which obtained spectrum in the auction of July/ August 2022 is given in the following table:

Table 2.9: LSA-wise Frequency Band-wise Number of Bidders which Obtained Spectrum in the Auction of July/ August 2022

LSA	No of bidders which obtained spectrum in the auction									
	600 MHz *	700 MHz	800 MHz	900 MHz	1800 MHz	2100 MHz	2300 MHz *	2500 MHz	3300 MHz	26 GHz
Andhra Pradesh		1			1			1	3	4
Assam		1	1	1					2	2
Bihar		1				1			3	2
Delhi		1				1			3	3
Gujarat		1			1	1			3	4
Haryana		1				1			3	3
Himachal Pradesh		1			1				2	2
Jammu & Kashmir		1	1	1					2	2
Karnataka		1				1			3	4
Kerala		1				1			3	3
Kolkata		1			1				3	3
Madhya Pradesh		1			1				3	3
Maharashtra		1			2				3	3
Mumbai		1			1				3	4
North East		1	1	1					2	2
Odisha		1			2				2	2
Punjab		1						1	3	3
Rajasthan		1			1				3	4
Tamil Nadu		1							3	4
UP (East)		1			2				3	3
UP (West)		1	1						3	3
West Bengal		1				1			3	3

* No participation from bidders

2.34 In the spectrum auction of July/ August 2022, the spectrum in only 1800 MHz in two LSAs viz. UP (East) and Odisha were sold at a price higher

than reserve price. A summary of band-wise auction results is given in the following table:

Table 2.10: Band-wise Results of Auction of July/ August 2022

Frequency Band	Total LSAs where spectrum put to auction	Total LSAs where bid received	No bids received in	No of LSAs where bid received for full quantity	Total No. of LSAs where bid received at price higher than Reserve Price
600 MHz	22	0	22	0	0
700 MHz	22	22	0	0	0
800 MHz	22	4	18	4	0
900 MHz	21	3	18	1	0
1800 MHz	22	10	12	2	2
2100 MHz	19	7	12	4	0
2300 MHz	6	0	6	0	0
2500 MHz	12	2	10	1	0
3300 MHz	22	22	0	0	0
26 GHz	22	22	0	0	0

2.35 In the spectrum auction held in June 2024, the spectrum across eight frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz were made available. The LSA-wise, frequency band-wise number of operators which obtained spectrum in the auction of June 2024 is given in the following table:

Table 2.11: LSA-Wise Frequency Band-wise Number of Bidders Which Obtained Spectrum in the Auction held in June 2024

LSA	No of bidders which obtained spectrum in the auction							
	800 MHz *	900 MHz	1800 MHz	2100 MHz	2300 MHz *	2500 MHz	3300 MHz *	26 GHz *
Andhra Pradesh		1						
Assam		1	1	1				
Bihar		1	2			1		
Delhi								
Gujarat								
Haryana			1					
Himachal Pradesh								
Jammu & Kashmir		1		1				
Karnataka		1						
Kerala								
Kolkata		1	1					
Madhya Pradesh			1					
Maharashtra								
Mumbai								
North East		1		1				
Odisha		1	1					
Punjab		1	1					
Rajasthan		2	1					
Tamil Nadu		1						
UP (East)		2	1					
UP (West)		1		1				
West Bengal		2	2					

*No participation from bidders

2.36 In the spectrum auction of June 2024, the spectrum in only 1800 MHz band in two LSAs viz. Bihar and West Bengal were sold at a price higher than reserve price. A summary of band-wise auction results is given in the following table:

Table 2.12: Band-wise Results of the Auction of June 2024

Band	Total LSAs where spectrum put to auction	Total LSAs where bids received	No bids received in	No of LSAs where bids received for full quantity	Total No. of LSAs where bids received at price higher than Reserve Price
800 MHz	19	0	19	0	0
900 MHz	22	14	8	4	0
1800 MHz	22	10	12	4	2
2100 MHz	15	4	11	3	0
2300 MHz	6	0	6	0	0
2500 MHz	5	1	4	1	0
3300 MHz	22	0	22	0	0
26 GHz	21	0	21	0	0

Possibility of enhancing competition

2.37 At present, only access service providers are permitted to take part in the auctions for IMT spectrum. *Prima facie*, one of the methods for enhancing competition in the spectrum auction could be by way of allowing other types of service providers (apart from access service providers) - which also might require IMT spectrum - to participate in the auction for IMT spectrum. Another method could be to establish an enabling regulatory framework for reducing entry barriers for access service providers so that new entities may also consider obtaining access service license/ authorisation and participate in the auction for IMT spectrum. In the past, TRAI has made recommendations on both of these aspects. The following paragraphs provide a brief description of the recommendations made by TRAI on these aspects.

2.38 In the 2018, the Government released the National Digital Communication Policy (NDCP) – 2018. One of the strategies of the NDCP-2018 under the Propel India Mission is ***reforming the licencing and regulatory regime to catalyse Investments*** *and Innovation, and promote Ease of Doing Business* by enabling unbundling of different layers (e.g. infrastructure, network, services and applications layer) through differential licensing. In this regard, based on a reference from DoT, TRAI sent its recommendations on 'Enabling Unbundling of Different Layers Through Differential Licensing' dated 19.08.2021 to DoT. The salient recommendations given by the Authority through these recommendations are reproduced below:

a) A separate authorization under Unified License should be created for Access Network Provider (network layer) to provide network services on wholesale basis. Under this authorization for Network layer only, the Access network provider shall not be permitted to directly provide services to the end customers under the authorization.

b) Scope of the Access Network Provider shall be to establish and maintain access network, including wireless and wireline access network, and selling the network services (capable of carrying voice and non-voice messages and data) on a wholesale basis to VNOs (service delivery operators) for retailing purpose. The Access Network Provider should be permitted to have capabilities to support all the services mentioned in the scope of Access Service authorization (Chapter VIII of UL).

c) The Access Network provider should also be permitted to provide/share its network resources to/ with the telecom service

providers who are licensees under section 4 of the Indian Telegraph Act, 1885, and vice versa.

….

f) *Like Unified Licensee with access service authorization, the Access Network provider should also be permitted to acquire spectrum through spectrum auctions, subjected to the prescribed spectrum caps, enter into spectrum trading and spectrum sharing arrangement with the other Access Network providers and unified licensees with Access service authorization. It should also have access to backhaul spectrum, numbering resources and the right to interconnection."* (Emphasis added)

2.39 In short, through the recommendations dated 19.08.2021, TRAI recommended for introducing a separate license authorization for Access Network Providers (ANPs), allowing these entities to establish access networks, obtain spectrum through auctions, and offer network infrastructure at wholesale level to Virtual Network Operators (VNOs). It is worth mentioning that the Government has not implemented the TRAI's recommendations on 'Enabling Unbundling of Different Layers Through Differential Licensing' dated 19.08.2021. Nevertheless, the Authority is of the view that the introduction of an authorization for Access Network Provider (network layer) could have enhanced competition in the spectrum auction.

2.40 Apart from the above, in the recent recommendations on the subject 'the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT' dated 04.02.2025 to the Government, the Authority recommended, *inter-alia*, that in addition to the access service providers, Internet Service Providers and M2M WAN service providers should also be permitted to participate in the auction of spectrum for frequency band n260 (37-40 GHz). Permitting Internet Service Providers

etc. also to participate in the auction for IMT spectrum may enhance the competition in the auction.

2.41 Further, through the recommendations dated 17.02.2025 on 'the Terms and Conditions of Network Authorisations to be Granted Under the Telecommunications Act, 2023', the Authority has recommended *inter-alia* that the Government should introduce Digital Connectivity Infrastructure Provider (DCIP) Authorisation and Cloud Hosted Telecom Network (CTN) Provider Authorisation under Section 3(1)(b) of the Telecommunications Act, 2023. The main scope of DCIP Authorisation and CTN Provider Authorisation are given below:

(a) Main scope of DCIP Authorisation: DCIP authorised entities may provide wireline access network, radio access network (RAN), transmission links, Wi-Fi systems, and In-Building Solution (IBS) to the service authorised entities under Section 3(1)(a) of the Telecommunications Act, 2023.

(b) Main scope of CTN Provider Authorisation: To provide cloud-hosted telecommunication network-as-a service (CTNaaS) to the entities authorised under Section 3(1)(a) of the Telecommunications Act, 2023.

2.42 The Authority is of the view that the introduction of the proposed DCIP Authorisation and CTN Provider Authorisation would permit access service providers to focus on provisioning of access service without the need for making large investments in establishing access network and core network; access service providers would be able to obtain the access network and core network from DCIP Authorised entities and CTN Provider Authorised entities respectively. This would substantially reduce the entry barriers for the access service providers. As a result, many new

entities may find it attractive to invest in terrestrial mobile business. In turn, the competition in the access service segment in the country would increase. Consequently, the competition in the auction for IMT spectrum would also get enhanced.

Possibility of mitigating over-supply

2.43 The number of bidders that may participate in any spectrum auction cannot be determined *apriori* as the eligibility criteria permit new entities to participate in spectrum auctions. Therefore, there may be difficulties in predicting the demand, i.e. amount of spectrum that may be bid by telecom service providers and other prospective bidders in the auction. Further, reducing the supply of spectrum based on the predicted demand may raise concerns relating to artificial scarcity of spectrum.

2.44 The mobile data traffic in India has followed a "hocky-stick curve" depicting sudden and extremely rapid growth after a significant period of tepid growth as depicted in the following figure.

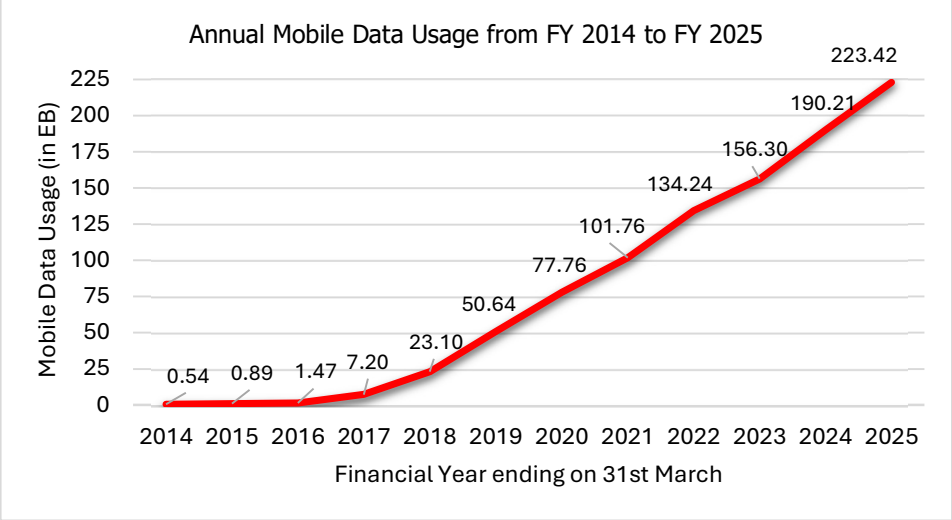


Figure 2.1: Annual Mobile Data Usage in the Past 11 Years

2.45 In India, September 2023 marked the beginning of 5G fixed wireless access (FWA) services. By the end of June 2024, the number of 5G FWA subscriptions reached about 1.5 million. This number rose to about 7.9 million by the end of June 2025.

2.46 With the consistent rise in the adoption of 5G, the wireless data traffic in the country is set to grow rapidly in the near future. Considering the strong growth of the cellular mobile usage in the country, the Government of India has identified many new frequency bands for IMT. For instance, in the last 10 years, the Government has identified, *inter-alia*, 600 MHz band, 700 MHz band, 3300 MHz band, upper 6 GHz band, 26 GHz band, 37-37.5 GHz band, 37.5-40 GHz band and 42.5-43.5 GHz band for IMT. The availability of spectrum in new frequency bands permits service providers to bid for the desired amount of spectrum in the frequency bands of their choice in the auction to meet their coverage and capacity demands in the near-to-medium term. Considering the predictions of strong growth in mobile data traffic owing to the adoption of 5G and 6G networks in future, any restriction in the supply of spectrum in any frequency band may constrain the service providers from meeting their coverage and capacity demands. In case the supply of spectrum is artificially restricted, the spectrum which could have been gainfully utilized by service providers would remain idle.

2.47 Broadband in India is predominantly wireless. Demand for telecom services is growing exponentially with digitization of services. Innovations based on Artificial Intelligence (AI) are also expected to fuel the demand for data consumption. In this context, the demand for access spectrum should not be seen only from the perspective of the extent of participation of bidders in a particular auction. It also needs to be seen from the perspective of overall demand for data consumption in society and the national economy.

2.48 It is noteworthy that TRAI on many occasions has recommended the Government for not putting spectrum in certain bands in the forthcoming auctions for technical reasons. A few examples are given below:

(a) Through the recommendations on Auction of Spectrum in frequency bands identified for IMT/ 5G dated 11.04.2022, TRAI recommended as below:

"Considering the facts that presently (i) band plan(s) for the frequency range 526-612 MHz is yet to be defined by 3GPP/ ITU, (ii) development of ecosystem for IMT in 526-612 MHz frequency range will take some time and (iii) MIB is using 526-582 MHz band extensively across the country for TV transmitters; the 526-612 MHz frequency range should not be put to auction in the forthcoming auction."

(b) Through the recommendations on the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT dated 04.02.2025, TRAI recommended as below:

"Owing to the non-availability of the device ecosystem in 42.5- 43.5 GHz frequency range, it will be prudent that the frequency range 42.5-43.5 GHz is not put to auction in the forthcoming spectrum auction."

2.49 It is noteworthy that in the past, TRAI, in no instance, has made recommendations for reducing the supply of spectrum to be put to auction.

2.50 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for Consultation:

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.

Q2. Whether the entire available spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz band should be put to auction in the forthcoming auction?

(a) If yes, what measures should be taken to ensure effective competition in the forthcoming auction?

(b) If no, what quantum of spectrum in each of the frequency bands should be put to auction in the forthcoming auction?

Kindly provide a detailed response with justifications.

(3) Band Plans for the Existing Bands

2.51 At present, the following band plans have been adopted for the existing bands in India:

Table 2.13: Band Plans for the Existing Bands

Band	3GPP Band Plan Number	Duplexing Scheme	Uplink (MHz)	Downlink (MHz)
800 MHz	5	FDD	824-844	869-889
900 MHz	8	FDD	890-915	935-960

1800 MHz	3	FDD	1710-1785	1805-1870
2100 MHz	1	FDD	1920-1980	2110-2170
2300 MHz	40	TDD	2300-2400	
2500 MHz	41	TDD	2535-2555 MHz and 2615-2655 MHz	
3300 MHz	n77/ n78	TDD	3300-3670	
26 GHz	n258	TDD	24250-27500	

2.52 As the band plans adopted for India have been chosen after due deliberations and are functioning well, the Authority proposes to continue to use the respective band plans adopted for the existing bands. In this context, the Authority solicits comments from stakeholders on the following question:

Issue for consultation:

Q3. Whether the band plans, which have been adopted for the existing bands viz. the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in India, should be retained in the forthcoming auction? If no, kindly suggest new band plan(s) for the existing bands with detailed justifications.

(4) Validity period, and area of assignment of the spectrum in the existing bands

2.53 Considering that cellular mobile services segment is capital-intensive, the access spectrum for cellular mobile services is generally assigned for a

sufficient period of validity to allow for network planning, rollout, and recovery of investments.

2.54 As indicated in Chapter I of this consultation paper, DoT, through its reference dated 13.09.2021, requested TRAI to provide recommendations on the auction of spectrum in 526-698 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 24.25-28.5 GHz bands identified for IMT/ 5G. Subsequently, through a letter dated 23.09.2021, DoT informed that the Government has taken several decisions with regard to future spectrum auctions and requested TRAI to consider/ factor in the same while providing recommendations in response to DoT's reference dated 13.09.2021. One of the decisions conveyed by DoT to TRAI through the letter dated 23.09.2021 was that "*in future auctions, access spectrum will be assigned for a period of 30 years*."

2.55 In this regard, TRAI, issued a consultation paper on 'Auction of Spectrum in frequency bands identified for IMT/ 5G' dated 30.11.2021. In the consultation paper, one of question raised for comments from stakeholders was as follows:

"In what manner, should the extended tenure of spectrum allotment from the existing 20 years to 30 years be accounted for in the spectrum valuation exercise? Please support your response with detailed rationale/ inputs."

2.56 After a comprehensive consultation process, TRAI, through the recommendations dated 11.04.2022, recommended the reserve price for spectrum in each frequency band for 20 years. TRAI further recommended that "*the reserve price of spectrum allocation in case of*

30 years should be equal to 1.5 times (one-and-a-half times) the reserve price of spectrum allocation for 20 years for the respective band."

2.57 Subsequently, the Government conducted the spectrum auction for the spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in July/ August 2022. It is noteworthy that in the NIA for that auction, the Government stipulated the following terms and conditions with respect to the validity period of spectrum:

"The validity period of right to use of the spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands won in this auction shall be twenty (20) years from the 'Effective Date'." [Emphasis added]

2.58 In short, DoT, in the spectrum auctions of July/ August 2022, had put the spectrum in various bands for auction for a validity period of 20 years. Again, in the spectrum auctions of June 2024, the validity period of assignment of spectrum was 20 years.

2.59 In the spectrum auction in India since the year 2010, the access spectrum has been assigned consistently for a validity period of 20 years. While there could be arguments in favour of increasing the validity period, the rapid shortening of technological cycles poses challenges in determining the fair value of spectrum for longer durations. One may extend this argument to contend that the validity period for the assignment of spectrum should be less than 20 years to increase regulatory flexibility, allow periodic market review, and respond to rapid changes in technology and usage patterns.

2.60 Further, in the spectrum auction in India since the year 2010, the access spectrum has been assigned consistently on a Telecom Circle/ Metro Area basis. This is mainly because the licenses/ authorisations for access service are granted on a Telecom Circle/ Metro Area-basis.

2.61 The Authority notes that the extant practice of assigning access spectrum through auction on a Telecom Circle/ Metro Area basis for a validity period of 20 years has been functioning well and is broadly in line with global practices.

2.62 In this context, the Authority solicits comments from stakeholders on the following question:

Issue for Consultation:

Q4. Whether the spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be auctioned on Telecom Circle/ Metro Area basis with a validity period of 20 years in the forthcoming auction? If no, what should be the area, and validity period of spectrum assignment in the existing bands? Please provide detailed response with justifications.

(5) Block Size and Minimum Bid Quantity in the Existing Bands

2.63 In a spectrum auction, the term 'block size' refers to the amount of frequency spectrum that is made available as a single unit for bidding. The block size is usually defined in terms of bandwidth, measured in Hertz (Hz), kilohertz (KHz) or megahertz (MHz). Further, the spectrum

auctions often also stipulate minimum bid quantity in terms of number of blocks.

2.64 The block size and the minimum bid quantity of spectrum in respect of existing licensees and new entrants in the existing bands as per the Notice Inviting Applications (NIA) for the spectrum auction conducted in June 2024 is given in the following table:

Table 2.14: Block size and minimum bid quantity for the existing bands as per the NIA for spectrum auction of 2024

Spectrum band	Block Size (MHz)	Minimum bid quantity (MHz)	
		For existing licensees	For new entrants
800 MHz	1.25 (Paired)	1.25	5, 3.75 (where only 3.75 MHz is available), 2.5 (where only 2.5 MHz is available). 1.25 (where only 1.25 MHz is available)
900 MHz	0.20 (paired)	0.2	5, 0.2 (where less than 5 MHz is available)
1800 MHz	0.20 (paired)	0.2	5, 0.2 (where less than 5 MHz is available)
2100 MHz	5 (paired)	5	5
2300 MHz	10 (unpaired)	10	10

Spectrum band	Block Size (MHz)	Minimum bid quantity (MHz)	
		For existing licensees	For new entrants
2500 MHz	10 (unpaired)	10	10
3300 MHz	10 (unpaired)	10	10
26 GHz	50 (unpaired)	50	50

2.65 The block sizes and minimum bid quantities mentioned above for various bands have been chosen to provide sufficient flexibility to bidders. In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for consultation:

Q5. Whether the block size and minimum quantity for bidding in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be kept the same in the forthcoming auction as those in the spectrum auction of June 2024 as mentioned in Table No. 2.14 of this consultation paper? If not, what should be the band-wise block size and minimum bid quantity? Kindly provide a detailed response with justifications.

(6) Eligibility Conditions for Participation in Auction

2.66 As per the NIA 2024[10] for the spectrum auction held in June 2024, the eligibility conditions for participation in auction were as below:

"3.1 Eligibility criteria to participate in the Auction
(i) Any licensee that holds a UASL/ UL with authorization for Access Services for that LSA; or
(ii) Any licensee that fulfils the eligibility criteria for obtaining a Unified License with authorization for Access Services, and gives an undertaking to obtain a Unified License with authorization for Access Services and an undertaking regarding compliance to FDI guidelines; or
(iii) Any entity that gives an undertaking to obtain a Unified License with authorization for Access Services through a New Entrant Nominee as per the DoT guidelines/ license conditions, and an undertaking regarding compliance to FDI guidelines, can bid for the Spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz Bands subject to other provisions of the Notice.
A Unified License can only be awarded to an Indian Company. Hence, any foreign applicants will need to form or acquire an Indian company, to obtain a Unified License. However, they are allowed to participate in the auctions directly and apply for a Unified License subsequently through an Indian company, where they hold equity stake, with a maximum foreign equity up to 100% under Automatic route subject to restrictions on investments from land border sharing countries as per extant guidelines. …"

2.67 Main conditions under Associated Eligibility Conditions as per the NIA 2024[11] for the spectrum auction held in June 2024 were as below:

[10] https://dot.gov.in/sites/default/files/Notice%20Inviting%20Applications%202023-24.pdf
[11] https://dot.gov.in/sites/default/files/Notice%20Inviting%20Applications%202023-24.pdf

(i) Existing UASL/UL with Access Services authorization licensees shall be treated as 'New Entrant' in those LSA(s) for the frequency bands in which they do not presently hold spectrum. In other words, UASL/UL with access service authorization licensees who hold spectrum only in a particular LSA are also allowed to participate in the auction as 'New Entrant' in that LSA for the frequency band in which they do not presently hold spectrum. Their eligibility to bid for spectrum blocks in that particular LSA will be that of a new entrant. They will also need to comply with conditions for spectrum assignment and other prescribed conditions such as rollout obligations, BG etc. For the limited purpose of this provision, 900 MHz and 1800 MHz Bands are considered as the same band.

(ii) Existing UASL/UL with Access Service authorization licensees shall be treated as 'Existing Licensee' in those LSAs for the frequency band(s) in which they already hold spectrum. Their eligibility to bid for spectrum blocks will be that of an existing operator. For the limited purpose of this provision, 900 MHz and 1800 MHz band will be treated as the same band.

…

(viii) Net Worth requirements: A Bidder is required to show a net worth of Rs.100 Crore per License Service Area (Rs. 50 Crore each for Jammu and Kashmir and North East Service Areas), in which the bidder wants to submit bids. The net worth requirement is applicable in case of 'New Entrants' and the same is not applicable in case of existing licensees. However, this condition of net worth requirement will be applicable on new entrants only in those LSAs where they do not hold any spectrum in any of the bands (i.e., any of the 800/900/1800/2100/2300/2500 MHz bands)."

2.68 As far as the eligibility conditions for participation in the spectrum auction are concerned, it is worth mentioning that in its recommendations on 'the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5

GHz bands Identified for IMT' dated 04.02.2025, the Authority made the following observations:

"2.101 It is noteworthy that mmWave frequency spectrum, including 37-40 GHz frequency range, are typically used for applications requiring very high-capacity and ultra-low latency, and deployment of such mmWave spectrum for IMT is not likely to be ubiquitous. The prime use case that is likely to be deployed in these bands is Fixed Wireless Access (FWA) i.e., broadband internet connections. Provisioning of internet connections can also be done under Internet Service Provider (ISP) authorisation. The Authority is of the view that allowing ISPs to participate in the spectrum auction for band n260 (37-40 GHz) could accelerate broadband penetration across the country. It will also help in increasing competition and choice for the consumers. Further, overall 3 GHz spectrum is available in the n260 band. Allowing ISPs to participate in spectrum auctions for these bands does not appear to cause scarcity of spectrum for access service providers."

…

2.104 … a new service authorisation for "Machine to Machine Service (M2M)" was introduced under the Unified License by the DoT, wherein it was mentioned, inter-alia, that –

"2(iii) The Licensee intending to provide services exclusively through the LPWAN or equivalent technologies using unlicensed spectrum shall be covered under this authorization. <u>Such licensees may also obtain licensed spectrum to provide M2M services exclusively, if they desire to provide M2M services in the licensed band</u>."

2.69 Considering the above, the Authority, through the recommendations on 'the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT' dated 04.02.2025, recommended, *inter-alia*, that in addition to the entities holding the access service

authorisation, the entities holding Internet service authorisation for Category A/ B service area and/ or the entities holding authorisation for M2M service for category A/ B service area under the Unified License (M2M WAN service), should also be permitted to participate in the auction of spectrum for frequency band n260 (37-40 GHz).

2.70 In view of the foregoing discussion, the issue that requires deliberation is as to what should be the eligibility criteria for bidding for the spectrum in the existing bands. Specifically, whether Internet service providers etc. should also be made eligible to participate in the forthcoming spectrum auction for the existing bands. Further, whether the net worth conditions as prescribed through NIA 2024 should continue to be made applicable in the forthcoming auction.

2.71 In this context, the Authority solicits comments from stakeholders on the following question:

Issue for consultation:

Q6. What should be the eligibility criteria and associated eligibility conditions for participation in the forthcoming auction for the existing bands viz. the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands? Kindly provide a detailed response with justifications.

(7) Roll-out obligations for the existing bands

2.72 Roll-out obligations or network deployment obligations refer to the conditions or obligations for a telecom service provider to deploy its

network infrastructure and launch the services within a specified time in a specified geographical area. The purpose of roll-out obligations is to ensure that the operators utilize the assigned frequency spectrum efficiently and start providing telecommunication services within the stipulated time.

2.73 In the recommendations dated 11.04.2022 on 'Auction of Spectrum in frequency bands identified for IMT/ 5G', TRAI deliberated on the aspect of roll-out obligations in detail. Based on the comments of stakeholders and its own analysis, the Authority made the following recommendations in respect of roll-out obligations:

(a) *As per the NIA 2021 provisions, the requirement of rollout obligation shall be treated as fulfilled once the required number of district headquarters or block headquarters or rural SDCAs are covered by use of any technology in any band by a licensee. Therefore, the licensee is not required to fulfil these roll-out obligations separately in respect of each of these bands. However, for 2100 MHz (Metro LSAs) and 2300/2500 MHz (non-Metro LSAs), the prescribed coverage targets as per the provisions of NIA for 2021 Auction, are specific to the use of respective bands, which seems to be continuing due to oversight. Therefore, DoT should make changes in the roll out obligations for 2100 MHz (Metro LSAs) and 2300/2500 MHz (non-Metro LSAs) to rectify this by removing "using the spectrum in 2100 MHz" and "using 2300/2500 MHz band".*

(b) *To facilitate the new entrants, in respect of roll out obligations for 700 MHz, 800 MHz, 900 MHz and 1800 MHz bands, the time period of 1 year for meeting the MRO for Metros LSAs (coverage of 90% of the LSA within one year from the effective date of license or the*

date of assignment of spectrum won in this auction process, whichever is later), should be enhanced to 2 years (40% coverage by the end of 1st year and 90% coverage by the end of 2nd year).

(c) *Besides the above, the roll-out obligations for 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz as stipulated in the NIA for last auctions held in March 2021 be continued for the forthcoming spectrum auction.*

(d) *The roll-out obligations and associated conditions for 600 MHz band shall be same as that applicable for 700 MHz band.*

(e) *Band specific minimum roll out obligations for 3300-3670 MHz band for all TSPs i.e., existing as well as the new entrants should be specified as under:*

Metros LSAs

Time Period	*Roll Out Obligations*
By the end of 1st year	*Commercial launch of services anywhere in the LSA*
By the end of 3rd Year	*Cumulative number of sites to be deployed: 2800*
By the end of 5th Year	*Cumulative number of sites to be deployed: 4600*

Non-Metro LSAs

Time Period	*Roll Out Obligations*
By the end of 1st year	*Commercial launch of services in at least 1 city in the LSA*
By the end of 3rd Year	*Cumulative number of sites to be deployed:* *Category A LSAs: 7000* *Category B LSAs: 4600* *Category C LSAs: 2600*
By the end of 5th Year	*Cumulative number of sites to be deployed (at least 5% of the sites to be in rural SDCA, including economic zones):* *Category A LSAs: 10000* *Category B LSAs: 7000* *Category C LSAs: 4700*

(f) *To keep the customers informed, the TSPs should be mandated to publish the network deployment map on their website depicting the areas where the services have been launched using 3300-3670 MHz spectrum band.*

(g) *Since the Minimum Roll Out Obligations will be equally applicable for all the TSPs i.e., existing as well as the new TSPs, the clause 8.1.4 of the NIA for spectrum auction held in March 2021 on 'Rollout obligation using any technology in any band' shall not be applicable for 3300-3670 MHz band.*

(h) *Band specific minimum roll out obligations for 24.25-28.5 GHz band for all TSPs i.e., existing as well as the new entrants should be specified as under:*

Metros LSAs

Time Period	*Roll Out Obligations*
By the end of 1st year	*Commercial launch of services anywhere in the LSA*
By the end of 3rd Year	*Cumulative number of sites to be deployed: 900*
By the end of 5th Year	*Cumulative number of sites to be deployed: 1500*

Non-Metro LSAs

Time Period	*Roll Out Obligations*
By the end of 1st year	*Commercial launch of services anywhere in the LSA*
By the end of 3rd Year	*Cumulative number of sites to be deployed:* *Category A LSAs: 2400* *Category B LSAs: 1500* *Category C LSAs: 800*
By the end of 5th Year	*Cumulative number of sites to be deployed* *Category A LSAs: 3300* *Category B LSAs: 2300* *Category C LSAs: 1500*

(i) *To keep the customers informed, the TSPs should be mandated to publish the network deployment map on their website depicting the areas where the services have been launched using 24.25-28.5 GHz spectrum band.*

(j) *Since the Minimum Roll Out Obligations will be equally applicable for all the TSPs i.e., existing as well as the new TSPs, the clause 8.1.4 of the NIA for spectrum auction held in March 2021 on 'Rollout obligation using any technology in any band' shall not be applicable for 24.25-28.5 GHz band.*

(k) *While assessing the fulfilment of roll out obligations of Access Network Provider, the network elements (such as BTS, BSC etc.) created by the attached VNO(s) should also be included.*

2.74 DoT considered the TRAI's recommendations dated 11.04.2022 and mandated the following roll-out obligations for the spectrum in various bands as below:

Roll out obligations for the 800 MHz, 900 MHz, 1800 MHz bands

Roll out Phase	Roll Out Requirement	Time Period
Metro LSAs		
Phase 1	Coverage of 40% of the LSA	by the end of one year
Phase 2	Coverage of additional 50% of the LSA (Cumulative 90% of the LSA)	by the end of two years
Non-Metro LSAs		
Phase 1	Coverage of 10% DHQs/ Towns	by the end of one year
Phase 2	Coverage of 50% DHQs/ Towns	by the end of three years

Roll out Phase	Roll Out Requirement	Time Period
Phase 3	Coverage of 10% BHQs	by the end of three years
Phase 4	Coverage of additional 10% BHQs (Cumulative 20% BHQs)	by the end of four years
Phase 5	Coverage of additional 10% BHQs (Cumulative 30% BHQs)	by the end of five years

Roll out obligations for the 2100 MHz Band

The Licensee shall be required to provide street level coverage as prescribed in the Test Schedule as detailed below:

Roll out Phase	Roll Out Requirement	Time Period
Metro LSAs	Coverage of 90% of the LSA	by the end of five years
Non-Metro LSAs		
Phase 1	50% of DHQs in the LSA out of which 15% of DHQs should be in rural SDCA	by the end of three years
Phase 2	Additional 10% of DHQs (Cumulative 60% DHQs) in the LSA	by the end of four years
Phase 3	Additional 10% of DHQs (Cumulative 70% DHQs) in the LSA	by the end of five years

Roll out obligations for the 2300 MHz and 2500 MHz bands

Roll out Phase	Roll Out Requirement	Time Period
Metro LSAs	Coverage of 90% of the LSA	by the end of five years
Non-Metro LSAs	Coverage of 50% of Rural SDCAs in the LSA	by the end of five years

Roll out obligations for the 3300 MHz band

<table>
<tr><th>Roll out Phase</th><th colspan="3">Roll Out Requirement</th><th>Time Period</th></tr>
<tr><td colspan="5">Metro LSAs</td></tr>
<tr><td>Phase-1</td><td colspan="3">Commercial launch of services anywhere in each LSA</td><td>By the end of 1st year</td></tr>
<tr><td>Phase-2</td><td colspan="3">Cumulative number of sites to be deployed in each LSA: 280</td><td>By the end of 3rd Year</td></tr>
<tr><td>Phase-3</td><td colspan="3">Cumulative number of sites to be deployed in each LSA: 920</td><td>By the end of 5th Year</td></tr>
<tr><td colspan="5">Non-Metro LSAs</td></tr>
<tr><td>Phase-1</td><td colspan="3">Commercial launch of services in at least 1 city in the LSA, Minimum number of towns to be covered using targeted sites (per LSA) – 1</td><td>By the end of 1st year</td></tr>
<tr><td>Phase-2</td><td>LSA Category</td><td>Cumulative number of sites to be deployed</td><td>Minimum number of towns to be covered using targeted</td><td>By the end of 3rd Year</td></tr>
</table>

<table>
<tr><th>Roll out Phase</th><th>Roll Out Requirement</th><th>Time Period</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>sites (per LSA)</td></tr>
<tr><td>A</td><td>700</td><td>14</td></tr>
<tr><td>B</td><td>460</td><td>9</td></tr>
<tr><td>C</td><td>260</td><td>5</td></tr>
</table>
</td><td></td></tr>
<tr><td>Phase-3</td><td>
<table>
<tr><td>LSA Category</td><td>Cumulative number of sites to be deployed (at least 5% of the sites to be in rural SDCA, including economic zones)</td><td>Minimum number of towns to be covered using targeted sites (per LSA)</td></tr>
<tr><td>A</td><td>2000</td><td>40</td></tr>
<tr><td>B</td><td>1400</td><td>28</td></tr>
<tr><td>C</td><td>940</td><td>19</td></tr>
</table>
</td><td>By the end of 5th Year</td></tr>
</table>

Roll-out obligations for the 26 GHz band

Roll out Phase	Roll Out Requirement	Time Period
Metro LSAs		
Phase-1	Commercial launch of services anywhere in each LSA	By the end of 1st year
Phase-2	Cumulative number of sites to be deployed in each LSA: 90	By the end of 3rd Year
Phase-3	Cumulative number of sites to be deployed in each LSA: 300	By the end of 5th Year

<table>
<tr><th>Roll out Phase</th><th colspan="3">Roll Out Requirement</th><th>Time Period</th></tr>
<tr><td colspan="5">Non-Metro LSAs</td></tr>
<tr><td>Phase-1</td><td colspan="3">Commercial launch of services anywhere in the LSA, Minimum number of towns to be covered using targeted sites (per LSA) – 1</td><td>By the end of 1st year</td></tr>
<tr><td>Phase-2</td><td colspan="3"><table>
<tr><td>LSA Category</td><td>Cumulative number of sites to be deployed</td><td>Minimum number of towns to be covered using targeted sites (per LSA)</td></tr>
<tr><td>A</td><td>240</td><td>2</td></tr>
<tr><td>B</td><td>150</td><td>1</td></tr>
<tr><td>C</td><td>80</td><td>1</td></tr>
</table></td><td>By the end of 3rd Year</td></tr>
<tr><td>Phase-3</td><td colspan="3"><table>
<tr><td>LSA Category</td><td>Cumulative number of sites to be deployed</td><td>Minimum number of towns to be covered using targeted sites (per LSA)</td></tr>
<tr><td>A</td><td>660</td><td>7</td></tr>
<tr><td>B</td><td>460</td><td>5</td></tr>
<tr><td>C</td><td>300</td><td>3</td></tr>
</table></td><td>By the end of 5th Year</td></tr>
</table>

2.75 In NIA 2022 for the auction of spectrum held in July/ August 2022, it was stipulated that the requirement of rollout obligations in respect of the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands, shall be treated as fulfilled once the required number of district headquarters or block headquarters or rural SDCAs are covered by a licensee by using any technology in any band;

therefore, the licensee would not be required to fulfil these roll-out obligations separately in respect of each of these bands. However, in that auction, the rollout obligations for the 3300 MHz and 26 GHz bands were specific to the frequency bands. It is noteworthy that the provisions related to roll out obligations in the subsequent NIA i.e. NIA 2024 were similar to those in NIA 2022.

2.76 Notably, in the spectrum auctions of July/ August 2022 and June 2024, rollout obligations in respect of the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands were coverage based, whereas the rollout obligations for the 3300 MHz and 26 GHz bands were network deployment based (in terms of number of sites to be deployed in each service area). It is worth mentioning that while recommending the rollout obligations in respect of the 3300 MHz and 26 GHz bands, TRAI, through the Recommendations dated 11.04.2022, had made the following observations:

"2.270 The existing TSPs are likely to utilize 3300-3670 MHz band for 5G, initially in NSA mode, using 4G network for core and RAN fallback option, mostly for capacity enhancement requirement or to serve the use cases where ultra-low latency is of prime importance. In other words, this band alone, may not be used for carpet coverage at least in initial period; thus, band specific coverage-based rollout obligations may not be practical. However, nominal network deployment-based rollout obligations should be specified to ensure that the spectrum purchased is put to an efficient use, in a timely manner.

…

2.281 mmWave spectrum is typically used for meeting the very high-capacity and ultra low latency requirement. Deployment of mmWave spectrum for IMT is not likely to be ubiquitous as it is likely to be used for creation of hotspots and provision of FWA services.

Therefore, prescribing band-specific coverage-based rollout obligations may not be appropriate. However, nominal network deployment-based rollout obligations (1/3rd of number of sites required to be deployed for 3300-3670 MHz band) may be specified to ensure that the spectrum purchased is put to an efficient use, in a timely manner..."

2.77 At present, most of the access service providers have already met roll-out obligations for the bands for 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands. In case the roll-out obligations in respect of these bands are stipulated as those in the previous auctions, then, in effect, such existing access service providers would not be required to meet any further roll-out obligations if they acquire spectrum in these bands.

2.78 The Authority has received complaints from consumers about no mobile coverage on (a) certain patches of highways and train routes, (b) certain pockets of residential and commercial areas, and (c) certain segments of rural and remote areas. Besides, in the drive tests conducted by TRAI, the issue of no mobile coverage at numerous places has come to the notice of the Authority. At this stage, it would be worthwhile to deliberate as to whether there is a need to modify the approach followed by the Government in terms of roll-out obligations in public interest.

2.79 The Authority is cognizant of the fact that roll-out obligations for spectrum should be reasonable, as onerous or stringent roll-out obligations may reduce the valuation of spectrum in the eyes of prospective bidders.

2.80 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issue for consultation:

Q7. Whether there is a need for modifying roll-out obligations for the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands, as stipulated in the Notice Inviting Application (NIA) for the spectrum auction held in June 2024 in order to improve mobile coverage in the country? If yes, what modifications should be made in the roll-out obligations for the existing bands? Kindly provide a detailed response with justifications.

(8) Spectrum cap for the spectrum in the existing bands

2.81 Spectrum cap is the limit of access spectrum a telecom operator can hold in a licensed service area. The objective of prescribing spectrum cap is to prevent large holdings of spectrum by one or a few service providers, which otherwise may create concerns for competition in the market. In the NIA 2024 for the spectrum auction held in June 2024, the spectrum cap was defined as below:

"Spectrum Cap shall be as follows:

a) A Cap of 40% on the combined spectrum holding in the sub-1 GHz bands i.e. 700 MHz, 800 MHz and 900 MHz bands, including existing spectrum holding of TSPs in these bands.

b) A Cap of 40% on the combined spectrum holding in 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands, including existing spectrum holding of TSPs in these bands.

c) A Cap of 40% on the spectrum holding in 3300 MHz band including existing spectrum holding of TSPs (rounded off considering the block size in this band).

d) A Cap of 40% on the total spectrum holding in 26 GHz band including existing spectrum holding of TSPs (rounded off considering the block size in this band).

Note:

The blocks/spectrum that are expiring in 2024 and are being put to auction (including those which are not available for assignment immediately after the auction, but at a later date) are not included in the spectrum holding of the existing licensees, for the purpose of spectrum holding cap rules.

The following principles will be applied for the calculation of various spectrum caps for an LSA.

a) All spectrum assigned to TSPs, including quantity of spectrum whose rights to use were put to auction but remained unsold, spectrum whose rights to use were assigned but subsequently surrendered by the TSPs or taken back by the licensor and quantity of spectrum whose rights to use are being put to auction would be counted for the purpose of the spectrum cap.

b) The spectrum which may become available to DoT for commercial use after its refarming from other uses (such as defence) at different points of time would not be counted for determining the spectrum caps until its rights to use are put to auction.

c) In case a situation arises where due to any subsequent assignment of spectrum to defence/ non-commercial usage, spectrum cap is affected adversely, no TSP would be asked to surrender right to use of any spectrum which it already holds.

d) For the sake of level playing field among Telecom Service Providers (TSPs), the same spectrum cap shall be made applicable for all the telecom service providers in that Licensed Service Area."

2.82 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for consultation:

Q8. Whether there is a need to review the spectrum caps for the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands for the forthcoming auction? If yes, what should be the spectrum cap per service provider for different frequency bands? Kindly provide a detailed response with justifications.

Q9. Are there any other inputs/ issues related to the auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands for the forthcoming auction? Suggestions may be made with detailed justifications.

B. The aspects related to the auction of the 600 MHz band

2.83 This section begins with a discussion on the band plan for the 600 MHz band, followed by international scenario of the 600 MHz band for IMT. Thereafter, this section examines the conditions for bidding such as amount of spectrum to be put for auction, validity period of assignment, block size, minimum quantity of spectrum to be bid, spectrum cap, roll

out obligations etc. in case the spectrum in the 600 MHz band is put in the forthcoming auction.

2.84 In the year 2021, DoT had sought TRAI's recommendations for the auction of frequency spectrum in the 600 MHz band for IMT for the first time. While examining the appropriateness of auction of the 600 GHz band, TRAI had observed that "*lower frequency bands provide wider coverage because they can penetrate objects effectively and thus travel farther, including inside buildings. Therefore, this band has the potential to enhance terrestrial mobile coverage, particularly in rural and far-flung areas and also to fill the in-building coverage gaps in urban areas. Thus, opening up of this band could be beneficial for the TSPs as well as the consumers.*" Besides, TRAI had noted the usage of the 600 MHz band in other countries.

2.85 At the time of making the Recommendations dated 11.04.2022, TRAI examined the aspect of an appropriate band plan for the 600 MHz band in India. TRAI observed that there were two prominent candidate band plans for the 600 MHz band, viz.

(a) US 600 MHz band (Band 71/ n71); and

(b) APT 600 MHz band (also referred to as "APT 600 Option B1")

2.86 Importantly, at that time, the two band plans viz. US 600 MHz band, and APT 600 MHz band were at different stages of maturity, as outlined below:

(a) The US 600 MHz band was already a 3GPP band (Band 71 for LTE and n71 for 5G-NR)[12]. USA, Mexico, Canada, and Hong Kong had already adopted this band plan.

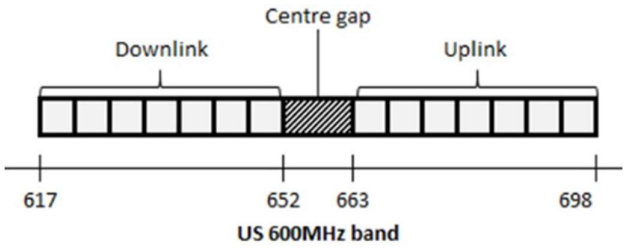
[12] 3GPP included the band 71 for LTE and n71 for 5G-NR in Release 15 in 2017-18.

(b) The APT 600 MHz band was an infant band at that time. Asia Pacific Telecommunity Wireless Group (AWG) had just adopted this band plan and had on 29.03.2022, invited 3GPP to start work on the technical specification to support APT 600 MHz band.[13]

2.87 An interesting aspect of the US 600 MHz band, and the APT 600 MHz band is that both band plans have a reverse Frequency Division Duplexing (FDD) configuration.[14] Since both the 600 MHz and 700 MHz bands are contiguous in frequency, the reverse FDD configuration in the 600 MHz band helps in minimizing the interference with the adjacent band operations. Thereby, it eliminates the need for any frequency gap between the 600 MHz frame and the 700 MHz frame.

2.88 A brief description of the US 600 MHz band, and APT 600 MHz band are given below:

(a) US 600 MHz band: FDD, 35 MHz (paired), [663-698 MHz (uplink), 617-652 MHz (downlink)]

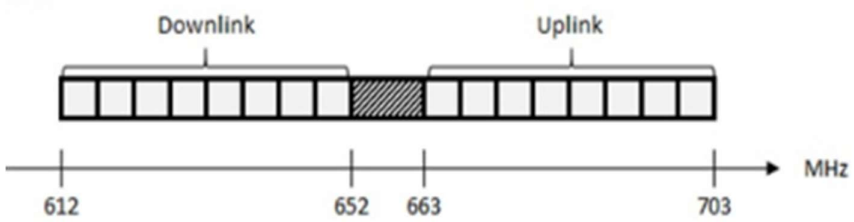


[13] Through the output document no. AWG-29/OUT-02 dated 29th March 2022, AWG made the following recommendations to 3GPP -

a. B1 is the preferred option for APT and be referred to as the 'APT 600 MHz' band.
b. AWG invites 3GPP to immediately start work on the technical specifications to support Option B1.
c. B2 may be considered as an option for later standardization should it be required (in a 35 MHz + 35 MHz configuration).

[14] Frequency Division Duplexing (FDD) normally refers to a duplex communication method where transmission (Tx) and reception (Rx) occur simultaneously on two different frequency bands, separated by a guard band. In a standard FDD configuration, the lower frequency band is used for uplink (from user device to base station) while the higher frequency band is used for downlink (from base station to user device). In reverse FDD, the usual uplink and downlink frequency bands are reversed.

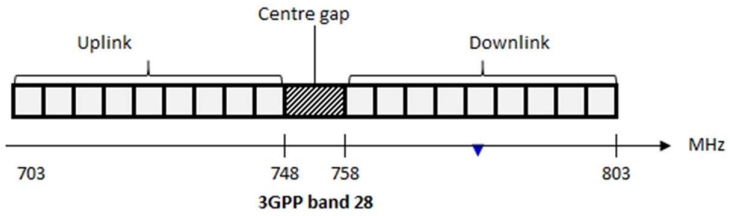
(b) APT 600 MHz band: FDD, 40 MHz (paired), [663-703 MHz (uplink), 612-652 MHz (downlink)]



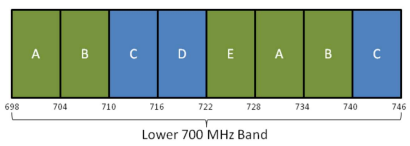
APT 600 MHz band

2.89 In USA, the band plan for the lower 700 MHz band[15] begins from 698 MHz. Therefore, USA adopted the US 600 MHz band (Band 71/ n71) which ends at 698 MHz. The key point to note here is that there is no frequency gap between the band plans adopted by USA for the 600 MHz band and the 700 MHz band.

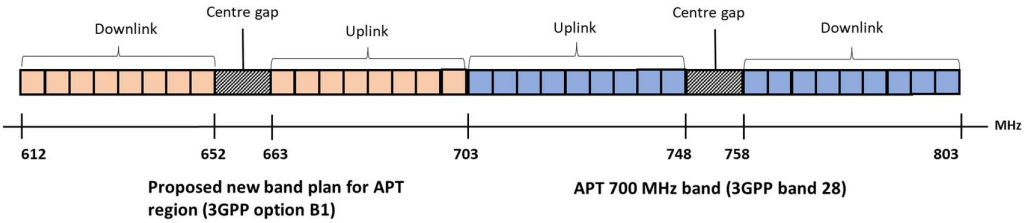
2.90 In India, For the 700 MHz band, the 3GPP band 28/ n28 (also referred to as APT 700 MHz band) has been adopted. For quick reference, the band plan of the 3GPP band 28/ n28 is depicted below:



[15] The lower 700 MHz band extends from 698-746 MHz band. This band is divided into five blocks as shown in the following figure. The first three blocks viz. A, B, and C are paired, while the remaining two blocks D and E are unpaired.



2.91 A juxtaposition of the band plan APT 600 MHz band with the APT 700 MHz band (3GPP band 28) is depicted below:

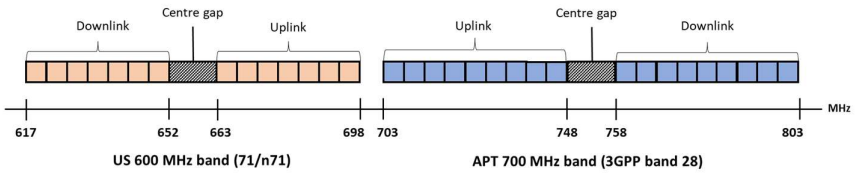


2.92 Notably there is no frequency gap between the APT 600 MHz band and APT 700 MHZ band (3GPP band 28).

2.93 In this context, while making recommendations to the Government for the auction of 600 MHz band for IMT through the Recommendations dated 11.04.2022, TRAI took note of the following aspects:

(a) Since the ecosystem for IMT is already available in the band 71/ n71, an obvious choice for the 600 MHz band in India could be the band 71/ n71. However, adoption of this band plan would lead to a wastage of 5 MHz spectrum from 698 MHz to 703 MHz as the band plan adopted for the 700 MHz band in India is the band 28/ n28 which begins at 703 MHz. [16]

[16] The juxtaposition of US 600 MHz band (n71) and 3GPP band 28 is depicted in the following figure:



(b) Adoption of the APT 600 MHz band plan will lead to the utilization of additional 5 MHz of paired spectrum in the 600 MHz band (612-617 MHz in the downlink and 698-703 MHz in the uplink). Conversely, if the APT 600 MHz band is not adopted in the country, India will stand out leading to non-harmonized band plan in the Region 3. It would be very difficult to go back and adopt the APT 600 MHz band plan later in time.

2.94 Accordingly, through the Recommendations dated 11.04.2022, TRAI recommended that for the 600 MHz frequency range (612-703 MHz), the band plan APT 600 (Option B1) should be adopted in India.

2.95 Based on the Recommendations dated 11.04.2022, the spectrum in the 600 MHz band was put to auction in the spectrum auction held in July/ August 2022. In that auction, DoT adopted the APT 600 Option B1 band plan for the 600 MHz band.

2.96 In the Reference dated 15.05.2025, DoT has mentioned as below in respect of the 600 MHz band:

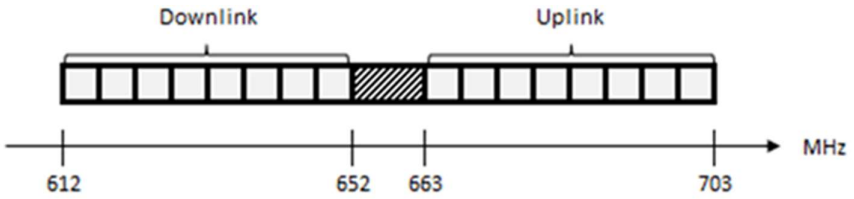
"2.6 In the auction held in 2024, 600 MHz (612-652/663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. In the ITU Radio Regulations also, this band has not been identified at the regional or global level for International Mobile Telecommunication. It was also decided that fresh consultations with TRAI may be taken before putting up this band for auction.

2.6.1 In view of the above, there is a need to re-examine and seek fresh recommendations for the auction of spectrum in the 600 MHz band."

2.97 The Authority notes that while there could be numerous factors that might have resulted in the 600 MHz band remaining unsold in the auction of July/ August 2022, it would be worthwhile examining the global developments with respect to the 600 MHz band which have taken place after the spectrum auctions held in July/ August 2022.

2.98 The Authority has observed the following notable development with respect to the 600 MHz band:

(a) In October 2022, 3GPP standardized the APT 600 MHz band through its technical report TR 38.892. The 3GPP's nomenclature for this band is n105 for 5G-NR. For a ready reference, the 3GPP band plan n105 is depicted below:



3GPP Band Plan n105

(b) As per the World Radiocommunication Conference 2023 Final Acts[17], in Micronesia, the Solomon Islands, Tuvalu and Vanuatu, the frequency band 470-698 MHz, or portions thereof, and in Bangladesh, Lao P.D.R., Maldives, New Zealand and Vietnam, the frequency band 610-698 MHz, or portions thereof, are identified for use by the administrations wishing to implement International

[17] https://www.itu.int/pub/R-REG-RR-2024

Mobile Telecommunications (IMT). In the Bahamas, Barbados, Belize, Canada, Colombia, El Salvador, the United States, Guatemala, Jamaica and Mexico, the frequency band 614-698 MHz, or portions thereof, is identified for International Mobile Telecommunications (IMT). In Gambia, Mauritania, Namibia, Nigeria, Senegal, Somalia, Tanzania and Chad, the frequency band 614-694 MHz is allocated to the mobile service on a secondary basis.

(c) In November 2024, the Communications, Space and Technology Commission (CST), Saudi Arabia conducted spectrum auction in various frequency bands including the 600 MHz band for Mobile Telecommunication Networks. According to the result of the spectrum auction announced by CST[18], STC won a total of 2x20 MHz in the 600 MHz band.

(d) United Arab Emirates (UAE): In 2024[19], the UAE's Telecommunications and Digital Government Regulatory Authority (TDRA) allocated 600 MHz band for IMT.

(e) Australia: In March 2024, the Australian Communications and Media Authority (ACMA) released draft Five-year spectrum outlook 2024–29 and 2024–25 work program for consultation[20]. In the draft, ACMA stated the following with respect to the 600 MHz band:

"In December 2019, an operator in the US was the first to deploy a 5G service in the band. In 2019, Canada issued licences for use

[18] https://www.cst.gov.sa/en/media-center/news/CST-Announces-the-Winners-of-the-Spectrum-Auction-in-the-Frequency-Bands-600-700-3800-MHz-for-Mobile

[19] https://tdra.gov.ae/-/media/TDRA-Media/Newsletters/Ext-Newsletter2024/English-Out-Nov-24.ashx?c=NewsLetters&t=TDRA+in+Brief+November+2024

[20] https://www.acma.gov.au/sites/default/files/2024-04/Draft%20FYSO%202024-29.pdf

of the 600 MHz band. In Q1 2024, Mexico consulted on arrangements to award spectrum in the 600 MHz band for use by WBB, including 5G.

In addition, the Radio Spectrum Policy Group (RSPG) of the European Commission (EC) provided a long-term strategy for the future of the UHF band, which suggests it remains available for broadcasting services until at least 2030. It also recommends that the band should be available for downlink-only broadband services on a secondary basis. This outcome is reflected in Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 2017 on the use of 470–790 MHz frequency band in Europe.

Recommendation ITU-R M.1036 was amended to include frequency arrangements for the implementation of the terrestrial component of IMT in the 600 MHz band.

The AWG meeting in 2022 updated APT Report 79 on Frequency Arrangements for IMT in the band 470–698 MHz, which includes a modified APT 600 MHz band plan alongside the US band plan. The modification consists of the addition of the 2 additional 5 MHz blocks. 3GPP have assigned band number 105 to this plan."

ACMA also noted that *"in the medium term (that is, within this 5-year outlook period), we will focus on ESLs in the 850 MHz and 700 MHz bands that will expire in 2028 and 2029, respectively. We will also continue to engage with industry and government and monitor international developments around the 600 MHz band"*.

(f) New Zealand: The Radio Spectrum Management (RSM) has undertaken initial technical work on the future use of the 600 MHz

band. RSM[21] has published on their website that further work on the 600 MHz band is now paused and will be picked up at a later stage, wherein it has also been mentioned that *"RSM has a strong preference for using the APT 600 MHz band plan (3GPP n105 / ITU-R A13) if possible. This band has been recently developed through international fora and completed standardisation in 3GPP in 2023. The APT 600 MHz band plan provides 2 x 40 MHz (paired Frequency Division Duplex) which is an additional 2 x 5 MHz compared with the 2 x 35 MHz (paired Frequency Division Duplex) North American 600 MHz band plan (3GPP n71 / ITU-R A12). RSM's view is that this makes better use of the spectrum where more bandwidth could be made available to mobile. This also eliminates the 698-703 MHz gap between the APT 600 MHz band plan and the APT 700 MHz (3GPP n28/ ITU-R A5) band plan that would be unusable for mobile, although it could be used for another purpose."*

(g) Qualcomm launched its chipset supporting the APT 600 MHz band (NR band n105) in October 2024 at the India Mobile Congress (IMC) 2024 at New Delhi.

2.99 According to the Global Mobile Suppliers Association (GSA) report on 'National Spectrum Positions' of August-2025[22], spectrum in the 600 MHz range (617-652/663-698 MHz, including bands 71 and n71) is of interest for mobile services, and although the market is at an early stage, increasing number of countries are considering this spectrum for IMT. According to GSA's report, global status of spectrum licensing for mobile services in the 600 MHz band is depicted below:

[21] https://www.rsm.govt.nz/projects-and-auctions/current-projects/future-use-of-the-600-mhz-spectrum-paused-and-not-active

[22] https://gsacom.com/paper/national-spectrum-positions-august-2025/

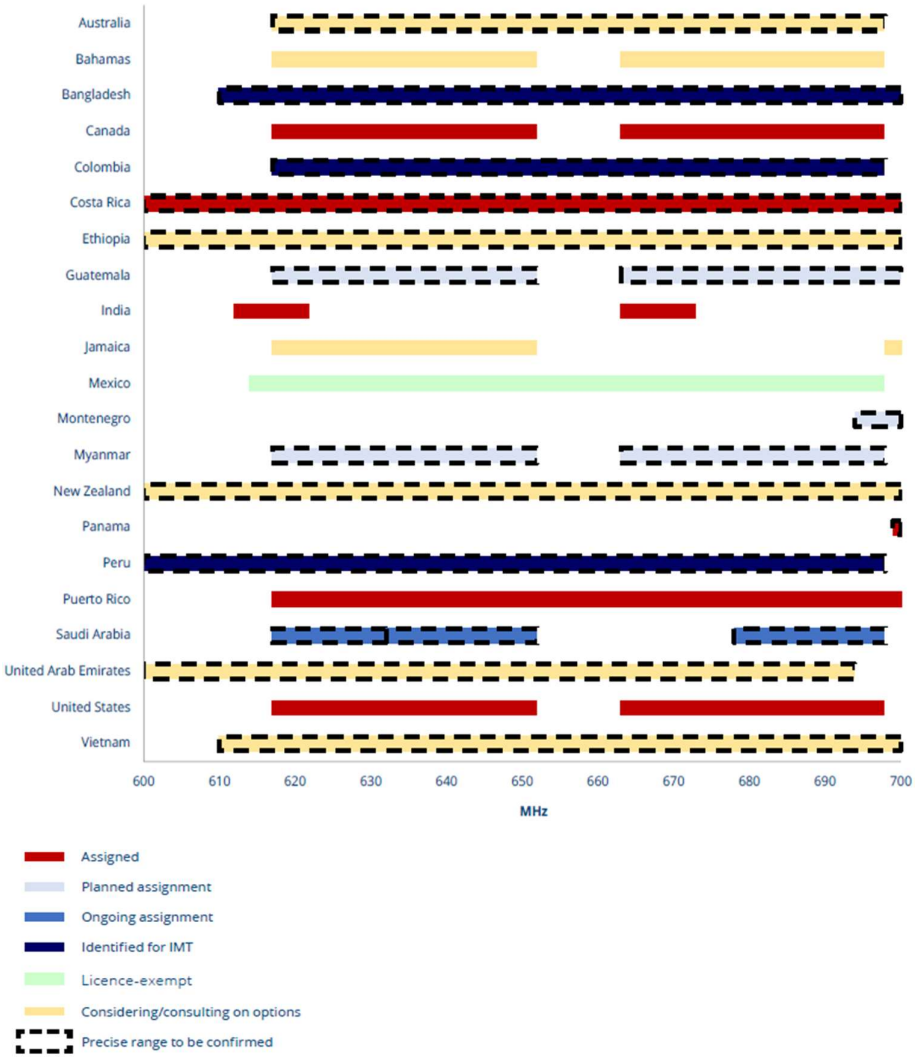


Figure 2.2: Global status of spectrum licensing for mobile services in the 600 MHz band[23]

2.100 In this context, the Authority solicits comments from stakeholders on the following set of questions:

[23] https://gsacom.com/paper/national-spectrum-positions-august-2025/

Issues for Consultation:

Q10. Whether the spectrum in the 600 MHz band should be put to auction in the forthcoming auction? If yes, whether the band plan n105 should be adopted for the 600 MHz band, or otherwise? Please provide a detailed response with justifications.

Q11. In case you are of the opinion that the 600 MHz band should not be put to auction in the forthcoming auction, what should be the timelines for auctioning of the 600 MHz band? Please provide a detailed response with justifications.

2.101 In the NIA for the auction which was conducted in July/ August 2022, the main conditions related to the 600 MHz band were as below:

(a) Band plan: APT 600 Option B1

(b) Total amount of spectrum available for bidding: 40 MHz (paired)

(c) Block size: 5 MHz (paired)

(d) Minimum bid quantity of spectrum: 5 MHz (paired)

(e) Validity period for the assignment of spectrum on LSA basis: 20 years

(f) Area of assignment: Telecom Circle/ Metro Area-basis

(g) Spectrum cap: A Cap of 40% on the combined spectrum holding in the sub-1 GHz bands i.e., 600 MHz (APT 600 Option B1), 700 MHz, 800 MHz and 900 MHz bands, including existing spectrum holding of TSPs in these bands.

(h) Roll out obligations:

Roll out Phase	Roll Out Requirement	Time Period
Metro LSAs		
Phase 1	Coverage of 40% of the LSA	by the end of one year
Phase 2	Coverage of additional 50% of the LSA (Cumulative 90% of the LSA)	by the end of two years
Non-Metro LSAs		
Phase 1	Coverage of 10% DHQs/ Towns	by the end of one year
Phase 2	Coverage of 50% DHQs/ Towns	by the end of three years
Phase 3	Coverage of 10% BHQs	by the end of three years
Phase 4	Coverage of additional 10% BHQs (Cumulative 20% BHQs)	by the end of four years
Phase 5	Coverage of additional 10% BHQs (Cumulative 30% BHQs)	by the end of five years

As per the NIA for the auction of July/ August 2022, the requirement of rollout obligations in respect of the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands, shall be treated as fulfilled once the required number of district headquarters or block headquarters or rural SDCAs are covered by a licensee by using any technology in any band. Therefore, the licensee is not required to fulfil these roll-out obligations separately in respect of each of these bands.

(i) Eligibility criteria to participate in the auction: (i) Any licensee that holds a UASL/ UL with authorization for Access Services for that LSA; or (ii) Any licensee that fulfils the eligibility criteria for obtaining a Unified License with authorization for Access Services, and gives an undertaking to obtain a Unified License with authorization for Access Services; or (iii) Any entity that gives an undertaking to obtain a Unified License with authorization for Access Services through a New Entrant Nominee as per the DoT guidelines/ license conditions, can bid for the Spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz & 26 GHz Bands subject to other provisions of the Notice.

(j) Associated Eligibility Conditions: (i) Existing UASL/UL with Access Services authorization licensees shall be treated as 'New Entrant' in those LSA(s) for the frequency bands in which they do not presently hold spectrum. In other words, UASL/UL with access service authorization licensees who hold spectrum only in a particular LSA are also allowed to participate in the auction as 'New Entrant' in that LSA for the frequency band in which they do not presently hold spectrum. Their eligibility to bid for spectrum blocks in that particular LSA will be that of a new entrant. They will also need to

comply with conditions for spectrum assignment and other prescribed conditions such as rollout obligations, bank guarantees (BGs) etc. For the limited purpose of this provision, 900 MHz and 1800 MHz Bands are considered as the same band.

Net Worth requirements: A Bidder is required to show a net worth of Rs.100 Crore per License Service Area (Rs. 50 Crore each for Jammu and Kashmir and North East Service Areas), in which the bidder wants to submit bids. The net worth requirement is applicable in case of 'New Entrants' and the same is not applicable in case of existing licensees. However, this condition of net worth requirement will be applicable on new entrants only in those LSAs where they do not hold any spectrum in any of the bands (i.e., any of the 800/900/1800/2100/2300/2500 MHz bands).

2.102 As mentioned earlier, the Authority, through the recommendations on 'the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT' dated 04.02.2025, recommended, *inter-alia*, that in addition to the entities holding the access service authorisation, the entities holding Internet service authorisation for Category A/ B service area and/ or the entities holding authorisation for M2M service category A/ B service area under the Unified License (M2M WAN service), should also be permitted to participate in the auction of spectrum for frequency band n260 (37-40 GHz).

2.103 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for consultation:

Q12. In case it is decided to auction the spectrum in the 600 MHz band in the forthcoming auction, -

(a) Should the entire available spectrum in the 600 MHz band be put for bidding in the forthcoming auction?

(b) Whether the eligibility criteria, associated eligibility conditions, block size, minimum bid quantity of spectrum, validity period for the assignment of spectrum, area of assignment on Telecom Circle/ Metro Area-basis, spectrum cap and roll out obligations for the spectrum in the 600 MHz band in the forthcoming auction should be kept the same as those in the spectrum auction of 2022, or otherwise?

Please provide a detailed response with justifications.

Q13. Are there any other inputs/ issues related to the auction of spectrum in the 600 MHz band for the forthcoming auction? Suggestions may be made with detailed justifications.

C. The aspects related to the auction of the 6425-6725 MHz and 7025-7125 MHz bands

2.104 Through the Reference dated 15.05.2025, DoT has requested TRAI to explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz & 7025-7125 MHz bands and accordingly, provide recommendations on timing of auction, applicable reserve price,

band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands.

2.105 This section begins with a description of the international scenario for the upper 6 GHz band. Thereafter, this section examines the aspects such as block size, minimum quantity of spectrum to be bid, spectrum cap, roll out obligations etc. in case the spectrum in the upper 6 GHz band is put in the forthcoming auction.

2.106 Through the Reference dated 15.05.2025, DoT informed TRAI that the Union Cabinet has decided to refarm, *inter-alia*, the 6425-6725 MHz range and 6725-7025 MHz for IMT-based services with the following timelines:

Frequency Range (MHz)	**Timeline/ Status for vacation of spectrum by existing users for IMT based services**
6425-6725[#]	Immediately
6725-7025[#]	31-12-2030

[#]Protection with geographical separation will be provided to the feeder link and space operation of the existing/ future satellite operations of Department of Space, at certain locations. The details of such locations as shared by the Department of Space is enclosed ….

2.107 In para 3 of the Reference dated 15.05.2025, DoT provided further details about the upper 6 GHz band (6425-7025 MHz range) as below:

"3. Further, it may be noted that out of the 700 MHz spectrum in the 6 GHz frequency band (6425-7125 MHz), only 400 MHz spectrum in two fragmented chunks at 6425-6725 MHz (300 MHz) and 7025-7125 MHz (100 MHz) are immediately available for auction and the remaining 300 MHz in frequency range 6725-7025 MHz will be available by December 2030.

3.1 Presently, the IMT ecosystem in the 6 GHz band is at nascent stage and very few countries like China, South Korea, UAE and Saudi Arabia have assigned this band for IMT based services."

3.2 In view of the above, appropriate time for the auction of this band is required to be explored considering the less developed ecosystem and availability of only 400 MHz spectrum in a fragmented manner". (Emphasis added)

2.108 In this context, the Authority perused the recent developments for the usage of the upper 6 GHz band internationally. A few notable developments are given below:

(a) Standardization of the upper 6 GHz band for IMT by the 3GPP: The 3GPP standardized the upper 6 GHz band (6425–7125 MHz) in June 2022 as part of Release 17. The 3GPP has designated frequency band number n104 to this band. The duplex mode for the band n104 is Time Division Duplex (TDD). It is worthwhile to mention that the 3GPP band n96 covering the entire 6 GHz band (5925–7125 MHz) was standardized in the year 2020 as part of the 3GPP Release 16. The following figure depicts the band plans standardized by the 3GPP for the 6 GHz band:

Figure 2.3: 3GPP Band Plans for the 6 GHz Band

Thus, technically, there are two band plans for the frequency ranges referred by DoT, i.e., 6425-6725 MHz and 7025-7125 MHz.

However, it is notable that the band plan n96 is restricted to operation with shared spectrum channel access as defined in TS 37.213 [20] and this band is applicable only in countries/regions designating this band for shared-spectrum access use subject to country-specific conditions[24].

(b) Identification of spectrum in the upper 6 GHz band for IMT at WRC-23: In the World Radio Conference 2023 (WRC-23), Agenda Item 1.2[25] considered identification of various mid-bands including 6425-7025 MHz, and 7025-7125 MHz for IMT. After considering the Agenda Item 1.2, ITU, in the Final Acts[26] of WRC-23, decided to add the following footnotes in the Table of Frequency Allocations of Article 5 of the Radio Regulations:

"5.457E The frequency bands 6425-7125 MHz in Region 1 and 7025-7125 MHz in Region 3 are identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. The frequency bands are also used for the implementation of wireless access systems (WAS), including radio local area networks (RLANs). (WRC-23)" [Emphasis added]

[24] ETSI TS 138 104 V18.6.0 (2024-08) [https://www.etsi.org/deliver/etsi_ts/138100_138199/138104/18.06.00_60/ts_138104v180600p.pdf]

[25] Agenda Item 1.2 of WRC-23: to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis, in accordance with Resolution 245 (WRC-19) Source: Agenda and relevant resolutions of WRC-23, accessible at the URL: https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-ARR.1-2022-PDF-E.pdf

[26] https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-ARR.1-2022-PDF-E.pdf

"5.457D In Cambodia, Lao P.D.R. and the Maldives, the frequency band 6425-7025 MHz is identified for the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. (WRC-23)"

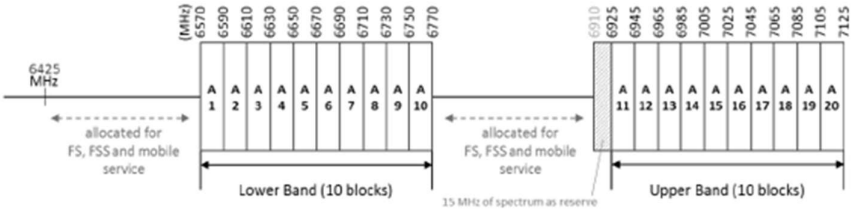
"5.457F In Brazil and Mexico, the frequency band 6425-7125 MHz is identified for the terrestrial component of International Mobile Telecommunications (IMT). The use of this frequency band for the implementation of IMT is subject to seeking agreement under No. 9.21 with neighbouring countries. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. The frequency band is also used for the implementation of wireless access systems (WAS), including radio local area networks (RLANs). (WRC-23)"

Apart from the above, ITU, through Resolution 220 of WRC-23, invited the ITU Radiocommunication Sector to develop harmonized frequency arrangements to facilitate IMT deployment within the 6425-7125 MHz band.

(c) Spectrum Assignment in Hong Kong: In March 2024, the Office of the Communications Authority (OFCA) of Hong Kong decided to amend the Hong Kong Table of Frequency Allocations to allocate the 6425 - 7075 MHz range to mobile service on a co-primary basis in addition to the existing allocations to fixed service (FS) and fixed satellite service (FSS) (Earth-to-space). OFCA stated that *"[t]o*

protect radio stations of co-primary FS, FSS (Earth-to-space) and mobile services operating in the 6425 – 7075 MHz band, any new radio station must refrain from causing harmful interference to, and will not be entitled to claim protection from harmful interference caused by, radio stations of other co-primary services already in existence. In gist, the radio stations of co-primary users will be protected on a first-come-first-served basis."

In November 2024[27], OFCA auctioned the 400 MHz spectrum in the 6425 - 7075 MHz range (referred to as 'the 6/7 GHz band' by OFCA) in 20 frequency blocks with a bandwidth of 20 MHz each for a validity period of 15 years. 15 MHz of spectrum in the 6910 - 6925 MHz range was left over as reserve. A spectrum cap of 140 MHz (i.e. 7 x 20 MHz) was imposed on each bidder in the auction. The following figure depicts the frequency blocks in 6910 - 6925 MHz range which were put to auction:



In the OFCA's auction of November 2024 for the upper 6 GHz band, a total of 300 MHz of spectrum in the band was bid for by three mobile network operators. Each of the successful bidders acquired 100 MHz of spectrum in the auction.

[27] https://www.ofca.gov.hk/filemanager/ofca/en/content_1713/6_7_ghz_band_auction_IM.pdf

(d) Allocation of the upper 6 GHz band for IMT in China: China allocated the spectrum in the upper 6 GHz band for licensed mobile (5G and 6G services) in the year 2023[28].

(e) Allocation of the 6 GHz band for IMT in UAE: In November 2024[29], the UAE's Telecommunications and Digital Government Regulatory Authority (TDRA) allocated the 6 GHz band for IMT.

(f) Consultation w.r.t. the upper 6 GHz band in Australia: As per the draft of Consultation[30] on *"Five-Year Spectrum Outlook 2025–30* and the *2025–26 Work Program"* of March 2025, the Australia Communications and Media Authority (ACMA) is in the process of introducing the new radio local area network (RLAN) arrangements in 6425–6585 MHz through a forthcoming update to the low interference potential device (LIPD) class licence. Regarding 6585-7100 MHz frequency range, in defined population areas, the reservation for Wide Area Wireless Broadband (WA WBB) use is subject to establishment of international markets for the manufacture of suitable equipment. Outside of defined population areas, ACMA will introduce arrangements for apparatus-licensed WBB services (supporting wi-fi and IMT technologies) on a coordinated basis with incumbent users, for which consultation is proposed in Q3 2025.

(g) Consultation w.r.t. the 6 GHz band in United Kingdom: In February 2025, the Office of Communications (Ofcom) initiated a

[28] Source: GSMA report on "Mobile Evolution in 6 GHz: The impact of spectrum assignment options in 6.425–7.125 GHz, September 2024" The report is accessible at the URL: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/09/GSMA_Mobile-Evolution-in-6-GHz.pdf

[29] https://tdra.gov.ae/-/media/TDRA-Media/Newsletters/Ext-Newsletter2024/English-Out-Nov-24.ashx?c=NewsLetters&t=TDRA+in+Brief+November+2024

[30] https://www.acma.gov.au/sites/default/files/2025-03/Draft%20FYSO%202025-30_0.pdf

Consultation on "Expanding Access to the 6 GHz Band for Mobile and Wi-Fi Services"[31]. Regarding the upper 6 GHz (6425–7125 MHz), Ofcom is consulting on a phased approach to maximize the use of spectrum by enabling commercial mobile and Wi-Fi to share the band. In Phase 1, it has proposed to authorise low power indoor Wi-Fi (up to 250 mW) across the whole band on a licence-exempt basis and intend to do this before end 2025. In Phase 2, Ofcom plans to propose specific sharing mechanism between Mobile Service and Wi-Fi, after the clarity about European harmonisation. The sharing solutions include (i) prioritised spectrum split and (ii) indoor/outdoor split (indoor for Wi-Fi and outdoor for mobile). However, Ofcom has mentioned that the preferred solution is a prioritised spectrum split (as depicted in the figure given below), reserving 160 to 400 MHz primarily for Wi-Fi and at least 300 MHz for mobile service. This split aims to support high-power mobile deployments in dense areas while still allowing Wi-Fi to operate across the entire band where mobile use is limited or absent.

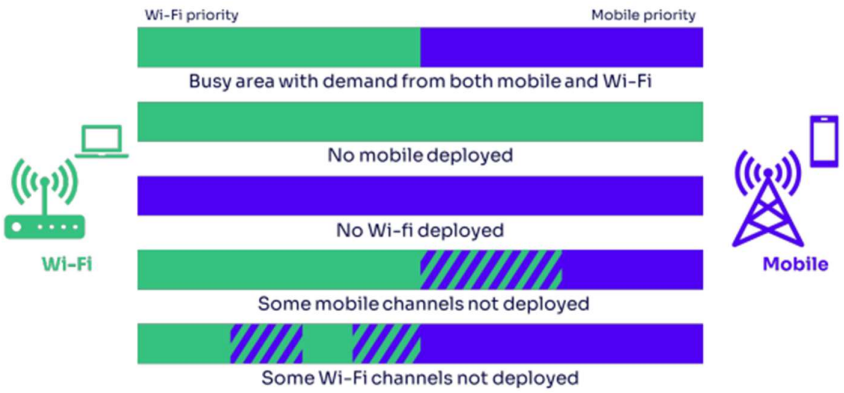


Figure 2.4: Prioritized spectrum split[32]

[31] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-3-4-weeks/consultation-expanding-access-to-the-6-ghz-band-for-commercial-mobile-and-wi-fi-services/main-document/expanding-access-to-the-6-ghz-band-for-mobile-and-wi-fi-services.pdf?v=391052

[32] [32] https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-3-4-weeks/consultation-expanding-access-to-the-6-ghz-band-for-commercial-mobile-and-wi-fi-services/main-document/expanding-access-to-the-6-ghz-band-for-mobile-and-wi-fi-services.pdf?v=391052

(h) Consultation w.r.t. the 6 GHz band in Brazil: In April 2024, ANATEL, the Brazilian National Telecommunications Agency, initiated public consultation with an objective to redefine the operational boundaries for Wi-Fi in the 6 GHz range[33]. The consultation proposed to restrict the Wi-Fi 6 GHz band from the current range of 5925-7125 MHz to a narrower band of 5925-6425 MHz. The purpose of this change is to allocate the 6425-7125 MHz range for future IMT systems, reducing spectrum interference. In January 2025, ANATEL revised Brazil's national frequency allocation plan and included the 6425–7125 MHz band under the IMT category. ANATEL has plans to auction the 6 GHz band by 2026[34].

2.109 Further, the Authority perused the outlook for the upper 6 GHz band from various reports published by telecom industry bodies etc. In this regard, the following observations are noteworthy:

(a) GSMA in its report[35] on 'Spectrum Policy Trends 2025' (February 2025)[36] has stated that *"Hong Kong recently concluded the world's first IMT auction of the upper 6 GHz band, and the UAE is assigning the full upper 6 GHz to its operators. Meanwhile, Sri Lanka, Indonesia, Thailand, Bangladesh and Cambodia have added it to their spectrum roadmaps and India is also progressing the use of 6 GHz for mobile. In 2024, Australia, Brazil, Chile and Mexico moved away from dedicating the entire band for unlicensed use*

[33] https://www.csagroup.org/global-certification-regulatory-update/brazil-anatel-public-consultation-no-29-2024/#:~:text=The%20Ag%C3%AAncia%20Nacional%20de%20Telecomunica%C3%A7%C3%B5es,to%20reach%20out%20to%20us.

[34] https://globalvalidity.com/brazil-anatel-approves-public-consultation-on-future-radio-frequency-planning/

[35] GSMA-Spectrum-Policy-Trends-2025-1.pdf
[Source: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/GSMA-Spectrum-Policy-Trends-2025-1.pdf]

[36] GSMA-Spectrum-Policy-Trends-2025-1.pdf
[Source: https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/GSMA-Spectrum-Policy-Trends-2025-1.pdf]

and identified the upper part of the band to IMT in the countries' table of frequency allocations. In 2025, many more nations will make 6 GHz available for IMT. Countries across APAC, the Gulf region and Latin America will help accelerate these regional trends."

(b) As per a report from PolicyTracker[37], 22 nations have plans to authorise IMT use of the upper 6 GHz range or portions thereof; this includes 12 nations in Asia that are now consulting on or planning, IMT/ licensed upper 6 GHz band policies. The following figure depicts the global status on the 6 GHz band:

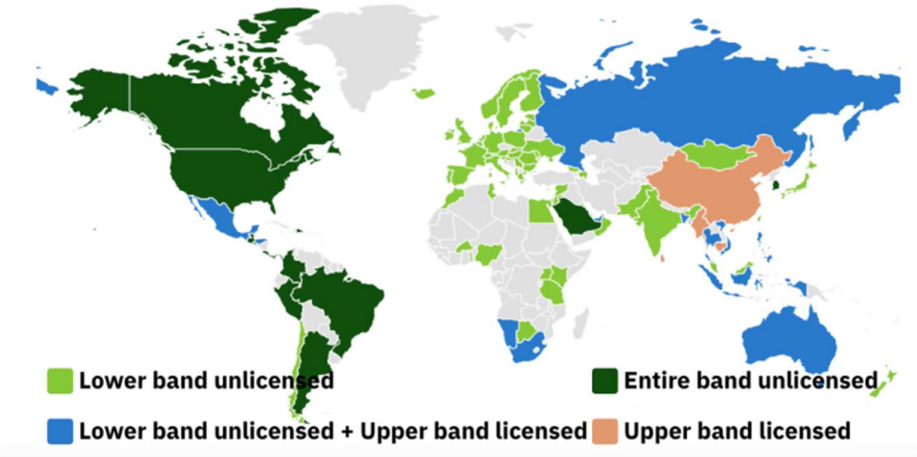


Figure 2.5: Global Status on the 6 GHz band[38]

2.110 The Authority also perused the outlook of original equipment manufacturers (OEMs) for the upper 6 GHz band. In this regard, the following observations are noteworthy:

[37] https://www.policytracker.com/blog/6-ghz-benchmark-updated-for-2025/

[38] https://www.policytracker.com/blog/6-ghz-benchmark-updated-for-2025/

(a) As per a report[39] from Ericsson, the industry needs more mid-band spectrum to enable 5G to scale up and head toward the next phase (5G Advanced); the 6 GHz spectrum can provide the additional mid-band frequency range needed to secure 5G innovation and socio-economic benefits in wide-area environments. The report mentions that Ericsson and MediaTek have successfully carried out an interoperability test on the 6 GHz licensed 5G band (3GPP-defined n104 band, 6.425-7.125 GHz) as part of efforts by telecom vendors, service providers, and device/ chipset makers to build a global ecosystem for this spectrum. The 5G-NR data call over 6 GHz band was performed with a MediaTek prototype test device and an Ericsson base station. In the report, Ericsson stated that it has commercial 3GPP radio solutions in the pipeline, ready to be deployed once the licensed spectrum is made available, based on market demand[40].

(b) As per a white paper by Nokia[41] on 'The potential of upper 6 GHz for 6G: Field insights and comparison with 3.6 GHz', in order to validate the feasibility of the upper 6 GHz spectrum for providing mobile broadband services, Nokia and Telia have collaborated to test the radio capabilities of the upper 6 GHz spectrum in both indoor and outdoor environments, by leveraging the existing macro network infrastructure. As per the white paper, Nokia and Telia used a 3.5 GHz massive MIMO cell of the same RF-bandwidth across various distances to replicate different real-world scenarios; in June 2024, they successfully completed a field pilot in the upper 6 GHz spectrum; the pilot examined compatibility of uplink

[39] https://www.ericsson.com/en/news/2023/11/ericsson-and-mediatek-demo-on-6-ghz-licensed-5g-band

[40] https://www.ericsson.com/en/news/2023/11/ericsson-and-mediatek-demo-on-6-ghz-licensed-5g-band

[41] https://www.nokia.com/asset/214700

coverage with the existing inter-site distances; the findings demonstrated that upper 6 GHz band is a practical and sustainable solution suitable for initial 6G deployment[42].

2.111 International scenario suggests that the upper 6 GHz band is being contemplated to be used for 5G/ 5G-Advanced/ 6G technologies. While 5G technology is widely deployed and the spectrum in the 6 GHz band could be used to meet the additional spectrum demand, work related to technical specifications for 5G-advanced and 6G technology is still going on. According to the 3GPP[43], the target date for "Technology proposals for IMT-2030" has been defined by ITU to be early 2029, and resulting specifications (i.e. full system definition) are to be submitted by mid-2030 at the latest. For Rel-20 5G-Advanced, 3GPP has set an 18-month roadmap focused on enhancing the current capabilities of 5G. The planned schedule ensures a steady progression toward critical upgrades, with progressive freezes as follows:

(a) Stage-1 (service requirements) freeze in June 2025
(b) Stage-2 (system architecture aspects) has a two-tier timeline, with 80% completion anticipated by June 2026, leading to a final freeze in September 2026
(c) Stage-3 (protocol details) is targeted for March 2027, followed by the final ASN.1/ OpenAPI freeze in June 2027.

2.112 In view of the foregoing discussion, one may contend that considering the importance of the upper 6 GHz band for 6G (IMT-2030), this band may be put to auction at a later date. The contrary view could be that all available frequency spectrum in the upper 6 GHz band may be put to auction in the forthcoming auction to meet the demand for the growing

[42] https://www.nokia.com/asset/214700

[43] https://www.3gpp.org/specifications-technologies/releases/release-20

data usage; as the spectrum is assigned in a technology-neutral manner, telecom service providers can later decide to redeploy the spectrum for the latest technologies of that time.

2.113 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for Consultation:

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.

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.

2.114 As per the ITU Radio Regulations of 2024, the allocations in the 6 GHz band are as below:

Table 2.15: Spectrum allocations in the 6 GHz band

Frequency Range	Region 1	Region 2	Region 3
5925-6700 MHz	FIXED 5.457 FIXED-SATELLITE (Earth-to-space) 5.457A 5.457B MOBILE 5.457C[44] 5.457D[45] 5.457E[46] 5.457F[47] 5.149 5.440 5.458		
6700-7250 MHz	FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 MOBILE 5.457D 5.457E 5.457F 5.458 5.458A 5.458B		

2.115 Through a letter dated 04.03.2025, Department of Space (DoS) conveyed to DoT that satellite-based services (uplink) running in the upper 6 GHz band viz. telemetry tracking and command (TT&C), MSS Feeder Link, Antarctica Uplink, GPS Aided GEO Augmented Navigation (GAGAN), and NavIC CDMA would co-exist with the IMT. Through the

[44] 5.457C In Region 2 (except Brazil, Cuba, French overseas departments and communities, Guatemala, Mexico, Paraguay, Uruguay and Venezuela), the frequency band 5925-6700 MHz may be used for aeronautical mobile telemetry for flight testing by aircraft stations (see No. 1.83). Such use shall be in accordance with Resolution 416 (WRC-07) and shall not cause harmful interference to, or claim protection from, the fixed-satellite and fixed services. Any such use does not preclude the use of this frequency band by other mobile service applications or by other services to which this frequency band is allocated on a co-primary basis and does not establish priority in the Radio Regulations. (WRC-15)

[45] 5.457D In Cambodia, Lao P.D.R. and the Maldives, the frequency band 6425-7025 MHz is identified for the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. (WRC-23)

[46] 5.457E The frequency bands 6425-7125 MHz in Region 1 and 7025-7125 MHz in Region 3 are identified for use by administrations wishing to implement the terrestrial component of International Mobile Telecommunications (IMT). This identification does not preclude the use of these frequency bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. The frequency bands are also used for the implementation of wireless access systems (WAS), including radio local area networks (RLANs). (WRC-23)

[47] 5.457F In Brazil and Mexico, the frequency band 6425-7125 MHz is identified for the terrestrial component of International Mobile Telecommunications (IMT). The use of this frequency band for the implementation of IMT is subject to seeking agreement under No. 9.21 with neighbouring countries. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. The frequency band is also used for the implementation of wireless access systems (WAS), including radio local area networks (RLANs). (WRC-23)

letter, DoS also conveyed to DoT the required EIRP density of Hub/ Feeder/ TTC Earth Stations for the satellite-based services mentioned above. DoS further stated that *"the Satellite Earth Stations used for the above-mentioned applications have the uplink in the frequency band 6425-7025 MHz. These services will be operational on 24/7 basis for existing/ future satellites. Considering the transmission from these stations, the IMT stations are likely to be impacted with the in-band interference. Therefore, based on the Satellite Earth Station Uplink EIRP density …, IMT/ terrestrial service providers may compute their keep-out zone of the base station taking into account the actual deployment scenario and technical characteristics of IMT BS & UE. While computing the keep-out zone, I/N criteria of -6 dB is recommended to be used. WPC is requested to share the analysis of IMT/ terrestrial service providers with DoS for further discussions. …"*

2.116 In this regard, TRAI, through its letter dated 19.06.2025, requested DoT to share the outcome of the analysis and keep-out distance determined by DoT for IMT/ terrestrial services, as recommended by DoS for the upper 6 GHz band. In response, DoT, through its letter dated 14.08.2025, informed that *"the determination of keep-out distances for satellite uplink stations shall be worked out by the TSPs in coordination with the DoS, based on the technical specifications of the base transceiver stations (BTS). At present, the technical details of IMT base stations operating in the 6 GHz band are not available. Once any technical analysis is carried out by the TSPs and DoS, the outcome will be duly communicated to TRAI."*

2.117 In view of the above, one could argue that pilot trials may be required to be conducted to ascertain the keep-out distances prior to putting the upper 6 GHz band in auction.

2.118 In this context, the Authority solicits comments from stakeholders on the following question:

Issue for consultation:

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.

2.119 In case it is decided to put the spectrum in 6425-6725 MHz and 7025-7125 MHz ranges in the forthcoming auction, the conditions for auctions such as band plan, amount of spectrum to be put to auction, block size, minimum bid quantity, spectrum cap, roll out obligations etc. would require to be ascertained. These aspects will be dealt in the following paragraphs.

(1) Band Plan for the upper 6 GHz band

2.120 GSMA in its report on '6 GHz in the 5G Era - Global Insights on 5925-7125 MHz' (July 2022), mentioned that "*5G equipment using 6 GHz is under development at network and chipset level and its support from a*

number of large markets already guarantees its scale. The upper 6 GHz band is now standardised as 3GPP band n104." Accordingly, one may argue that the 3GPP band plan n104 with the TDD-based configuration may be adopted for the frequency ranges under reference in the 6 GHz band for IMT.

(2) Amount of spectrum to be made available for bidding

2.121 As per the Reference dated 15.05.2025, a total of 400 MHz is immediately available in the upper 6 GHz band for IMT in two distinct chunks i.e. 6425-6725 MHz (300 MHz) and 7025-7125 MHz (100 MHz), while 300 MHz of spectrum in the 7725-7025 MHz range would become available for IMT by 31.12.2030. In this regard, it requires to be deliberated as to whether the entire 400 MHz, which is immediately available for IMT in the upper 6 GHz band, should be put in the forthcoming auction.

(3) Block size of the spectrum in the upper 6 GHz band

2.122 As per the 3GPP specifications[48] for band n104, the supported channel bandwidth is 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, and 100 MHz. As the upper 6 GHz band is likely to be used for 5G/ 6G technologies, larger chunks of spectrum may be required by telecom service providers. However, a large block size may have the potential to restrict potential bidders; therefore, a balanced approach could be to keep smaller block size and let the telecom service providers decide the quantum of spectrum based on their requirement. One option could be to keep the block size as 10 MHz with a requirement of minimum number of blocks that may be bid as two i.e. 20 MHz spectrum.

[48] 3GPP TS 38.104 version 18.6.0 Release 18
[https://www.etsi.org/deliver/etsi_ts/138100_138199/138104/18.06.00_60/ts_138104v180600p.pdf]

This will enable the telecom service providers to configure their networks for different 3GPP supported channel bandwidths. It is worth mentioning that in the spectrum auction conducted by Hong Kong, 400 MHz spectrum was auctioned in 20 blocks of 20 MHz each.

(4) Roll out obligations for the upper 6 GHz band

2.123 As per the provisions of NIA for the auction conducted in July/ August 2022, the requirement of rollout obligations in respect of the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands, shall be treated as fulfilled once the required number of district headquarters or block headquarters or rural SDCAs are covered by a licensee by using any technology in any band; therefore, the licensee is not required to fulfil these roll-out obligations separately in respect of each of these bands. However, rollout obligations for 3300 MHz and 26 GHz bands are specific to the frequency bands.

2.124 With respect to the newly identified frequency bands in the upper 6 GHz band, as mentioned earlier, to validate the feasibility of the upper 6 GHz spectrum for providing mobile broadband services, Nokia and Telia collaborated to test its radio capabilities in both indoor and outdoor environments, leveraging the existing macro network infrastructure. In the white paper on '*The potential of upper 6 GHz for 6G: Field insights and comparison with 3.6 GHz*', Nokia mentioned as below:

"Critical to the attractiveness of the upper 6 GHz band is the ability to build economically viable and high-performing networks, for example, by leveraging the existing site grid on which current networks are deployed."

2.125 As mentioned above, Hong Kong is the only country where the spectrum in the upper 6 GHz band has been auctioned for IMT till date. The Authority perused the roll-out obligations prescribed by OFCA, Hong Kong for the upper 6 GHz band and compared it with the rollout obligations prescribed by Hong Kong for the 3.5 GHz band earlier. A comparison of the rollout obligations prescribed by Hong Kong for the 3.5 GHz band and the upper 6 GHz band (referred to as 6/7 GHz band boy OFCA, Hong Kong) is given in the following table:

Table 2.16: Comparison of rollout obligations prescribed by Hong Kong for the 3.5 GHz band and the upper 6 GHz band

Frequency band	Roll out obligations
3.5 GHz band[49]	The Licensee shall meet network and service rollout requirement for the mobile service authorised under the Licence, namely that, within five years from the issue of the Licence, coverage of the network and the service shall be provided, and shall be maintained thereafter, to a minimum coverage of 45% of the population of Hong Kong, and shall be maintained thereafter, for the provision of mobile service using its assigned spectrum in the 3.5 GHz band. [It may be noted that during the consultation process, there is general concern from respondents that part of Hong Kong's population reside within the restriction zones and counting them in the

[49] https://www.coms-auth.hk/filemanager/statement/en/upload/481/joint_statement_st_062018.pdf

	network and service rollout obligations does not deem fit. The CA agreed that the deployment will be subject to constraints at least in the initial years and hence it is amenable to excluding the population residing within the restriction zones from the calculation of the network rollout obligation. With about 740,000 individuals (or about 10% of the total population) residing in the restriction zones.
6 GHz band[50] [51]	Each successful bidder of the spectrum in the 6/7 GHz band will be required to provide a minimum coverage of 50% of the population of Hong Kong, and shall be maintained thereafter, by using the spectrum assigned within the first five years from the date of spectrum assignment.

2.126 As can be seen from the above, the roll out obligations prescribed by Hong Kong for the upper 6 GHz band is similar to those for the 3.5 GHz band. In response to the request that the rollout obligations should be in terms of base stations to be deployed with the use of assigned spectrum, OFCA its statement[52] mentioned that *"the CA anticipates that the 6/ 7 GHz band will not only be deployed in indoor environments or hotspots, but will also be suitable for the outdoor environments to provide full network coverage with speed and capacity enhancement."*

[50] https://www.ofca.gov.hk/filemanager/ofca/en/content_1713/6_7_ghz_band_auction_IM.pdf

[51] https://app2.coms-auth.hk/doc/licence/ucl_002.pdf

[52] https://www.coms-auth.hk/filemanager/statement/en/upload/632/ca_statement_20240301.pdf

(3) Spectrum cap for the spectrum in the upper 6 GHz band

2.127 As mentioned above, a band-specific spectrum cap of 40% has been prescribed for the 3300 MHz band. One may contend that considering the Nokia study wherein it has been concluded that *"[c]ritical to the attractiveness of the upper 6 GHz band is the ability to build economically viable and high-performing networks, for example, by leveraging the existing site grid on which current networks are deployed"*, a combined spectrum cap should be prescribed for the 3300 MHz band and the upper 6 GHz band. However, a counter argument to the above view could be that with a combined spectrum cap, there could be a possibility of a telecom service provider monopolizing one of the frequency bands, particularly in the case of the combination of an existing frequency band with a new frequency band. In this regard, it may be worth noting that Hong Kong, the only country where spectrum in the upper 6 GHz band has been auctioned, 400 MHz spectrum was put to auction and band specific spectrum cap of 140 MHz per operator was prescribed, which is 35% of the total spectrum put to auction.

2.128 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for consultation:

Q17. In case it is decided to put the spectrum in 6425-6725 MHz and 7025-7125 MHz ranges in the forthcoming auction, -

(a) Whether the 3GPP band plan n104 should be adopted for the upper 6 GHz band? If no, which band plan should be adopted for the upper 6 GHz band?

(b) What amount of spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should be put to auction?

(c) Whether the spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should be auctioned on Telecom Circle/ Metro service area basis with a validity period of 20 years? If no, what should be the area and validity period of spectrum assignment in the 6425-6725 MHz and 7025-7125 MHz ranges?

(d) What should be the block size, minimum bid quantity, and roll-out obligations for the spectrum in these ranges?

(e) What should be the eligibility criteria and associated eligibility conditions for bidding for the spectrum in these ranges?

Please provide a detailed response with justifications.

Q18. What provisions with respect to the spectrum cap per service provider in a licensed service area (LSA) should be made applicable for the spectrum in the upper 6 GHz band for IMT? Specifically, -

(a) Whether a combined spectrum cap for the 3300 MHz band and the upper 6 GHz band should be prescribed? If yes, what should be the spectrum cap per service provider?

(b) In case your response to (a) above is in the negative, what should be the spectrum cap per service provider for the spectrum in the upper 6 GHz band?

Please provide a detailed response with justifications.

(4) Interference mitigation in TDD bands

2.129 The band plan n104, which is being contemplated for the spectrum in the upper 6 GHz band, is based on time division duplexing (TDD). When more than one TDD network operates in the same band and the same geographical area, interference may occur if the networks are uncoordinated i.e., if some base stations (BSs) are transmitting while others are receiving. Synchronization is one of the techniques to avoid uplink/ downlink interference and thereby obviate the need for reserving a chunk of frequency spectrum as a guard band. A synchronized operation of TDD networks prevents simultaneous uplink and downlink. It can be implemented by (a) starting the frame at the same time and (b) configuring compatible frame structures (length of the frame, and uplink/downlink ratio) so that all transmitters stop before any receiver starts.

2.130 In the Recommendations dated 11.04.2022, the Authority examined this aspect in detail and noted as below:

"To cater to the different 5G use cases, the TSPs may like to implement Dynamic TDD, wherein each cell in the network can adapt its uplink-downlink ratio depending on the traffic requirement. Prescribing a frame structure with a downlink and uplink configuration could come in way of implementation of dynamic TDD.

However, in case of multiple service providers environment and spectrum is assigned on LSA basis, possibility of interference on border areas cannot be ruled out. Therefore, there may be a need to synchronize outdoor networks or adjacent frequencies of different TSPs.

Considering the global trend, 3300-3670 MHz and 24.25-28.5 GHz bands are likely to be used for 5G deployment, and TSPs may like to acquire larger chunk of spectrum in each of these bands. As already

recommended that in case a TSP acquires more than one block, the entire spectrum should be assigned in a contiguous manner. Thus, contiguous spectrum assignment will reduce the chances of interference to a large extent. Further, since spectrum is assigned on LSA basis, cross border interference issues could still be there if the overlapping frequency spots have been assigned to different TSPs in neighboring LSAs. This can also be avoided if a TSP is assigned same frequency spots across different LSAs, to the extent possible. Further interference mitigation be left to the mutual coordination between the TSPs."

2.131 The Authority proposes that the above-mentioned approach adopted for 3300 MHz and 26 GHz bands should also be made applicable for the newly identified spectrum in the upper 6 GHz band. In this context, the Authority solicits comments from stakeholders on the following set of questions.

Issues for consultation:

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.

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.

D. The aspects related to the band plan for the 67 GHz spectrum between 1427-1518 MHz

2.132 In the Reference dated 15.05.2025, DoT mentioned that 67 MHz of spectrum in the 1427-1518 MHz range is to be re-farmed for IMT based services by 31.12.2026; however, DoT did not seek the recommendations of TRAI for the auction of the spectrum in this range. In this regard, TRAI, through its letter dated 19.06.2025, requested DoT to provide the reasons for not including this spectrum for the forthcoming auction along with the details of the exact frequencies in this range that would be made available for IMT and the expected timelines to put the spectrum to auction. In this regard, DoT, through the Letter dated 14.08.2025, informed as below:

"Out of the total 91 MHz spectrum in the 1427-1518 MHz band, 67 MHz has been identified for IMT, while 24 MHz is reserved for assignment to a government user. This band will be refarmed for IMT-based services only after 2026 and band plan is also not finalised, therefore, it is not included in the upcoming auction. Hence, TRAI is requested to recommend a possible band plan for the 67 MHz spectrum between 1427-1518 MHz considering the need to assign a continuous 24 MHz block to the Government user."

2.133 In essence, DoT has requested TRAI to recommend only the band plan for the 67 MHz spectrum in the 1427-1518 MHz band considering the need to assign a continuous 24 MHz block in this range to the Government user.

2.134 The band plan of any frequency band, essentially, lays out how the frequency band is subdivided and structured for use. Generally, the frequency bands for IMT operate in either frequency division duplex (FDD) or time division duplex (TDD) mode. Though less common, a

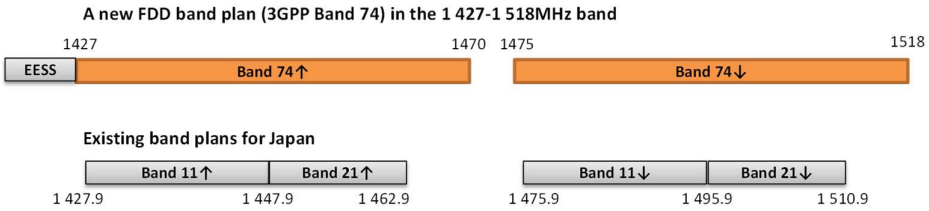
frequency band may also be used as supplementary downlink-only (SDL) or supplementary uplink-only (SUL) to provide additional capacity in the respective direction.

2.135 The 3GPP has designated the following band plans for LTE and 5G-NR in the 1427-1518 MHz range:

Table 2.17: 3GPP Band Plans for the 1427-1518 MHz Range

Band Plan for LTE	Band Plan For 5G NR	Uplink (MHz)	Downlink (MHz)	Mode	Duplex spacing (MHz)
74	n74	1427-1470	1475-1518	FDD	48
51	n51	1427-1432		TDD	-
50	n50	1432-1517		TDD	-
75	n75	-	1427-1432	SDL	-
76	n75	-	1432-1517	SDL	-

2.136 It may be noted that the FDD band plan n74 is an extension of the existing FDD bands in Japan, viz. band 11 [FDD, 2 × 10 MHz, 1427.9–1447.9 MHz (uplink), 1475.9–1495.9 MHz (downlink)], and band 21 [FDD, 2 × 15 MHz, 1447.9–1462.9 MHz (uplink), 1495.9–1510.9 MHz (downlink)] and is compatible with them. The following figure depicts the band 74.



2.137 About the use of SDL, it is worth mentioning that in mobile broadband networks, there is much more traffic on the downlink than on the uplink. SDL allows the bonding of unpaired spectrum with FDD bands to significantly enhance network downlink capacity and users experience.[53] It is noteworthy that the CEPT (European Conference of Postal and Telecommunications Administrations) ECC Decision (17)[54] designated the 1427-1452 MHz and 1492-1518 MHz bands for Mobile/ Fixed Communications Networks Supplemental Downlink (MFCN SDL), which is a downlink-only service.

2.138 GSA in its report[55] on National Spectrum Positions (August 2025) mentioned that "*[s]pectrum in the 1400-1500 MHz range (1427-1518 MHz, including bands 11, 21, 32, 45, 50, 51, 74, 75, 76 and n50, 51, n74, n75, n76, n91, n92, n93 and n94) is of interest for mobile services, and although the market is at an early stage, an increasing number of countries are considering this spectrum for IMT:*

- *1427-1452 MHz: Identified for IMT globally*
- *1452-1492 MHz: Identified for IMT globally except CEPT countries*
- *1492-1518 MHz: Identified for IMT globally*
- *The CEPT has decided on the harmonised use of 1427-1518 MHz for mobile/fixed communications networks*
- *The ASMG has decided on the harmonised use of 1427-1518 MHz for IMT".*

[53] Source: https://tec.gov.in/pdf/Studypaper/Supplementary%20Downlink.pdf

[54] https://docdb.cept.org/download/1471#:~:text=1.,ECC%20Decision%20is%20nationally%20implemented.
[55] https://gsacom.com/paper/national-spectrum-positions-august-2025/

2.139 In the report on National Spectrum Positions, GSA also provided the global status on national spectrum licensing for mobile services in the 1400 MHz to 1500 MHz range as below:

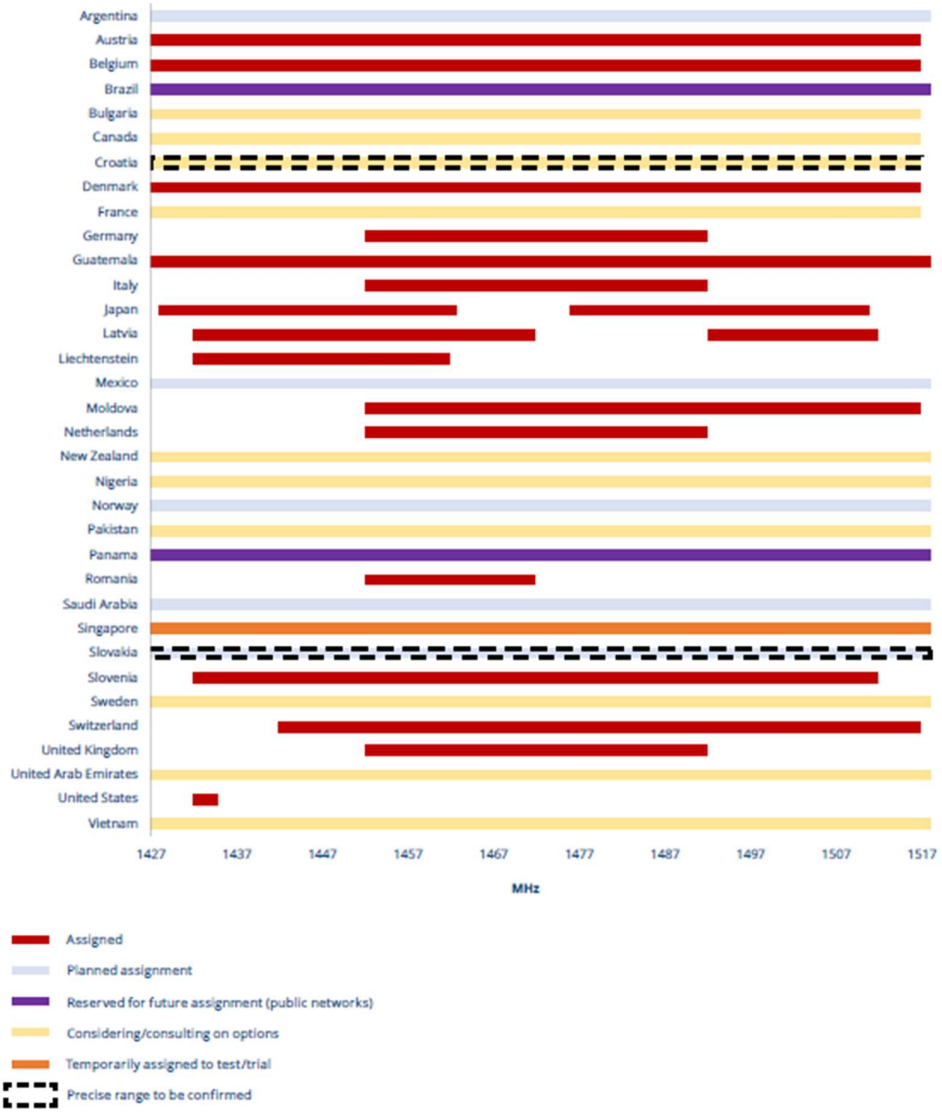
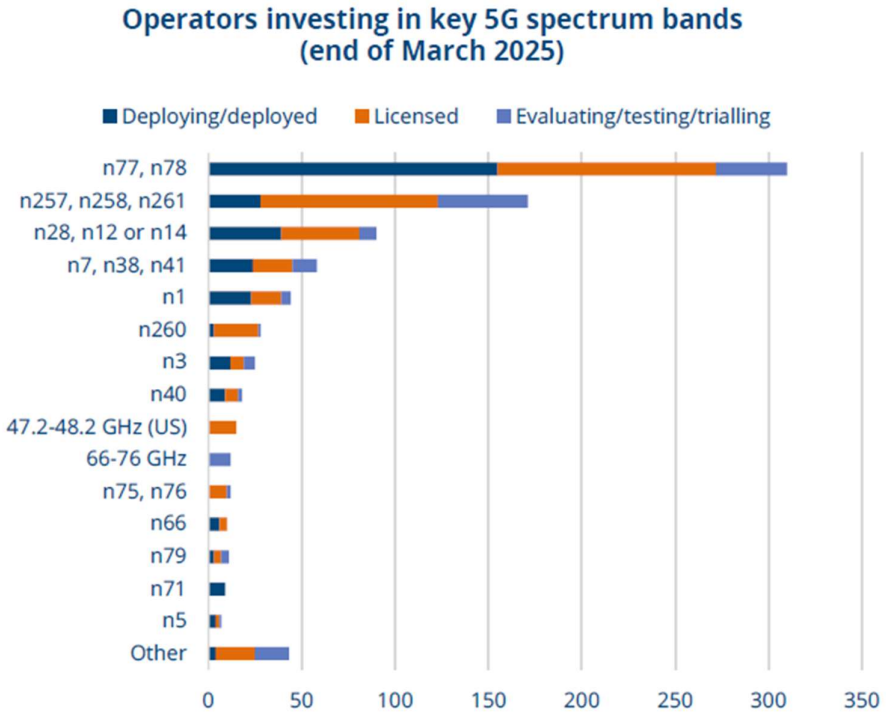
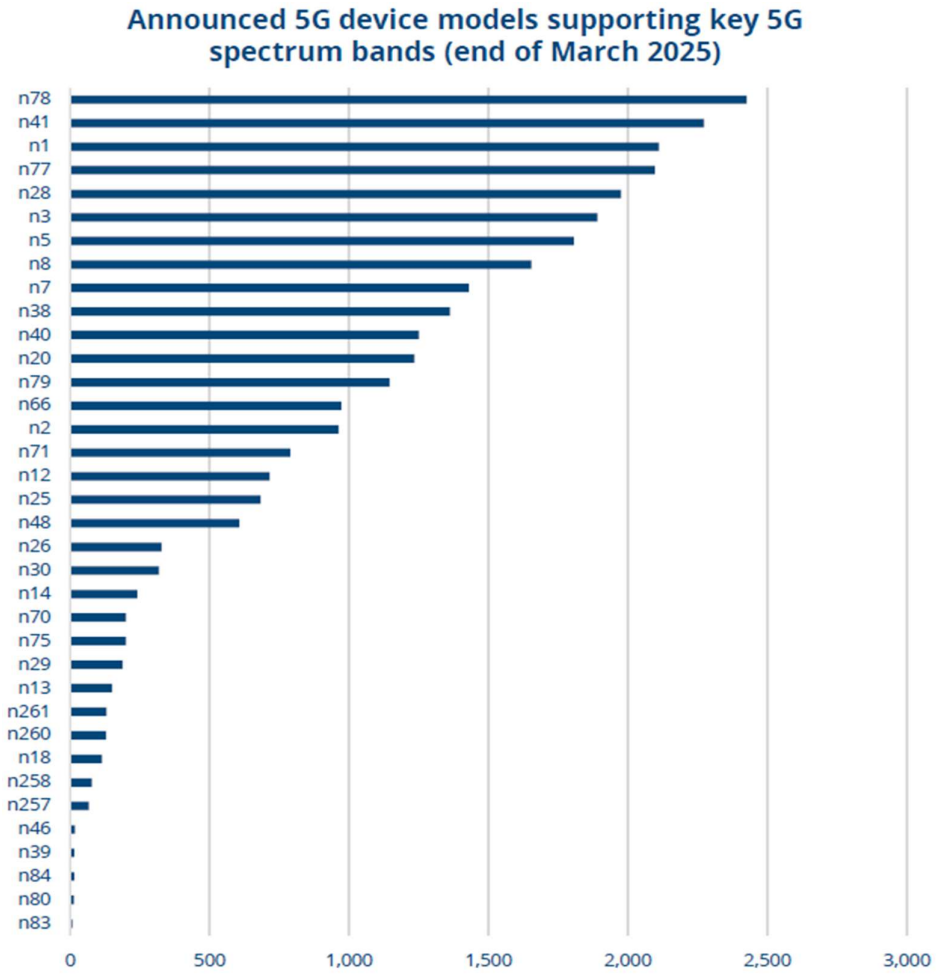


Figure 2.6: Global Status for national spectrum licensing for mobile services in the 1400 MHz to 1500 MHz range

2.140 The Authority also perused the information available on the frequency check website[56] regarding the availability of the ecosystem in the 1427-1518 MHz range. As per the frequency check website, 222 devices of over 10 brands currently support the n75 band and 150 devices of three brands currently support n76 band. Further, as per the GSA report[57] on 5G-Market Snapshot April 2025, many operators are investing in band n75/ n76. The relevant figures depicting the operators investing in the key spectrum bands and announced 5G device models supporting key spectrum bands are given below:



[56] FrequencyCheck - Mobile Network Compatibility Search for Unlocked Phones and Devices
[57] https://gsacom.com/paper/5g-market-snapshot-april-2025/



2.141 In May-2022[58], Qualcomm Technologies, Inc., Three Austria and ZTE successfully executed a 5G network demonstration using a standalone (SA) coverage layer based on 700 MHz (n28) and the supplemental downlink (SDL) band 1400 MHz (n75) with an aim to boost rural throughput and the capacity of standalone mode NR.

2.142 From the examination of international scenario, it has been observed that many countries such as Switzerland, Netherlands, Belgium have

[58] https://www.qualcomm.com/news/releases/2022/05/qualcomm-three-austria-and-zte-achieve-europes-first-5g-standalone#:~:text=Press%20Note-,Qualcomm%2C%20Three%20Austria%20and%20ZTE%20Achieve%20Europe's%20First%205G%20Standalone,capacity%20of%20standalone%20mode%20NR.

already auctioned the spectrum in the 1400 MHz band for IMT as detailed below:

(a) **Switzerland**: The Federal Office of Communications (OFCOM), Switzerland auctioned the spectrum in the 1400 MHz band along with other frequency bands in 2019 as "supplemental downlink" frequencies. Licenses in this band were awarded to the country's three main mobile operators: Swisscom (50 MHz), Salt (10 MHz), and Sunrise (15 MHz).[59]

(b) **Netherlands**: The Netherlands held an auction for 5G spectrum, which included the spectrum in the 1400 MHz band in July 2020 for supplemental downlink (SDL). The country's three major mobile network operators all secured licenses for the 1400 MHz band. KPN acquired 15 MHz, Vodafone Ziggo acquired 15 MHz, and T-Mobile Netherlands acquired 10 MHz in the 1400 MHz band.[60]

(c) **Belgium**: In July 2022, the Belgian Institute for Postal Services and Telecommunications (BIPT) awarded a total of 90 MHz in the 1.4 GHz band. Orange Belgium, Proximus, and Telenet Group took part in the simultaneous auction of the 1400 MHz radio frequency band. BIPT in its press release mentioned that the 1400 MHz radio frequency band is in principle mainly suited for supplemental downlink (SDL) capacity. The result for the auction of the spectrum in the 1400 MHz band is given below:[61]

[59] comcom.admin.ch/en/nsb?id=73916

[60] https://www.rcrwireless.com/20200723/5g/dutch-operators-secure-5g-spectrum#:~:text=The%20carrier%20paid%20a%20total,80%25%20of%20the%20country's%20population

[61] https://www.bipt.be/file/cc73d96153bbd5448a56f19d925d05b1379c7f21/75cde6b9aa34a554c89eef48699f03c2cc8b2bd1/pr_radio_spectrum_auction_ultimately_yields_more_than_1.4-billion_euro_2022-07-20.pdf

Candidate	Amount of spectrum	Sub-band
Orange Belgium	30 MHz	1427-1457 MHz
Telenet Group	15 MHz	1457-1472 MHz
Proximus	45 MHz	1472-1517 MHz

2.143 The Authority also notes that Ofcom, UK has released a consultation paper[62] on the subject 'Award of the 1492-1517 MHz spectrum for mobile services – Competition Assessment" in July 2025, wherein it has been mentioned that 40 MHz of this spectrum (1452-1492 MHz) has already been deployed by mobile network operators ("MNOs") in the UK.

2.144 In this background, the Authority solicits comments from stakeholders on the following set of questions:

Issues for Consultation:

Q21. Considering the need to assign a contiguous 24 MHz block in the 1427-1518 MHz range to the Government user,

(a) Which band plan and duplexing scheme should be adopted for IMT in the 1427-1518 MHz range?

(b) Which range of spectrum (a contiguous block of 24 MHz) should be assigned to the Government user?

Kindly provide a detailed response with justifications.

[62] https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/call-for-input-1.4-ghz-band-available-for-mobile

Q22. Are there any other inputs/ issues related to the spectrum in the 1427-1518 MHz range? Suggestions may be made with detailed justifications.

E. Aspects related to the methodology of auction of spectrum

2.145 The theory of auctions is an elegant theory with enormous potential for applications. The simplest form of auction involves sale of a single (indivisible) object. Suppose there are some potential buyers (bidders) who want to buy this object. Each bidder has a valuation for the object which is completely known to the bidder but not known to other bidders or the seller. An auction tries to recover the valuation information, either directly or indirectly, from the bidders. Inputs to the auction are typically bids that depend on the valuations of the bidders. As an output, an auction produces two things as a function of the input: (a) an allocation indicating who wins the object and (b) prices indicating who pays how much. There are many formats of auction, differing in their input and output that achieve efficiency. Some of the commonly used auction formats are described below:

(a) **Sealed bid Auction:** In this auction, each bidder is asked to submit a bid. The highest bidder wins the auction but pays an amount equal to his bid amount. However, a drawback of this process is that this might lead to an outcome where the bidder who values the block of spectrum the most does not win. This is because it is not necessary that the bidder with the highest value will place the highest bid because the bid amount of a bidder depends on what he believes other bidders are bidding. But the merit of this process lies in the simplicity of the process. Another variant of this auction is Second-price sealed bid auction (Vickrey auction), where

the highest bidder wins the object but pays an amount equal to the second highest bid.

(b) **Dutch auction (descending price auction):** The auctioneer sets a high price on the object initially and lowers it continuously. A bidder who expresses his willingness to buy the object first wins the auction at the current price. One of the problems with the descending price auctions is that the seller must have a good knowledge of the upper bound on the values of the bidders. Otherwise, the seller may lose potential revenue from the auction. Theoretically, this auction is equivalent to the first price sealed-bid auction.

(c) **English or Japanese auction (ascending price auction):** In an English auction, bidding starts low and increases until no higher bids are made; the last bidder wins and pays their bid. In a Japanese (or clock) auction, the price rises gradually, and bidders drop out when they're unwilling to pay more. The auction ends when only one bidder remains, who wins and pays roughly the second-highest value - like a second-price sealed bid auction.

2.146 Since 1990s, for assignment of access spectrum to mobile operators, auctions became the preferred method in several countries. The nudge towards market-oriented assignment was because auctions allow spectrum to be placed in the hands of operators who are able to use it best. Spectrum auction is a market-based mechanism through which governments or regulatory authorities assign spectrum licenses to entities (typically telecom operators) willing to pay the highest price. The goal is to assign spectrum to those who value it the most and can use it efficiently. Auctions are also more transparent, eliminating the subjectivity of a beauty contest. However, auctions are not entirely free

from challenges. Auctions can be affected by the presence of externalities, market power and collusion on the buyer side and asymmetric information between buyers and sellers. The choice of auction format and its design is crucial since it can influence auction outcomes as well as the resulting competition. The most used spectrum auction methods are SMRA (Simultaneous multiple round auctions) and CCA (combinatorial clock auctions), which follow an ascending price auction.

(a) **Simultaneous ascending auction (SAA or SMRA):** A simultaneous multiple-round auction (SMRA), which is also known as a simultaneous ascending auction (SAA), is a simple but flexible format to sell multiple licenses/blocks in parallel. The SMRA proceeds in a series of rounds, with bidders free to place bids on many licenses, based on the pre-defined activity rules. Despite the simplicity of its rules, the SMRA may create strategic difficulties for bidders interested in acquiring combinations of licenses. Since licenses have to be won one-by-one in the SMRA, bidders who compete aggressively for a desired combination risk winning an inferior subset at high prices. This is known as the exposure problem. Foreseeing the possibility of being exposed, bidders may act cautiously with adverse effects for revenue and efficiency.[63]

(b) **Combinatorial Clock Auctions:** The defining characteristic of the CCA is a two-stage bidding process. The first stage is a dynamic clock auction: the auctioneer announces prices for the items in the auction; and bidders respond with quantities desired at the announced prices. Bidding in this stage progresses in multiple rounds as prices increase until aggregate demand is less than or equal to supply for every item. In the second stage, bidders submit

[63] Bichler M, Goeree JK, eds. *Handbook of Spectrum Auction Design*. Cambridge University Press; 2017.

a multiplicity of supplementary bids, both to improve upon their bids from the clock rounds and to express values for other packages. Following the second stage, the bids from both the clock rounds and the supplementary round are entered into winner determination and pricing problems. The winner determination problem treats these bids as package bids and determines the value-maximizing allocation of the items among the bidders. The pricing problem is based on second-price principles. As such, the CCA is the first format that has the potential to eclipse the simultaneous multiple-round auction (SMRA) as the standard for spectrum auctions. The first practical implementations were the Trinidad and Tobago Spectrum Auction, in 2005, and the UK's 10-40 GHz and L-Band Auctions, in 2008.[64]

2.147 In short, in SMRA, related spectrum lots are auctioned simultaneously in a sequence of rounds. One of the primary drawbacks of SMRA is the existence of 'aggregation risk' i.e., auctioning specific blocks of spectrum in parallel may lead to non-contiguous allocations. The CCA, following two-stage bidding, is a variation of SMRA in which bidders bid on packages of generic lots rather than on individual lots in the first stage, and the second stage consists of separate assignment round(s) for positioning in the band.

Recent developments in spectrum auction methodologies

2.148 The SMRA has successfully been used to assign spectrum for more than two decades.[65] However, in retrospect, the year 2008 was a turning point for combinatorial auction design, in terms of practical application

[64] Ausubel, L. M., & Baranov, O. V. (2014). Market Design and the Evolution of the Combinatorial Clock Auction. *The American Economic Review*, *104*(5), 446–451. http://www.jstor.org/stable/42920978

[65] Bichler M, Goeree JK, eds. *Handbook of Spectrum Auction Design*. Cambridge University Press; 2017

and fundamental research. That year, the FCC successfully applied the hierarchical package bidding (HPB) auction to sell their 700 MHz spectrum, resulting in record revenues of close to $19 billion. At the same time, regulators around the globe decided to substitute away from the SMRA and employ a combinatorial clock auction (CCA) or other combinatorial formats (e.g. Australia, Austria, Canada, Denmark, Montenegro, the Netherlands, Ireland, Slovenia, Switzerland, and the UK). Depending on the type of spectrum being sold the SMRA is still being used but most spectrum auctions conducted since 2008 have allowed for combinatorial bidding. Successful implementation of the CCA design in various countries as of 2016 is given below[66]:

Combinatorial Clock Auctions to date, as of 2016

Country and auction	Year	Revenues
Trinidad and Tobago Spectrum Auction	2005	$25.1 million ($US)
UK 10–40 GHz Auction	2008	£1.43 million
UK L-Band Auction	2008	£8.33 million
Netherlands 2.6 GHz Spectrum Auction	2010	€2.63 million
Denmark 2.5 GHz Spectrum Auction	2010	DKK 1.01 billion
Austria 2.6 GHz Spectrum Auction	2010	€39.5 million
Switzerland Spectrum Auction	2012	CHF 996 million
Denmark 800 MHz Spectrum Auction	2012	DKK 739 million
Ireland Multi-Band Spectrum Auction	2012	€482 million
Netherlands Multi-Band Spectrum Auction	2012	€3.80 billion
UK 4G Spectrum Auction	2013	£2.34 billion
Australia Digital Dividend Spectrum Auction	2013	$1.96 billion ($AU)
Austria Multi-Band Spectrum Auction	2013	€2.01 billion
Slovakia 800, 1,800 and 2,600 MHz Spectrum Auction	2013	€164 million
Canada 700 MHz Spectrum Auction	2014	$5.27 billion ($CA)
Slovenia Multi-Band Spectrum Auction	2014	€149 million
Canada 2,500 MHz Spectrum Auction	2015	$755 million ($CA)

2.149 In India, the spectrum auction began in the year 2010. DoT conducted the auction of 2010 based on the recommendations of TRAI on 'Allocation and pricing of spectrum for 3G and broadband wireless access services' dated 27.09.2006. In those recommendations, TRAI made the following observations with respect to auction design:

[66] Source: Ausubel, L. M., & Baranov, O. (2017). A PRACTICAL GUIDE TO THE COMBINATORIAL CLOCK AUCTION. *The Economic Journal, 127*(605), F334–F350. [http://www.jstor.org/stable/45022990]

"This is a one-seller many-buyer (i.e. monopoly) situation. The preferred auction method would have to be some type of an ascending auction, i.e. one where bids go up with time. This method would also allow price discovery. In addition, given the multiple blocks available, and the Authority's concern with ensuring a level playing field, it is preferable to have a simultaneous auction, i.e. one where all the blocks to be given are auctioned simultaneously. Given these needs, the Authority finds that the simultaneous ascending auction (SAA) is the best mechanism to determine a clear winner in a fair and transparent fashion."

2.150 Since 2010, for auction of spectrum, simultaneous multiple round ascending auction system (SMRA) has been consistently used. In India, SMRA has been designed with two-stage process. The first stage, i.e., the clock stage establishes the bidders and the number of block(s) to be awarded in each of the LSAs. In this stage, the bidders bid for generic lots (in terms of number of blocks) rather than on individual lots. The Clock Stage is followed by a frequency identification stage to identify specific frequency blocks for the winning bidders. In this stage, specific frequency identification to each of the successful bidders takes place based on the pre-defined rules published in the relevant NIA for the spectrum Auction. All successful bidder(s) are considered for contiguous spectrum in order of their ranking, subject to availability of sets of contiguous spectrum. The details of the auction designs and related rules may be seen in the NIA[67] for spectrum auctions held in June 2024.

2.151 DoT in its reference dated 15.05.2025 has mentioned that the Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed, inter-alia, *"Examine the demand &*

[67] https://dot.gov.in/sites/default/files/Notice%20Inviting%20Applications%202023-24.pdf

supply dynamics and explore possibility of enhancing competition and mitigating over-supply."

2.152 In this context, the Authority solicits comments from stakeholders on the following set of questions:

Issues for Consultation:

Q23. Whether there is a need to review the spectrum auction method and design followed in India? If yes, suggestions on spectrum auction method and design may be made with detailed justifications and international practice in this regard.

2.153 The following chapter examines the issues related to valuation and reserve price of spectrum.

CHAPTER III: VALUATION AND RESERVE PRICE OF SPECTRUM

A. Introduction

3.1 Spectrum refers to the radio frequencies allocated for communication across various sectors such as telecommunications, space, defence, and railways. It plays a vital role in the operations of these sectors and serves as a crucial input for the delivery of telecom services, making it an indispensable resource for the telecommunications sector. Due to its high utility across different domains, there is an aggregate demand for spectrum from multiple sectors. Since spectrum is a finite resource that is both rivalrous and in several cases excludable, this aggregate demand limits the availability of spectrum for the telecom sector.

3.2 In this context, determining the price of spectrum becomes important to prevent inefficient use and avoid problems such as free riding and overuse. Apart from ensuring coordination among sectors for the efficient allocation and use of spectrum, the Government, as the Licensor, exercises control over both the supply and the pricing of different spectrum bands.

3.3 The demand for spectrum is a derived demand, which depends on the demand for telecom services. This demand is influenced by several factors that affect the uptake of telecom services. These include prevailing market conditions such as tele-density and internet penetration, and techno-economic factors like investment in telecom infrastructure. Other relevant variables such as geographic features, population demographics, and living standards also influence consumer preferences and the demand for telecom services. In addition, various macroeconomic, financial and

market related factors have an impact on the demand for telecom services.

3.4 The supply of spectrum is relatively inelastic, as the Government decides when the rights to use existing spectrum will expire, when spectrum will be re-auctioned, and when new spectrum will be released and in what quantity.

3.5 It is worth mentioning that National Frequency Allocation Plan(NFAP) of India provides a broad regulatory framework, identifying which frequency bands are available for cellular mobile service, Wi-fi, sound and television broadcasting, radionavigation for aircrafts and ships, defence and security communications, disaster relief and emergency communications, satellite communications and satellite-broadcasting, and amateur service, to name just a few. NFAP, though governing the use of spectrum in India, does not by itself provide the right to use the spectrum. Before any part of the spectrum is put to use in India, a licence is required to be obtained from the Wireless Planning and Coordination Wing (WPC Wing), Ministry of Communications, unless such a requirement is exempted by the WPC Wing.[68]

3.6 Further, in this regard, the Authority vide its Recommendations dated 11.04.2022 on Auction of Spectrum in frequency bands identified for IMT|5G, inter alia, recommended the following,

"Considering that there are certain additional bands which are already identified by ITU for IMT services and few additional bands are under consideration in WRC-23 for IMT identification, the Authority recommends that DoT should explore the possibility to make these bands available for

[68] https://dot.gov.in/sites/default/files/NFAP%202022%20Document%20for%20e-release.pdf?download=1%22%5B1

IMT services at the earliest and come out with a spectrum roadmap for opening up of new bands for IMT to meet the future demand. At least a 5-year roadmap on spectrum likely to be made available for IMT in each year and likely date/month of auction should be made public. Such a spectrum roadmap will provide certainty, enable the bidders to take informed decisions and may also encourage new entrants."[69]

3.7 Along with controlling the supply of spectrum, the Government also sets its reserve price. The demand for spectrum is influenced by a range of technical and economic factors. The reserve price also acts as one of the factors that influence demand for spectrum. The reserve price that is set too high may discourage participation and limit competition. At the same time, the reserve price should not be set too low.

3.8 Spectrum is a valuable resource for the provision of telecom services. The telecom sector, through its backward and forward linkages, contributes significantly to broader economic outcomes such as economic growth, employment generation, and citizen participation. Therefore, any policy decision related to spectrum pricing has a direct impact on the cost and availability of telecom services. Since public interest is closely linked to the pricing of spectrum, it is essential that spectrum pricing is based on a clear and well-reasoned approach. A rational and effective pricing framework is necessary to ensure optimal use of this important resource in a manner that best serves the public interest.

B. DoT's reference dated 15.05.2025

3.9 Through the letter dated 15.05.2025, DoT requested TRAI to provide its recommendations under Section 11(1)(a) of the TRAI Act, 1997, as amended by TRAI Amendment Act 2000, on the following:

[69] http://trai.gov.in/sites/default/files/2024-09/Recommendations_11042022.pdf

(a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

(b) explore the possibilities of auction and timing of auction for the newly identified 6425- 6725 MHz & 7025-7125 MHz bands. Accordingly, provide recommendations on timing of auction, applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands.

(c) re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band.

(d) provide any other recommendations deemed fit for the purpose of spectrum auction in these frequency bands, including the regulatory technical requirements as enunciated in the relevant provisions of the latest NFAP/Radio Regulations of the ITU.

3.10 The DoT, in its reference dated 15.05.2025, has also stated the following:

"4. The Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed the following, among others: "Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply…

… 7.1 Further, while providing its recommendations, TRAI may also take into account the observations of Department of Economic Affairs as mentioned in para 4 above."

C. Valuation of spectrum in existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands

3.11 Through the reference dated 15.05.2025, DoT has inter alia requested TRAI to provide recommendations on applicable reserve price for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

3.12 Since the year 2013, the Authority has been furnishing its recommendations on valuation and reserve price of various spectrum bands following a bottom-up approach (LSA-wise valuation using LSA specific inputs) using several valuation methodologies. Through the last recommendations, which were furnished in April 2022, the Authority had recommended reserve price of spectrum in 600MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3.3GHz(mid-band) and 26 GHz (mmWave band)

3.13 This section deals with the valuation of spectrum in existing bands—i.e., those bands that were put to auction in the past and had received bids.

3.14 Past auction determined prices are available for these spectrum bands. Since service providers have acquired these bands through auction, relevant financial, technical, and other data is also available. Therefore, the use of past auction determined prices for specific bands may serve as one of the approaches for its valuation.

3.15 The valuation of spectrum in existing bands could also be based on comparative values that can be achieved by using relative spectral efficiency approach where characteristics like coverage of a particular

spectrum band can be compared with the same characteristics of another spectrum band and a spectral efficiency factor can be derived as a ratio.

3.16 Along with using past auction determined prices and spectral/technical efficiency factor, following valuation models may also be used to determine the valuation of existing bands viz.800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands due to the availability of financial, technical and other relevant data for these bands:

(i) Multiple Regression Model**,**
(ii) Trend Line Approach**,**
(iii) Production Function Model**,**
(iv) Producer Surplus Model**,**
(v) Revenue Surplus Model**,** and
(vi) Economic Efficiency Model

3.17 The use of past auction-determined prices as one of the approaches for valuation of spectrum is discussed first in the succeeding paragraph.

(i) Use of Past Auction Prices

3.18 The Authority in various valuation exercises in the past, including the IMT/5G valuation exercise of 2022 considered past auction prices as one of the basis/approaches for valuation of spectrum band. The Authority has, in the past, taken a view that auction determined price is an indicator of the valuation of spectrum by the market. Details regarding the reserve price (RP), auction determined price (ADP), quantity put to auction and quantity sold in the IMT|5G auctions held in 2022 and 2024, have been tabulated below:

Table 3.1: Details regarding quantity put to auction, quantity sold, RP and ADP -2022 Spectrum Auction

Spectrum Band	Total Qty. Put to auction (in MHz)	Total Reserve Price (RP) per MHz (in Rs crore)	Qty Sold (in MHz)	LSA where no bids were received	Total RP & ADP of LSAs where spectrum was sold	
					RP per MHz (in Rs crore)	ADP per MHz (in Rs crore)
600MHz	6600 (22 LSAs)	3927 (22 LSAs)	-	22	Received no bid	
700MHz	550 (22 LSAs)	3927 (22 LSAs)	220 (22 LSAs)	0	3927 (22 LSAs)	3927 (22 LSAs)
800MHz	136.25 (22 LSAs)	3620 (22 LSAs)	20 (4 LSAs)	18	210 (4 LSAs)	210 (4 LSAs)
900MHz	74.40 (21 LSAs)	3658 (21 LSAs)	12.8 (3 LSAs)	18	86 (3 LSAs)	86 (3 LSAs)
1800MHz	267.20 (22 LSAs)	2116 (22 LSAs)	88.40 (10 LSAs)	12	1148.76 (10 LSAs)	1221.76 (10 LSAs)
2100MHz	160 (19 LSAs)	1486 (19 LSAs)	35 (7 LSAs)	12	636 (7 LSAs)	636 (7 LSAs)
2300MHz	60 (6 LSAs)	362 (6 LSAs)	-	6	Received no bid	
2500MHz	230 (12 LSAs)	482 (12 LSAs)	20 (2 LSAs)	10	65 (2 LSAs)	65 (2 LSAs)
3300MHz (Mid band)	7260 (22 LSAs)	317 (22 LSAs)	5490 (22 LSAs)	0	317 (22 LSAs)	317 (22 LSAs)

Spectrum Band	Total Qty. Put to auction (in MHz)	Total Reserve Price (RP) per MHz (in Rs crore)	Qty Sold (in MHz)	LSA where no bids were received	Total RP & ADP of LSAs where spectrum was sold	
					RP per MHz (in Rs crore)	ADP per MHz (in Rs crore)
26GHz (mmWave)	62700 (22 LSAs)	6.99 (22 LSAs)	45350 (22 LSAs)	0	6.99 (22 LSAs)	6.99 (22 LSAs)

3.19 The salient features of the 2022 IMT|5G spectrum auction are as follows:

- A total of 72,098 MHz spectrum was put to auction, of which 51,236 MHz (71% of the total) was sold with bid amounting to Rs. 1,50,173 crores.
- No bids were received for 600MHz and 2300MHz
- Regarding 600MHz band The Ministry of Communication vide its Press release dated 02.08.2022, communicated that *"The device ecosystem of 600 MHz band is still not developed for mobile telephony. In a few years, this band may become important."*[70]
- 4 bidders participated and acquired spectrum in various bands in the auction
- ADP of 700MHz, 3300Mhz(mid-band) and 26GHz (mmWave band) is available across all 22 LSAs

[70] https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1847279

Table 3.2: Details regarding quantity put to auction, quantity sold, RP and ADP -2024 Spectrum Auction

Spectrum Band	Total Qty. Put to auction (in MHz)	Total Reserve Price per MHz (in Rs crore)	Qty Sold (in MHz)	LSA where no bids were received	Total RP & ADP of LSAs where spectrum was sold	
					RP per MHz (in Rs crore)	ADP per MHz (in Rs crore)
800 MHz	118.75 (19 LSAs)	3426 (19 LSAs)	**-**	19	Received no bid	
900 MHz	117.20 (22 LSAs)	3855 (22 LSAs)	60.80 (14 LSAs)	8	1851 (14 LSAs)	1851 (14 LSAs)
1800 MHz	221.40 (22 LSAs)	2337 (22 LSAs)	50.60 (10 LSAs)	12	789 (10 LSAs)	791.92 (10 LSAs)
2100 MHz	125 (15 LSAs)	1353 (15 LSAs)	20 (4 LSAs)	11	109 (4 LSAs)	109 (4 LSAs)
2300 MHz	60 (6 LSAs)	443 (6 LSAs)	-	6	Received no bid	
2500 MHz	70 (6 LSAs)	77 (6 LSAs)	10 (1 LSA)	5	15 (1 LSA)	15 (1 LSA)
3300 MHz	1110 (19 LSA)	355.04 (19 LSA)	-	19	Received no bid	
26 GHz	8700 (21LSA)	7.61 (21 LSA)	-	21	Received no bid	

3.20 The salient features of the 2024 IMT|5G spectrum auction are as follows:

- The expiring spectrum in 2024 and the unsold spectrum of previous Spectrum Auction held in 2022 were put to auction this year to meet

spectrum requirement of Telecom Service Providers (TSPs) to ensure continuity and growth of the services.[71]

- Spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands were put to auction. Bids were received for 900MHz, 1800MHz, 2100MHz and 2500 MHz bands.
- 3 bidders (service providers) participated and acquired spectrum in various bands in the auction
- The Ministry of Communication vide its Press release dated 22.07.2024, communicated that: "*As auction for 5G spectrum was held recently & 5G Monetization is still in progress, no bidding took place in 800MHz, 2300MHz, 3300MHz and 26GHz bands. A total quantum of 141.4 MHz (26.5%) was sold from the balance 533.6 MHz Spectrum. This is despite the fact that a very large amount of spectrum i.e., 51.2 GHz of spectrum was sold in August 2022.*"[72]

3.21 In both the 2022 and 2024 auctions, it may be noted that most of the spectrum was sold at the reserve price. However, in the case of the 1800 MHz band, in 2 LSAs (each in 2022 and 2024 auctions), the entire spectrum put up for auction was sold. The spectrum in these LSAs was sold at prices above the reserve price. The details are tabulated below.:

[71] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2028885

[72] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2028885

Table 3.3: Spectrum band and LSAs where ADP is above RP in the 2022 and 2024 auctions

2022 Auction				2024 Auction			
Spectrum Band	**LSA**	**RP per MHz (in Rs crore)**	**ADP per MHz (in Rs crore)**	**Spectrum Band**	**LSA**	**RP per MHz (in Rs crore)**	**ADP per MHz (in Rs crore)**
1800MHz	Orissa	35	35.175	1800MHz	Bihar	82	84.05
	UP(E)	91	164.6		West Bengal	58	58.87

3.22 Considering the above details regarding the quantity of spectrum put to auction and sold in the 2022 and 2024 auctions, it may be noted that, in paragraph 2.28 of Chapter II, the Authority is deliberating whether, at this stage, the entire available spectrum in the existing bands should be put for auction.

3.23 DoT, in its reference dated 15.05.2025, has stated the following:

"4. *The Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed the following, among others: "Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply*
… 7.1 Further, while providing its recommendations, TRAI may also take into account the observations of Department of Economic Affairs as mentioned in para 4 above."

3.24 In response to the above observations of the Department of Economic Affairs, the Authority has examined the issues related to demand and supply dynamics, the possibility of enhancing competition, and the issue

of over-supply in paragraphs 2.30 to 2.36 of Chapter II. For reference, certain key points from same paragraph are summarized below:

- The Authority has noted that the supply of spectrum in the auction process is primarily determined by the availability of globally harmonized IMT bands, while demand is driven by market forces and influenced by several economic and technological factors.
- To enhance competition, the Authority, in its recommendations on the 'Frequency Spectrum in 37–37.5 GHz, 37.5–40 GHz, and 42.5–43.5 GHz bands identified for IMT' dated 04.02.2025, has recommended that, in addition to access service providers, Internet Service Providers and M2M WAN service providers should also be permitted to participate in the auction of the n260 (37–40 GHz) band.
- The Authority has observed that several factors constrain prediction of the demand for spectrum in an auction in advance, that is, prior to the auction. It has further noted that in the context of telecom scenario, reducing the supply of spectrum based on the predicted demand of potential bidders could raise concerns regarding the creation of artificial scarcity.

3.25 Furthermore, several aspects related to the observations of the Department of Economic Affairs, to ensure effective competition in the spectrum auctions and determine the quantum of spectrum to be auctioned have been discussed in paragraphs 2.37 to 2.49 of Chapter II. Some other relevant aspects are discussed in the following para.

3.26 The Authority, in its past recommendations, has held that the entire available spectrum should be put up for auction. For instance, in its recommendations dated 11.04.2022, the Authority recommended the following:

"*The Authority recommends that in 600 MHz (APT 600 Option B1), 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3670 MHz and 24.25-28.5 GHz spectrum bands, the entire available spectrum should be put to auction in the forthcoming auction. The Authority also notes that the Government is already considering assignment of spectrum to BSNL/MTNL for 5G Services.*"

The Authority was of the view that, "*some of the spectrum bands viz. 3300-3670 and 24.25-28.5 GHz to be auctioned in the forthcoming auction, are likely to be used for 5G services, for which sufficient spectrum in globally harmonized bands is a prerequisite. Further, in existing bands, the TSPs may like to enhance their spectrum holding considering the increasing data consumption. Requirements and priorities of different TSPs could be different i.e., to strengthen their existing 4G services, launch 5G services, some new operator may like to come in straight with 5G. Therefore, to give flexibility and choice to the TSPs, it will be prudent to include entire available spectrum in each band in the forthcoming auction".*

3.27 The *National Digital Communications Policy 2018* (NDCP)[73] also highlights the importance of ensuring adequate availability of spectrum to support new and emerging technologies and calls for developing a transparent, normative and fair policy for spectrum assignments and allocations. The Draft National Telecom Policy (NTP), 2025[74] also prioritizes release of spectrum for IMT, mmWave, and sub-THz for 6G.

3.28 Also, in the Notice Inviting Applications (NIA) for the auction of spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands, dated 15th June 2022, as

[73] https://dot.gov.in/sites/default/files/Final%20NDCP-2018_0.pdf

[74] https://www.py.gov.in/sites/default/files/draftntp2025.pdf

well as in the subsequent Notice Inviting Applications dated 8th March 2024, the Government had set the following objectives for the auction:

- *Obtain a market determined price of Spectrum through a transparent process;*
- *Ensure efficient use of spectrum and avoid hoarding;*
- *Stimulate competition in the sector;*
- *Promote rollout of the respective services;*
- *To arrive at optimal price of spectrum to ensure sustainable and affordable access to Digital Communications*[75]*.*

3.29 There was distinction in the objectives of the previous NIAs —for example, one of the objectives of the Notice Inviting Applications dated 6th January 2021 for the auction of spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands was to "maximize revenue proceeds from the auctions within the set parameters." However, this objective is not included in the NIAs for 2022 and 2024, as outlined in paragraph 3.28.

3.30 To obtain deeper insights, details of the percentage of spectrum sold are provided in **Annexure 3.1**. The data is presented LSA-wise and band-wise, as a proportion of the total quantity of spectrum offered. The Annexure also shows the relationship between demand (D) and supply (S), that is, whether $D \geq S$ or $D < S$, as observed in the 2022 and 2024 auctions.

3.31 As stated above, the demand for spectrum is a derived demand, which depends on the demand for telecom services. The demand for spectrum

[75] Notice Inviting Applications For Auction of Spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz Bands dated 15th June, 2022

is shaped by market forces as well as various economic and technological factors, such as:

(a) Demand for Telecom Services – The current and projected growth in the number of subscribers, total wireless traffic, and coverage requirements within a Licensed Service Area (LSA)—all of which influence potential revenue—collectively affect the demand for spectrum by a bidder (in this case, the Access Service Provider).

(b) Number of bidders participating in the auction – a higher number of bidders typically leads to greater bidding intensity (increasing the possibility of ADP>RP) and a higher total sale of spectrum.

(c) Financial health and investment capacity of the bidders.

(d) Amount of spectrum acquired in previous auctions – when bidders have purchased sufficient spectrum earlier, bidding intensity in subsequent auctions tends to be lower. For e.g.,

(e) Post the completion of 2024 spectrum auction, The Ministry of Communication vide its Press release dated 22.07.2024, communicated that: "As auction for 5G spectrum was held recently & 5G Monetization is still in progress, no bidding took place in 800MHz, 2300MHz, 3300MHz and 26GHz bands. A total quantum of 141.4 MHz (26.5%) was sold from the balance 533.6 MHz Spectrum. This is despite the fact that a very large amount of spectrum i.e., 51.2 GHz of spectrum was sold in August 2022."[76]

(f) In addition, demand for spectrum in any particular auction also depends upon business plans of individual bidders.

(g) Expiry of spectrum license – if a bidder's spectrum license is expiring for a particular LSA, bidding intensity is usually higher and the auction-determined price often exceeds the reserve price. For e.g., the same was observed for 1800MHz in some LSAs in 2024 auctions.

[76] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2028885

(h) Technology for which spectrum is being acquired – for example, when new technologies such as 5G are introduced and new spectrum bands (such as mid-band, mmWave etc.) are auctioned for the first time, increase in demand is typically observed.

(i) Development of device ecosystem- If the device ecosystem for a particular spectrum band is underdeveloped, it adversely affects the demand for that band. For instance, the 600 MHz band did not receive any bids in the 2022 auction due to the lack of a developed device ecosystem.

(j) Reserve price – as it serves as the starting point for an ascending auction, an unreasonably high reserve price can negatively affect participation and reduce demand.

3.32 It is important to note that the purpose of reserve price is to provide a floor price in an ascending auction. The final auction price is ultimately determined by the interaction of demand and supply. This section discusses the use of past auction-determined prices and their comparison with reserve prices. Considering that the reserve price acts as one of the factors that can influence both demand and bidder participation, the issues relating to demand–supply dynamics and enhancing competition in the auction are dealt in the following paragraphs.

3.33 It is also observed that demand for spectrum primarily depends upon the demands of telecommunication needs and data consumption requirements of the society and the economy. The Authority noted that the total mobile data consumption has been steadily growing over the years as shown in the figure below.

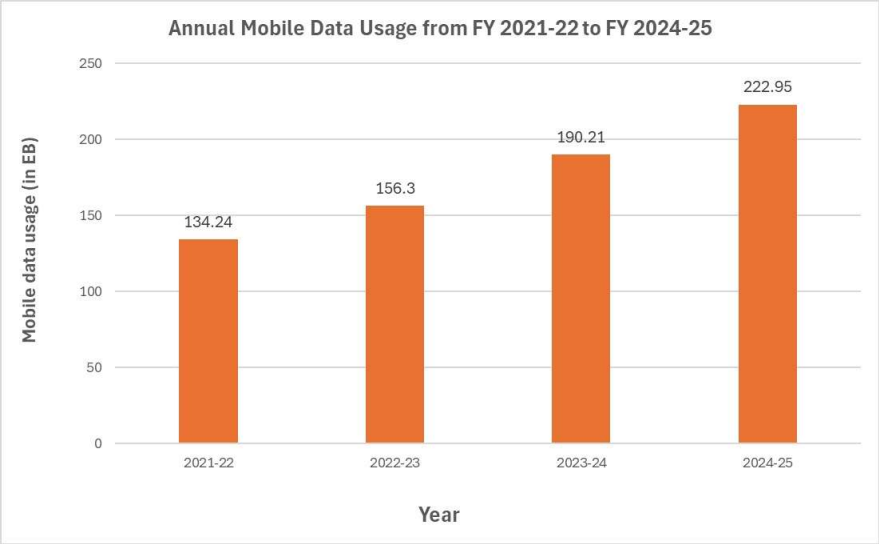


Figure 3.1: Annual mobile data usage (in EB)

3.34 The Government and the economy are rapidly adopting more and more digitisation of services. The rapid adoption of AI is also likely to fuel data consumption requirements. Indian broadband adoption is predominantly wireless and enhancement of capacity needs spectrum besides densification of network infrastructure. Hence, demand & supply of spectrum cannot be seen only with the perspective of extant of participation of bidders in a particular auction. Moreover, participation of bidders in auction also depends on policies of the Government which can influence attractiveness of the sector for (i) private investment (ii) financial sustainability of existing service providers (iii) entry of new service providers. The spectrum planning by the DoT including the NFAP and its implementation will also determine the supply of spectrum to the service providers and prospective bidders.

3.35 There is a common perception that if the entire quantity of spectrum is not sold, or if it is sold at the reserve price, it reflects low demand. Such low demand is attributed to a high reserve price, which is seen as a "prohibitive price" that affects bidder participation and price discovery. However, as discussed above, demand for spectrum is influenced by a

range of technical, economic, and other factors in addition to the reserve price. The reserve price alone is not the decisive factor in determining actual demand, the quantity of spectrum sold, or whether the auction-determined price equals or exceeds the reserve price. Several factors, as highlighted in paragraph 3.32 (a)-(j), collectively shape demand and auction outcomes.

3.36 The reserve price is determined after assessing the valuation of spectrum, which will be discussed in detail in subsequent paragraphs. This valuation is derived by the Authority after considering various financial, economic, technical, and other relevant factors. Best-in-class valuation approaches and methodologies are adopted to incorporate these factors and arrive at an optimal valuation.

3.37 Although the reserve price is not the sole determinant of demand, the efficiency of the valuation exercise can be improved by examining and considering any additional factors that could influence demand, competition, and the final outcomes of the auction.

3.38 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issue for Consultation:

Q24. What additional economic, technical, or market-related factors should be taken into account while determining the valuation and, subsequently, the reserve price of spectrum, in order to promote effective competition, ensure optimal spectrum utilization, and encourage wider participation in auctions?

3.39 Based on the foregoing discussion on demand and supply, it is reasonable to state that as the entire quantum of spectrum of certain frequency bands, put to auction was not sold in certain Licensed Service Areas (LSAs), the auction-determined price may not represent a market-clearing price. However, as the auction-determined price is discovered through the interaction of market forces of demand and supply, it continues to reflect a market-determined price.[77]

3.40 In this regard, it worth mentioning that the Authority in various past recommendations has noted the following:

- Economic theory suggests that pricing of a public resource should reflect, as far as possible, its current economic value, so as to encourage its most efficient, optimal and equitable use.
- The economic value of a particular item, or good, is measured by the maximum amount of other things that a person is willing to give to have that good. This is also termed as Willingness to Pay. The amount or the price paid by the consumer for a good in a market economy is an accepted measure of economic value. Thus, the market determined price is considered an important indicator of economic value of a good.
- Accordingly, the price discovered through the auction process is regarded as a reliable indicator of the market's valuation of spectrum and has therefore been adopted as one of the valuation approaches for spectrum in the past.

3.41 Since 2018 the authority has taken a consistent view that the 'Marginal Cost of Funds based Lending Rates (MCLR) system' has replaced the base rate system with effect from 1st April 2016 and therefore, the Marginal Cost of Funds based Lending Rates (MCLR) represents the most realistic rate at which indexation should be carried out and should replace SBI

[77] http://www.trai.gov.in/sites/default/files/2024-09/CP_30112021_0.pdf

base rate for the indexation purposes.[78] In the 2022 valuation exercise, auction determined prices for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, and 2300 MHz bands were available from the 2021 auction. Accordingly, for the valuation of these bands, the auction determined prices of the respective bands, duly indexed using the MCLR, were considered as one of the valuation methodologies.

3.42 It is pertinent to highlight that in the 2022 valuation exercise, only the auction prices from the most recent auction, that is, the 2021 auction, were taken into account since the Authority considered it proper that the spectrum prices discovered in the auctions conducted up to two years should be used as one of the methods of valuation of spectrum. If a similar approach is followed in the current valuation exercise, then only the auction prices from the 2024 IMT|5G auction may be considered.

3.43 However, in the 2024 auction, spectrum was sold only in a few bands and that too in a limited number of licensed service areas. This was partly due to the fact that a substantial quantum of spectrum, that is, 51.2 gigahertz, had already been sold in August 2022. The licensed spectrum going to expire in in 2024 along with the unsold spectrum in the 2022 auction was put up for auction in 2024. The objective was to meet the requirements of telecom service providers for ensuring continuity and growth of services.

3.44 Therefore, since auction prices for various spectrum bands in most licensed service areas are available from the 2022 auction, it may be appropriate to consider the auction prices from both the 2022 and 2024 auctions. It may also be noted that the 2300 MHz spectrum band did not

[78] RBI Notification No. RBI/2015-16/273 DBR.No.Dir.BC.67/13.03.00/2015-16 December 17, 2015

receive any bids in either of these auctions, and accordingly, auction determined prices for this band is not available.

3.45 The Authority is also examining whether, in case the last auction-determined prices are to be used as a valuation approach and indexed for the time gap, the indexation should continue to be based on MCLR or whether an alternative metric such as the Wholesale Price Index (WPI), Cost Inflation Index[79](CII) or any other suitable indicator can be adopted for this purpose.

3.46 As discussed above, in the current scenario, auction prices for the spectrum bands under consideration are available from the latest 5G auctions held in 2022 and 2024. In this context, it is necessary to examine whether:

(i) The value of the respective spectrum band may be set equal to its past auction determined price, with or without adjustment for the time gap; or

(ii) The past auction determined prices may only be considered as one of the approaches for valuation, alongside other valuation methodologies.

3.47 In this regard, it is worth mentioning that the Authority at para 3.40 of its Recommendations on Auction of Spectrum in frequency bands identified for IMT/5G dated 11.04.2022, recommended that:

[79] The Cost Inflation Index table is a financial metric used in tax calculations, particularly for capital gains taxation. It is a numerical index that helps adjust the purchase price of an asset to reflect the effects of inflation over time.

Essentially, the CII allows taxpayers to adjust the purchase price of an asset by the inflation index factor when calculating capital gains. This adjustment is crucial because it accounts for the impact of inflation on the asset's value. By factoring in inflation, the indexed cost is a more accurate representation of the actual value of the asset at the time of its sale.

Indexed Cost = (Actual Cost of Asset) x [(CII of the Year of Sale) / (CII of the Year of Purchase)].

https://www.religareonline.com/knowledge-centre/income-tax/cost-inflation-index/

(I) For existing bands (including for the bands being put to auction for the first time in the forthcoming auction), a fresh spectrum valuation exercise be conducted once every three years; a suitable reference be made to the Authority by Government for this purpose.

(II) For auctions conducted in the interim period between periodic valuation exercises conducted once every three years,

(1) for LSAs where the spectrum put to auction in a previous auction is sold, the auction determined prices (duly indexed using applicable MCLR if more than one year has elapsed since the previous auction) should be used for arriving at the reserve prices for the next auction;

(2) for LSAs, where spectrum remains unsold in previous auctions, past recommended reserve price (without indexation) should be used.

3.48 As outlined in the preceding paragraph, the Authority vide its Recommendation dated 11.04.2022 recommended that spectrum valuation be conducted every three years, with auctions in the interim relying on auction-determined prices (ADP) from previous auctions, duly indexed where applicable. It is pertinent to note that more than three years have passed since the valuation exercise conducted in 2022. Hence the parameters influencing spectrum value need to be examined to assess whether any significant changes have occurred since the last valuation. Based on this analysis, it may then be examined whether the reserve price for a spectrum band in the current exercise be solely determined on the basis of its past auction-determined price or whether other valuation methodologies should also be considered.

3.49 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for Consultation:

Q25. Should the valuation of a given spectrum band, among 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz, and 26 GHz, be based exclusively on its respective auction-determined price from the 2022 and/or 2024 auctions, without applying any other valuation approach? In such a case, should the auction price be indexed using MCLR or any other basis (please specify) to account for the time gap? Please provide detailed justification.

Q26. If the answer to the above is in the negative, should the past auction-determined price of the respective spectrum band still be considered as one of the approaches or basis for valuation, along with other approaches? Please provide justification for your response. In such a case, should the auction price be indexed using MCLR or any other basis (please specify) to account for the time gap? Please provide detailed justification.

Q27. Should the spectrum valuation exercise be undertaken once every three years, as recommended by the Authority in its recommendations dated 11.04.2022? If not, what should be the revised periodicity for conducting the valuation exercise? Please justify your response along with detailed basis for conducting a fresh valuation exercise.

(ii) Application of Valuation Methodologies/ Models

3.50 The previous section, C(i) discussed various aspects related to use of past auction prices as an approach for valuation of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz bands**.** The present section deals with the application of Valuation methodologies/Models for valuation of existing spectrum bands.

3.51 For the purpose of spectrum valuation, it has been noted by the Authority that the economic valuation of spectrum depends on numerous variables. In functional form, valuation of spectrum is a function of available market information I; technological factors T; macro and micro economic variables E.[80]

$$V = f(I, T, E)$$

3.52 Based on the above functional relationship between the valuation of spectrum and the relevant variables, the Authority, in its various past recommendations, has adopted multiple valuation models and methodologies to estimate the value of spectrum. The Authority has consistently maintained the view that it is not feasible to deterministically identify any single valuation methodology/model as the 'correct' one. Each model possesses its own strengths and limitations.

3.53 While certain models are better suited to capture intrinsic technical characteristics, others are more firmly rooted in economic and market dynamics. No single model is capable of comprehensively encompassing all variables—technical, economic, sectoral, geographic, and regulatory—that influence spectrum valuation. Therefore, to arrive at a reasonable estimate of valuation, the Authority in various past valuation exercises has

[80] http://trai.gov.in/sites/default/files/2024-09/Recommendations%2009.09.2013.pdf

employed a range of models, each reflecting specific financial, technical, or market-related aspects.

3.54 These models are based on a range of financial, technical, and market-related parameters. In addition to variables such as revenue, subscriber base, past auction-determined prices, number of BTS deployed, Gross State Domestic Product (GSDP) per capita, capital expenditure, and costs, the models also incorporate a set of assumptions pertaining to the growth rates of different parameters and other structural assumptions specific to each model. Furthermore, certain models employ forecasting techniques and statistical analyses. These models make use of both historical and the most recent data available for various parameters. Based on rational assumptions and after examining the robustness and statistical significance of the results, these models are used to derive the valuation of spectrum.

3.55 The valuation models/methodologies employed by the Authority include the following:

(i) Multiple Regression Model,
(ii) Trend Line Approach,
(iii) Production Function Model,
(iv) Producer Surplus Model,
(v) Revenue Surplus Model, and
(vi) Economic Efficiency Model

3.56 It is pertinent to note that all the models listed above are not applicable to every frequency band considered for auction. Models such as the Multiple Regression Model and Trend Line Approach, which do not require spectrum band-specific data and rely instead on economic, demographic, or time-based factors, can be applied across multiple bands.

3.57 In contrast, Production Function Model, Producer Surplus Model, Economic Efficiency Model, and Revenue Surplus Model are suitable only for specific bands. This distinction arises primarily due to the availability of spectrum band wise segregated data. To apply a model across multiple bands, spectrum band-wise data such as total revenue, number of BTS deployed, subscriber base, and expenditure on radio equipment must be available. However, such disaggregated data is generally not reported. Typically, information on financial, technical, and other parameters is reported in an aggregated manner.

3.58 In such circumstances, the spectrum holdings of a service provider across various bands are converted into a representative band (generally 1800MHz in past valuation exercises) using an efficiency factor (which will be elaborated upon in subsequent sections). The model is then simulated for this representative band, and the valuation thus derived is subsequently used to estimate the valuation of other bands through back-calculation, applying the corresponding efficiency factor.

3.59 Furthermore, there are models that, though feasible for application across all spectrum bands, are not finally used for valuation if the results obtained are not statistically significant or lack robustness.

3.60 A brief description of each of the above-mentioned models, along with the spectrum bands for which they were used during the 2022 valuation exercise, is provided in the succeeding paragraphs.

1. <u>Multiple Regression Model</u>

(a) Using this approach, the prices realized through previous auctions i.e. the past ADP can be correlated with other relevant variables such as Gross State Domestic product (GSDP), population density,

wireless subscribers etc. that affect the demand for wireless services for estimating the values of spectrum in the LSAs where spectrum was auctioned

(b) A multiple regression equation may be expressed as below:

$Y = \beta0 + \beta1 * X1 + \beta2 * X2 + \ldots\ldots\ldots\ldots + \beta n * Xn + \varepsilon$

Where Y is the dependent variable. X1, X2, …, Xn are the explanatory variables. β0 is the intercept. β1, β2, ..., βn are the coefficients of explanatory variables.

ε is the error term.

(c) The regression analysis examines significance of the explanatory variables by analyzing certain statistical parameters of the model such as 'p-value' of the coefficients of the explanatory variables and 'Adjusted RSquared' of the model. The effect of an explanatory variable is also analyzed through the magnitude and sign of the beta (coefficient) estimates.

(d) In the model, the ADP of the past auctions has been taken as the dependent variable (Y).

(e) It has been regressed upon the following explanatory variables (X1, X2, X3) for each LSA:

LSA-wise number of mobile subscribers in an LSA (X1)

LSA-wise gross domestic product (GSDP) per capita (X2)

LSA-wise population density (X3)

(f) Auction determined price is regressed upon certain economic and market variables that may have a linkage with demand for spectrum and hence may have a bearing on the price of spectrum.

(g) In 2022 valuation exercise, this model was utilized for the valuation of the 800 MHz, 1800 MHz, and 2300 MHz bands, as it yielded statistically significant results for these bands only.

2. Trend-Line Approach

(a) The Trend-Line approach forecasts the expected auction-determined price (ADP) per MHz of spectrum based on historical price movements across past auctions. It applies a simple time-series regression where ADP is modeled as a linear function of time. By fitting a linear trend line through observed ADPs from 2010 to 2021, this approach estimates the intercept (a) and slope (b), which are then used to project future values. Th trend line used to estimate the coefficients may be expressed as ***ADP=a+b*T***, where T is the year of auction.

(b) To account for regional variation, LSAs are grouped into (Metro & Category-A), Category B, and Category C, and regressions are run separately for each group. Dummy variables are introduced to reflect differences in economic development across these categories.

(c) In 2022 valuation exercise, this model was utilized for the valuation of the 1800 MHz, and 2300 MHz bands, as it yielded statistically significant results only for these bands.

3. Production Function Model

(a) Valuation under this approach is equal to the savings generated in the form of reduced Capex and Opex on Base Stations (BTS) to existing TSP when additional spectrum is allotted

(b) The production function has been specified as a Cobb-Douglas functional form which is widely used to estimate the statistical relationship between inputs & output. The Cobb-Douglas functional form is represented by the following equation:

$$\mathbf{X = Ay^{\alpha} z^{\beta}}$$

(c) In the above equation, the dependent variable (X) is the total mobile traffic. The independent or explanatory variables are: i) allocated amount of spectrum (y) and ii) Number of BTSs deployed by a service provider (z). The parameters α and β reflect the percentage change in minutes of usage for a unit change in spectrum and BTS respectively.

(d) The above specification is based on the assumption that the two inputs i.e. quantum of spectrum holding and BTS can be substituted for each other over a given range of output, i.e. mobile traffic. An optimal mix of both will be used by telecom service providers to produce the required traffic and that optimal mix is determined by input prices.

(e) A higher charge for spectrum will induce telecom service providers to substitute the less expensive BTS for spectrum over the relevant range to get the same minutes of usage and vice versa.

(f) In 2022 valuation exercise, this model was used for valuation of 1800MHz band.

4. **Producer Surplus Model**

(a) The Producer Surplus Model values spectrum as the net savings a telecom service provider (TSP) achieves by acquiring additional spectrum, resulting in reduced capital and operating expenditures on the radio access network (RAN) over 20 years. Similar to production function, the model too works on the principle of substitutability between spectrum holdings and BTS.

(b) The model capitalizes on the inverse relationship between quantum of spectrum and expenditure on RAN required to serve a particular level of mobile traffic demand, particularly in capacity-constrained urban areas. This net saving—termed "producer surplus"—represents the maximum price a rational TSP would be willing to pay for the additional MHz.

(c) The model simulates two scenarios: one with the existing spectrum holding ('x' MHz) and another with additional spectrum of 'a' MHz ('x+a' MHz). It estimates network demand, base station requirements, and associated expenditures (CAPEX + OPEX + SUC) for both cases. By comparing the present value of total expenditures under both scenarios using realistic growth projections and financial parameters, the model quantifies the producer surplus per MHz. This value serves as the estimated spectrum valuation for an average TSP in each LSA.

(d) In 2022 valuation exercise, this model was used for valuation of 1800MHz band.

5. Revenue Surplus Model

(a) The Revenue Surplus Model is premised on the assumption that the net present value (NPV) of the projected revenue surplus over the next 20 years could potentially represent the maximum amount which a telecom service provider (TSP) would be willing to pay for additional spectrum in 1800 MHz band.

(b) NPV of Revenue surplus of wireless access service segment in an LSA for a period of 20 years =
NPV [(projected total revenue) minus (all operating expenditures) minus (all capital expenditures excluding spectrum related capital expenditures)] of all wireless access service providers in the LSA for a period of 20 years

(c) Valuation of 1 MHz of spectrum in an LSA for a period of 20 years =
NPV of Revenue Surplus of wireless access service segment in the LSA divided by total spectrum holding of all wireless access service providers in the LSA

(d) In 2022, valuation exercise, this model was used for valuation of 1800MHz band.

(e) In paragraphs 2.53–2.61 of Chapter II, the Authority is examining the validity period of spectrum, that is, whether it should be auctioned with the existing validity period of 20 years. In this regard, it is worth noting that the Authority, in its valuation models requiring growth projections, has relied on 20-year projections.

(f) In its Recommendation dated 11.04.2022, the Authority stated that the present valuation exercise has been conducted using 20-year projections wherever projections are applicable in some of its models, since these projections are based on the learning and experience gained by the Authority from previous modelling and valuation exercises.

6. Economic Efficiency Approach

(a) The spectrum in 900 MHz band is technically more efficient as compared to spectrum in 1800 MHz band in terms of propagation characteristics which results in reduced Capex and Opex requirements on radio networks in 900 MHz band. This savings in costs plus value of 1800 MHz band is the estimated value of 900 MHz band. The technical efficiency of the spectrum in 900 MHz band leads to economic efficiency in comparison to the spectrum in 1800 MHz band in the form of lesser expenditure on radio network

(b) The present method derives a relative valuation of the spectrum in 900 MHz band from the valuation of spectrum in 1800 MHz band by estimating the saving in the expenditure (CAPEX and OPEX) on radio network when the spectrum in the technically more efficient 900 MHz band is used in place of the spectrum in the technically less efficient 1800 MHz band.

(c) The additional cost per MHz to a telecom service provider (TSP) operating in the 1800 MHz band represents the saving to the TSP if it switches operations to the 900 MHz band. This saving may be viewed as the premium that a TSP would be willing to pay for

acquiring spectrum in 900 MHz band vis-a-vis the spectrum in 1800 MHz band.

(d) Other things being equal, the maximum price that a TSP may pay for 1 MHz of spectrum in 900 MHz band would be equal to the price of 1 MHz of spectrum in 1800 MHz band plus the expenditure (CAPEX and OPEX) on the radio network that the TSP saves by using the spectrum in 900 MHz band instead of the spectrum in 1800 MHz band.

(e) In 2022, valuation exercise, this model was used for valuation of 900MHz band.

3.61 Details of the spectrum bands for which the above models have been applied in various valuation exercises are provided in **Annexure 3.2**.

3.62 As discussed above, the valuation models employed by the Authority are based on a set of assumptions pertaining to growth rates of various parameters, structural considerations, forecasting techniques, and other related factors.

3.63 The Authority intends to examine whether there is a need to modify or revise the methodologies currently adopted in the spectrum valuation models. Such revision may involve consideration of additional factors, revision of the representative band (currently 1800 MHz), or inclusion of technology-specific parameters. For instance, in the 2022 valuation exercise, several parameters were specific to 4G; however, with the subsequent introduction of 5G, parameters relevant to 5G may also need to be considered. Based on examination, the Authority may also decide to discontinue an existing model or introduce a new model.

3.64 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for Consultation:

Q28. Should the valuation models as adopted by the Authority in its last recommendation, continue to be used as a basis for valuation of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands? Please provide a detailed justification.

Q29. Is there a need to introduce any changes to the valuation models or methodologies currently followed by the Authority for spectrum valuation exercises, including the discontinuation of any existing model or the introduction of a new model? If yes, please provide specific suggestions along with a detailed justification.

(iii) Technical/Spectral Efficiency Approach

3.65 The preceding Sections C(i) and C(ii) discussed various aspects related to the use of past auction prices and application of valuation methodologies/ models for valuation of spectrum in the existing bands. The present section focuses on the use of the Technical/Spectral Efficiency Approach for the valuation of spectrum in existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz bands.

3.66 One of the approaches for valuation of spectrum in existing bands could be based on comparative values that can be achieved by using relative spectral efficiency approach where characteristics like coverage of a

particular spectrum band can be compared with the same characteristics of another spectrum band and a spectral efficiency factor can be derived as a ratio.

3.67 The Authority, in its 2022 recommendation, utilised the spectral efficiency factor for the valuation of spectrum in various band viz. Sub-GHz bands, 2100MHz, 2300MHz, 2500MHz and mid-band.

3.68 The Authority in its Recommendations on Auction of Spectrum in frequency bands identified for IMT|5G dated 11.04.2022 utilized the Technical Note (2018) of M/s Nokia on "5G spectrum and Coverage Consideration Aspects" to compare the coverage characteristics of various spectrum bands and accordingly derive technical efficiency factor. Based on the cited technical note/report:

- The coverage of the 2300 MHz (and the 2500 MHz) spectrum bands in TDD, is around 50% of the 1800 MHz band FDD coverage. Therefore, a technical efficiency factor of 0.5 was adopted for the spectrum in the 2300 MHz (and the 2500 MHz) band with respect to the spectrum in the 1800 MHz band.

- Mid band (3300-3600 MHz) spectrum band TDD coverage is approximately 30% of the 1800 MHz FDD coverage. Accordingly, a technical efficiency factor of 0.3 was adopted for the spectrum in the mid-band with respect to the spectrum in the 1800 MHz band.

3.69 As can be seen from the above example, the use of the technical efficiency factor by the Authority was supported by technical literature and reports. However, at present, no publicly available data exists on the spectral efficiency factor of the mmWave (26 GHz) spectrum band. In particular, there is no information on how it compares with other spectrum bands

that may be considered for fresh valuation or that already have auction determined prices (ADPs) from recent 5G auctions. If such spectral efficiency factors were available, they could serve as a basis for valuing this band. Accordingly, in the 2022 valuation exercise the Authority considered the ratio of auction prices for 26 GHz and 3.3 GHz bands, across various countries wherein auctions for both these bands were concluded. Taking into account, the ratio of auction prices of 26 GHz and 3.3 GHz of various countries, the Authority arrived at an average ratio of international auction prices between these two bands. This average ratio of international auction prices was then applied to the calculated valuation of 3.3 GHz band to determine the valuation of 26 GHz band.

3.70 Although technical efficiency factors are available for Sub-GHz bands, 2100 MHz, 2300 MHz, 2500 MHz and mid-band spectrum and the same have been used in past valuation exercises for the respective bands, however if required these factors may be reviewed by the authority in the light of recent technological and other developments to evaluate the need for any revision.

3.71 In this background, the Authority seeks comments from stakeholders on the following set of question(s):

Issues for Consultation:

Q30. Should the auction determined price of other bands by using spectral efficiency factor serve as a basis of valuation for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz 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.

Q31. Apart from the approaches highlighted above which other valuation approaches should be adopted for the valuation of spectrum in existing bands? Please provide detailed information along with justifications.

D. Valuation of 6425- 6725 MHz & 7025-7125 MHz bands

3.72 The previous Section(C) discussed various aspects related to the valuation of spectrum in existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. The present section focuses on the aspects related to valuation of spectrum in 6425- 6725 MHz & 7025-7125 MHz bands, in case it is decided to put this band in the upcoming auction.

3.73 With regard to the 6425- 6725 MHz & 7025-7125 MHz bands, DoT vide its letter dated 15.05.2025, has stated the following:

"3. Further, it may be noted that out of the total 700 MHz spectrum in the 6 GHz frequency band (6425-7125 MHz), only 400 MHz spectrum in two fragmented chunks at 6425-6725 MHz (300 MHz) and 7025-7125 MHz (100 MHz) are immediately available for auction and the remaining 300 MHz in the frequency band 6725-7025 MHz will be available by December 2030.

3.1 Presently, the IMT ecosystem in the 6 GHz band is at a nascent stage and very few countries like China, South Korea, UAE, and Saudi Arabia, have assigned this band for IMT based services.

3.2 In view of the above, appropriate time for the auction of this band is required to be explored considering the less developed ecosystem and availability of only 400 MHz spectrum in a fragmented manner."

3.74 DoT vide the said letter has further requested TRAI "*to explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz & 7025-7125 MHz bands and accordingly, provide recommendations on timing of auction, applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands."*

3.75 The issues related to the timing of the auction, band plan, block size, and quantum of spectrum have been discussed in Chapter II. This section, deals with aspects pertaining to the valuation of the 6425–6725 MHz and 7025–7125 MHz bands. The methodology and considerations relevant to the valuation of these bands are discussed in detail in subsequent paragraphs.

3.76 As detailed in the preceding paragraphs, the Authority has, in the past, employed various methodologies for spectrum valuation and reserve price determination, including the Multiple Regression Model, Trend Line Analysis, Production Function Model, Producer Surplus Model, Revenue Surplus Model, and the Economic Efficiency Model. These models generally rely on comprehensive datasets comprising market and financial parameters such as past auction prices, revenue, spectrum holdings, BTS deployment, etc., relevant to the respective spectrum bands.

3.77 Considering the extensive data requirements for the application of these models, they are feasible only for valuing existing spectrum bands, i.e., those bands that have previously been put to auction and for which past auction prices and other relevant financial, technical, and market-related

information are available. In the case of the 6425–6725 MHz and 7025–7125 MHz bands, this would be the first instance of these bands being auctioned in India. Consequently, the aforementioned valuation approaches cannot be directly applied due to the unavailability of requisite market, financial, and technical data. Therefore, it may be necessary to explore alternative methodologies for valuation of these bands.

3.78 It is worth mentioning that in 2022 a similar situation existed while arriving at valuation and reserve price for mid-band (3.3 GHz) and mmWave band (26 GHz) and again in 2025 for the 37–37.5 GHz and 37.5–40 GHz band. Since at that time it marked the first instance of these bands being auctioned in India. Besides no market or financial data relevant to these bands was available. For valuation of these bands, the Authority used alternative approaches such as Technical/ Spectral efficiency approach for mid band and International Benchmarking for mmWave band.

3.79 In view of the above, some of the alternative valuation methodologies that may be considered for valuation of 6425–6725 MHz and 7025–7125 MHz bands include:

(i) Technical/Spectral Efficiency approach

(ii) International Benchmarking

(i) Technical/ Spectral Efficiency approach

3.80 One of the approaches for valuation of 6425–6725 MHz and 7025–7125 MHz bands could be based on comparative values that can be achieved by using relative spectral efficiency approach where characteristics like coverage of a particular spectrum band can be compared with the same characteristics of another spectrum band and a spectral efficiency factor

can be derived as a ratio. This approach has been explained in detail in para 3.65 to para 3.70 above.

3.81 As stated above, the use of technical efficiency factor by the Authority has been backed up by technical literature/report. However, at present, no publicly available data exists on the spectral efficiency factor of the 6425–6725 MHz and 7025–7125 MHz bands. In particular, there is no information on how it compares with other spectrum bands that may be considered for fresh valuation or that already have auction determined prices (ADPs) from recent 5G auctions. If such spectral efficiency factors were available, they could serve as a basis for valuing this band.

3.82 In this background, the Authority seeks comments from stakeholders on the following set of question(s):

Issue for Consultation:

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.

(ii) International Benchmarking

3.83 The previous Section D(i) discussed aspects related to technical/ spectral efficiency as an approach for valuation of spectrum in 6425- 6725 MHz & 7025-7125 MHz bands. The present section focuses on international

benchmarking as an approach for valuation of spectrum in 6425-6725 MHz & 7025-7125 MHz bands.

3.84 It may be mentioned that when using International Benchmarking, there are cross-country differences in GDP, population, subscriber base etc. This may need to be normalized for use in the context of valuation of spectrum for a particular country.

3.85 The Authority, in its Recommendations on the 'Auction of Spectrum in Frequency Bands Identified for IMT/5G' dated 11.04.2022, considered the ratio of auction prices for 26 GHz and 3.3 GHz bands, across various countries wherein auctions for both these bands were concluded. Taking into account the ratio of auction prices of 26 GHz and 3.3 GHz of various countries, the Authority arrived at an average ratio of international auction prices between these two bands. This average ratio of international auction prices was then applied to the calculated valuation of 3.3 GHz band (during IMT|5G valuation exercise of 2022) to determine the valuation of 26 GHz band.

3.86 Further, the Authority in its Recommendations on the "Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT" dated 04.02.2025 utilized the ratio of auction price of 37-40GHz and the 24 GHz band in the USA as one of the valuation approaches for valuing the 37-40GHz band in India. Since the ratio was between auction prices of the two bands in the same country, cross-country divergences did not arise, and thereby no normalization was done.

3.87 DoT, in its letter dated 15.05.2025, has stated that only a few countries such as China, South Korea, the UAE and Saudi Arabia have assigned the 6 GHz band for IMT based services. However, in all of these countries,

the band has not been assigned on an auction basis. Accordingly, there is no availability of auction determined prices for the 6 GHz band in these countries.

3.88 In this context, it is pertinent to note that Hong Kong is one of the countries that has auctioned spectrum in the 6 GHz (6.575 GHz to 7.025 GHz) bands for mobile services. Therefore, it is necessary to examine whether the ratio of the Auction-Determined Prices of 6 GHz band to those of mid-band or mmWave spectrum in Hongkong could serve as a relevant basis for valuing 6425- 6725 MHz & 7025-7125 MHz bands in India. Details regarding the international auction prices in Hong Kong can be seen in **Annexure 3.3**, titled "International Auction Determined prices".

3.89 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for Consultation:

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.

E. Valuation of the 600 MHz Band

3.90 The previous Section(D) discussed the various aspects related to the valuation of spectrum in 6425- 6725 MHz & 7025-7125 MHz bands. The present section focuses on the aspects related to valuation of spectrum in 600MHz band.

3.91 With regard to the 600 MHz band, DoT vide its letter dated 15.05.2025, has stated the following:

"2.6 In the auction held in 2024, 600 MHz (612-652/663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. In the ITU Radio Regulations also, this band has not been identified at the regional or global level for International Mobile

Telecommunication. It was also decided that fresh consultations with TRAI may be taken before putting up this band for auction.

2.6.1 In view of the above, there is a need to re-examine and seek fresh recommendations for the auction of spectrum in the 600 MHz band."

3.92 DoT vide the said letter has further requested TRAI to re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band.

3.93 The technical and other aspects/issues related to 600MHz band have been discussed in Chapter II. The current section, deals with aspects pertaining to the valuation of the 600 MHz band. The methodology and considerations relevant to the valuation of this band are discussed in detail in subsequent paragraphs.

3.94 For the purpose of valuation of the 600 MHz band, in the Recommendation dated 11.04.2022 it was noted that:

"Considering that the technical characteristics of the 600 MHz band are comparable to that of the 700 MHz band, and considering further that the ecosystem in the 600 MHz band is relatively less developed than that in the 700 MHz band[81], the Authority has decided to approach the valuation of the 600 MHz band by treating it as equal to the valuation of the 700 MHz band"

3.95 Accordingly, using technical efficiency approach, the valuation and consequently the reserve price of the 600 MHz band was set equal to the 700 MHz band. In the auction held in 2024, 600 MHz (612-652/663-703 MHz) band was not put to auction considering that this band was not sold

[81] GSA - Low Band Spectrum for LTE and 5G (May 2021)

in the Auction held during 2022, Accordingly, past auction prices for this band are not available from either the 2024 or the 2022 auctions. Furthermore, the financial, technical, and other data required to simulate various valuation models is not available for this band.

3.96 In view of the above, some of the alternative valuation methodologies that may be considered for valuation of 600 MHz band include:

(i) Technical/Spectral Efficiency approach

(ii) International Benchmarking

(i) Technical/ Spectral Efficiency approach

3.97 This approach is the same as that adopted by the Authority in 2022 for the valuation of the 600 MHz band. Under this approach, valuation of 600 MHz band can be calculated by using relative spectral efficiency approach where characteristics like coverage of a particular spectrum band can be compared with the same characteristics of another spectrum band and a spectral efficiency factor can be derived as a ratio.

3.98 Given the similarity in the technical characteristics of sub-1 GHz bands, the Authority, in its recommendation dated 11.04.2022, applied a technical efficiency factor of 1 for spectrum in one sub-1 GHz band with respect to another sub-1 GHz band.

3.99 This approach has been explained in detail in para 3.65 to para 3.70 above. As highlighted in the preceding paragraphs, in the recommendation dated 11.04.2022, the valuation of the 600 MHz band was set equal to that of the 700 MHz band using the technical efficiency approach. A similar approach may be adopted in the present valuation exercise as well, wherein the valuation of this band may be derived using relative technical or spectral efficiency factors from the freshly estimated

valuation (in case it is freshly valued) of other Sub-GHz bands such as 800MHz and 900MHz band.

3.100 Alternatively, the valuation of the 600 MHz band may also be derived from past auction-determined prices of other sub-1 GHz spectrum bands, such as 700 MHz, 800 MHz, and 900 MHz, using relative technical or spectral efficiency factors.

3.101 In this background, the Authority seeks comments from stakeholders on the following set of question(s):

Issue for Consultation:

Q36. Should the auction determined price of other bands by using spectral efficiency factor serve as a basis of valuation for 600 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.

(ii) International Benchmarking

3.102 The previous Section E(i) discussed aspects related to technical/spectral efficiency as an approach for valuation of spectrum in 600 MHz band. The present section focuses on international benchmarking as an approach for valuation of spectrum in 600 MHz band.

3.103 As already detailed in paragraphs 3.84 to 3.88 above, the International Benchmarking approach involves comparing auction determined prices of spectrum across countries. However, cross-country differences in parameters such as GDP, population, and subscriber base may need to

be normalized while applying this method for spectrum valuation in a specific country. In its Recommendations on the 'Auction of Spectrum in Frequency Bands Identified for IMT/5G' dated 11.04.2022, the Authority considered the ratio of auction prices for the 26 GHz and 3.3 GHz bands across countries where auctions for both bands had been conducted. An average international auction price ratio was derived and applied to the calculated valuation of the 3.3 GHz band (from the IMT/5G valuation exercise of 2022) to determine the valuation of the 26 GHz band. Further, in its Recommendations dated 04.02.2025 on the "Frequency Spectrum in 37–37.5 GHz, 37.5–40 GHz, and 42.5–43.5 GHz bands Identified for IMT," the Authority used the ratio of auction prices of the 37–40 GHz and 24 GHz bands in the USA as one of the valuation approaches. Since the comparison was made between two bands within the same country, normalization for cross-country variations was not required.

3.104 In this context, it is pertinent to note that the USA and Canada have conducted auctions for spectrum in the 600 MHz band. Therefore, it becomes necessary to examine whether the ratio of auction-determined prices of the 600 MHz band to those of other Sub-GHz bands or other relevant bands in these countries could serve as an appropriate basis for valuing the 600 MHz band in India. Details of international auction-determined prices in the USA and Canada are provided in Annexure 3.3, titled "International Auction-Determined Prices."

3.105 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for Consultation:

Q37. Should the auction determined price of other countries in 600 MHz band serve as a basis of valuation of 600 MHz

band 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.

Q38. 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 600MHz band vs other sub GHz spectrum bands 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.

Q39. Apart from the approaches highlighted above which other valuation approaches may be adopted for the valuation of 600 MHz band? Please provide detailed information.

F. Single vs. Multiple Approaches

3.106 The Authority, since September 2013, has taken a consistent view that instead of depending on the valuation arrived at using any single approach, it would be better to rely on several such approaches to arrive at a final reasonable valuation and then determine reserve price based on such valuation.

3.107 This approach is justified since the attempt is to arrive at the 'Expected Value' of the valuation of spectrum from the set of available valuations, and the simple mean serves this purpose as a measure of central location.

3.108 The Authority has been using various approaches to arrive at the valuation of different spectrum bands and to determine the reserve price of different spectrum bands for the auction of various bands of spectrum from time to time.

3.109 The Authority has been of the view that it is not possible to say deterministically that any one methodology/ approach is the right method for determining the value of spectrum in various bands. Each method/ approach/ model has certain strengths as well as limitations. Some models capture intrinsic technical features better, whereas others are based on economic and market realities. No particular model completely captures every variable related to technical, economic, sectoral, geographic and regulatory realms that influence the valuation of spectrum. Accordingly, it would be appropriate to rely on several such approaches to arrive at a final reasonable valuation rather than depending on the valuation arrived at using only one approach.

3.110 The Authority in its spectrum valuation exercises has used probabilistic average valuation (simple mean) of the valuations obtained through the different approaches attempted for valuation of a particular spectrum band.

3.111 In this background, the Authority seeks comments of stakeholders on the following set of questions:

Issues for consultation:

Q40. Should the value of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, 6425- 6725 MHz & 7025-7125 MHz and 600 MHz bands be determined using a single valuation approach? If yes, please indicate which single valuation approach or method should be adopted in each case and provide detailed justification

Q41. In case your response to the above question is negative, will it be appropriate to take the average valuation (simple mean) of the valuations obtained through the different approaches attempted for valuation of the above spectrum bands, or some other approach like taking weighted mean etc. should be followed? Please support your answer with detailed justification.

G. Reserve Price estimation

3.112 A reserve price is the starting point for an ascending price auction and bidding is the means to true price discovery. The reserve price also acts as one of the factors that influence demand for spectrum. It is important that the reserve price is set at a balanced level, neither too high nor too low. Such an approach is expected to encourage participation and promote competition in the auction process

3.113 A balanced reserve price satisfies the basic objectives of reserve price setting viz., ensuring realization of the underlying value of the asset being auctioned and ensuring competitive bidding. In order to ensure price

discovery, the reserve price should not be too close to the expected/predicted valuation of the object put up for auction.

3.114 For arriving at the reserve prices, the Authority in its recommendation dated 11.04.2022 had primarily set reserve price equal to 70% of the mean of value derived from all possible approaches. The Authority was of the view that reserve price set at the level of 70% of average valuation in view of the context of the forthcoming auction, will ensure healthy competition, leading to the discovery of the true market price.

3.115 While framing the said recommendation, the Authority also took into account following considerations:

- It referred to various economic and market-related studies which indicated that, in many instances, regulators adopt a practice of setting reserve prices at 70% to 80% of estimated spectrum value. Some of these were highlighted, as follows:
  - Brown and Morgan[82] found from results of field experiments of auctions of collectible coins that positive reserve prices set at the level of 70% of the purchase price of the coins lead to higher revenues and lower number of bidders relative to zero reserve prices
  - Malisuwan[83] et al noted that the ratio of reserve price to auction price "…possibly varies greatly across the historical database -from less than 0.1 to 1", and that in many cases, regulators determine

[82] Brown, Jennifer and John Morgan (2009), How much is a Dollar Worth? Tipping versus equilibrium co-existence on competing online auction sites, The Journal of Political Economy

[83] Malisuwan, Settapong, et al (2016), Mobile Spectrum Value and Reserve Price by using Benchmarking Approaches, International Journal of Scientific Engineering and Technology, 5:1 (pp. 81-4)

to multiply estimates of spectrum value by 70%-80% to derive the reserve prices

- The Authority also noted that Plum Consulting, as part of the ITU team advising the National Broadcasting and Telecommunications Commission (Thailand) ahead of the 2015 auctions in the 900 MHz and 1800 MHz bands, had recommended reserve prices at approximately 70% of the estimated value.[84]
- Furthermore, the Authority reviewed bidding activity in previous auctions, including the number of bidders, the quantum of spectrum put to and sold through auction, and comparisons between Auction Determined Prices and reserve prices.

3.116 On this basis, the Authority considered that a reserve price set at 70% of the average valuation of spectrum band would go a long way in helping to discover the market clearing price of the spectrum.

3.117 Also, the authority in its Recommendations on the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT dated 04.02.2025 recommended that the reserve price for 37–37.5 GHz and 37.5–40 GHz bands should be set at 70% of the average valuation arrived at.

3.118 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for consultation:

Q42. What ratio should be adopted between the reserve price for the auction and the valuation of the spectrum in 800

[84] Chan, Yi Shen and Sarongrat Wongsaroj (2016), Valuing Spectrum in Thailand: what can we learn?, Plum Insight, available at plumconsulting.co.uk.

MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, 6425- 6725 MHz & 7025-7125 MHz and 600 MHz bands and why? Please support your answer with detailed justification.

H. Payment Terms

3.119 For the auction of spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands, 6425- 6725 MHz & 7025-7125 MHz bands and 600 MHz bands payment terms and associated conditions need to be determined.

3.120 It is important to note that various aspects of the payment terms—such as the total number of instalments, the applicable interest rate for preserving the net present value (NPV), upfront payment, and related elements—are linked to the validity period. The issues pertaining to the validity period for assignment of spectrum through auction, have been discussed in detail in Chapter II. This section of this chapter addresses key aspects of the payment terms, including the upfront payment, moratorium period, total number of instalments for deferred payment recovery, and the interest rate applicable to safeguard the NPV of the bid amount.

3.121 In this context, a reference can be drawn from the payment terms prescribed under Notice Inviting Applications (NIA) for auction of spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz Bands dated 08.03.2024 for validity of 20 years:

(i) Successful Bidders shall make the payment (in Indian Rupees) in accordance with any of the following two options:

Option 1: Full or part upfront payment of the bid amount within 10 days of declaration of final price. Where part upfront payment has been made, which can be a multiple of complete years with a minimum of two years, the buyer shall have the option of availing moratorium for the corresponding number of years for which the upfront payment has been made and the balance amount shall be payable in equal annual instalments over the remaining period, payable in advance at the beginning of each year, after the period of moratorium if any, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.

Option 2: Payment of 20 equal annual instalments of the bid amount, duly protecting the NPV of the bid amount at the applicable rate of interest, in advance at the beginning of the year, the first instalment becoming payable within 10 days of declaration of final price. The balance 19 instalments shall become due and payable on the Effective Date anniversary of each following year.

(ii) Prepayment option: - Pre-payment of one or more instalments has been allowed on any date, provided that the NPV of the due amount is protected at the applicable interest rate.

(iii) Number of instalments: For the case of deferred payments, the balance amount is to be paid in equal annual instalments over the remaining period, payable in advance at the beginning of each year, after the period of moratorium if any, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.

(iv) The NPV of the bid amount was protected at applicable rate of interest. In this regard, the following questions arise for consultation: -

3.122 In this background, the Authority seeks comments from stakeholders on the following set of questions:

Issues for consultation:

Q43. What should the payment terms and associated conditions for the assignment of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands, 6425- 6725 MHz & 7025-7125 MHz bands and 600 MHz bands relating to:

(i) Upfront payment

(ii) Moratorium period

(iii) Total number of instalments to recover deferred payment

(iv) Applicable interest rate for protecting the NPV of bid amount

Please support your answer with detailed justification.

Q44. Any other suggestion relevant to the subject may be submitted with detailed justification.

3.123 The following chapter lists the issues for consultation.

CHAPTER IV: ISSUES FOR CONSULTATION

Stakeholders are requested to provide their input on the following questions with detailed justifications:

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.

Q2. Whether the entire available spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz band should be put to auction in the forthcoming auction?

(a) If yes, what measures should be taken to ensure effective competition in the forthcoming auction?

(b) If no, what quantum of spectrum in each of the frequency bands should be put to auction in the forthcoming auction?

Kindly provide a detailed response with justifications.

Q3. Whether the band plans, which have been adopted for the existing bands viz. the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in India, should be retained in the forthcoming auction? If no, kindly suggest new band plan(s) for the existing bands with detailed justifications.

Q4. Whether the spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be auctioned on Telecom Circle/ Metro Area basis with a validity period of 20 years in the forthcoming

auction? If no, what should be the area, and validity period of spectrum assignment in the existing bands? Please provide detailed response with justifications.

Q5. Whether the block size and minimum quantity for bidding in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be kept the same in the forthcoming auction as those in the spectrum auction of June 2024 as mentioned in Table No. 2.14 of this consultation paper? If not, what should be the band-wise block size and minimum bid quantity? Kindly provide a detailed response with justifications.

Q6. What should be the eligibility criteria and associated eligibility conditions for participation in the forthcoming auction for the existing bands viz. the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands? Kindly provide a detailed response with justifications.

Q7. Whether there is a need for modifying roll-out obligations for the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands, as stipulated in the Notice Inviting Application (NIA) for the spectrum auction held in June 2024 in order to improve mobile coverage in the country? If yes, what modifications should be made in the roll-out obligations for the existing bands? Kindly provide a detailed response with justifications.

Q8. Whether there is a need to review the spectrum caps for the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands for the

forthcoming auction? If yes, what should be the spectrum cap per service provider for different frequency bands? Kindly provide a detailed response with justifications.

Q9. Are there any other inputs/ issues related to the auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands for the forthcoming auction? Suggestions may be made with detailed justifications.

Q10. Whether the spectrum in the 600 MHz band should be put to auction in the forthcoming auction? If yes, whether the band plan n105 should be adopted for the 600 MHz band, or otherwise? Please provide a detailed response with justifications.

Q11. In case you are of the opinion that the 600 MHz band should not be put to auction in the forthcoming auction, what should be the timelines for auctioning of the 600 MHz band? Please provide a detailed response with justifications.

Q12. In case it is decided to auction the spectrum in the 600 MHz band in the forthcoming auction, -

(a) Should the entire available spectrum in the 600 MHz band be put for bidding in the forthcoming auction?

(b) Whether the eligibility criteria, associated eligibility conditions, block size, minimum bid quantity of spectrum, validity period for the assignment of spectrum, area of assignment on Telecom Circle/ Metro Area-basis, spectrum cap and roll out obligations for the spectrum in the 600 MHz

band in the forthcoming auction should be kept the same as those in the spectrum auction of 2022, or otherwise?

Please provide a detailed response with justifications.

Q13. Are there any other inputs/ issues related to the auction of spectrum in the 600 MHz band for the forthcoming auction? Suggestions may be made with detailed justifications.

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.

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.

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.

Q17. In case it is decided to put the spectrum in 6425-6725 MHz and 7025-7125 MHz ranges in the forthcoming auction, -

(a) Whether the 3GPP band plan n104 should be adopted for the upper 6 GHz band? If no, which band plan should be adopted for the upper 6 GHz band?

(b) What amount of spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should be put to auction?

(c) Whether the spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should be auctioned on Telecom Circle/ Metro service area basis with a validity period of 20 years? If no, what should be the area and validity period of spectrum assignment in the 6425-6725 MHz and 7025-7125 MHz ranges?

(d) What should be the block size, minimum bid quantity, and roll-out obligations for the spectrum in these ranges?

(e) What should be the eligibility criteria and associated eligibility conditions for bidding for the spectrum in these ranges?

Please provide a detailed response with justifications.

Q18. What provisions with respect to the spectrum cap per service provider in a licensed service area (LSA) should be made applicable for the spectrum in the upper 6 GHz band for IMT? Specifically, -

(a) Whether a combined spectrum cap for the 3300 MHz band and the upper 6 GHz band should be prescribed? If yes, what should be the spectrum cap per service provider?

(b) In case your response to (a) above is in the negative, what should be the spectrum cap per service provider for the spectrum in the upper 6 GHz band?

Please provide a detailed response with justifications.

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.

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.

Q21. Considering the need to assign a contiguous 24 MHz block in the 1427-1518 MHz range to the Government user,

(a) Which band plan and duplexing scheme should be adopted for IMT in the 1427-1518 MHz range?

(b) Which range of spectrum (a contiguous block of 24 MHz) should be assigned to the Government user?

Kindly provide a detailed response with justifications.

Q22. Are there any other inputs/ issues related to the spectrum in the 1427-1518 MHz range? Suggestions may be made with detailed justifications.

Q23. Whether there is a need to review the spectrum auction method and design followed in India? If yes, suggestions on spectrum auction method and design may be made with detailed justifications and international practice in this regard.

Q24. What additional economic, technical, or market-related factors should be taken into account while determining the valuation

and, subsequently, the reserve price of spectrum, in order to promote effective competition, ensure optimal spectrum utilization, and encourage wider participation in auctions?

Q25. Should the valuation of a given spectrum band, among 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz, and 26 GHz, be based exclusively on its respective auction-determined price from the 2022 and/or 2024 auctions, without applying any other valuation approach? In such a case, should the auction price be indexed using MCLR or any other basis (please specify) to account for the time gap? Please provide detailed justification.

Q26. If the answer to the above is in the negative, should the past auction-determined price of the respective spectrum band still be considered as one of the approaches or basis for valuation, along with other approaches? Please provide justification for your response. In such a case, should the auction price be indexed using MCLR or any other basis (please specify) to account for the time gap? Please provide detailed justification.

Q27. Should the spectrum valuation exercise be undertaken once every three years, as recommended by the Authority in its recommendations dated 11.04.2022? If not, what should be the revised periodicity for conducting the valuation exercise? Please justify your response along with detailed basis for conducting a fresh valuation exercise.

Q28. Should the valuation models as adopted by the Authority in its last recommendation, continue to be used as a basis for valuation of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100

MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands? Please provide a detailed justification.

Q29. Is there a need to introduce any changes to the valuation models or methodologies currently followed by the Authority for spectrum valuation exercises, including the discontinuation of any existing model or the introduction of a new model? If yes, please provide specific suggestions along with a detailed justification.

Q30. Should the auction determined price of other bands by using spectral efficiency factor serve as a basis of valuation for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz 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.

Q31. Apart from the approaches highlighted above which other valuation approaches should be adopted for the valuation of spectrum in existing bands? Please provide detailed information along with justifications.

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.

Q36. Should the auction determined price of other bands by using spectral efficiency factor serve as a basis of valuation for 600 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.

Q37. Should the auction determined price of other countries in 600 MHz band serve as a basis of valuation of 600 MHz band 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.

Q38. 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 600MHz band vs other sub GHz spectrum bands 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.

Q39. Apart from the approaches highlighted above which other valuation approaches may be adopted for the valuation of 600 MHz band? Please provide detailed information.

Q40. Should the value of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, 6425- 6725 MHz & 7025-7125 MHz and 600 MHz bands be determined using a single valuation approach? If yes, please indicate which single valuation approach or method should be adopted in each case and provide detailed justification

Q41. In case your response to the above question is negative, will it be appropriate to take the average valuation (simple mean) of the valuations obtained through the different approaches attempted for valuation of the above spectrum bands, or some other approach like taking weighted mean etc. should be

followed? Please support your answer with detailed justification.

Q42. What ratio should be adopted between the reserve price for the auction and the valuation of the spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, 6425- 6725 MHz & 7025-7125 MHz and 600 MHz bands and why? Please support your answer with detailed justification.

Q43. What should the payment terms and associated conditions for the assignment of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands, 6425- 6725 MHz & 7025-7125 MHz bands and 600 MHz bands relating to:

(i) Upfront payment

(ii) Moratorium period

(iii) Total number of instalments to recover deferred payment

(iv) Applicable interest rate for protecting the NPV of bid amount

Please support your answer with detailed justification.

Q44. Any other suggestion relevant to the subject may be submitted with detailed justification.

ANNEXURES

Annexure 1.1: DoT's letter No. L-14006/01/2025-IMT dated 15.05.2025

Government of India
Ministry of Communications
Department of Telecommunications
Wireless Planning & Coordination (WPC) Wing

6th floor, Sanchar Bhawan,
20, Ashoka Road, New Delhi – 110001.

No.: L-14006/01/2025-IMT Date: 15.05.2025

To,

The Secretary
Telecom Regulatory Authority of India
Tower-F,World Trade Centre,
Nauroji Nagar, New Delhi -110029

भारतीय दूरसंचार विनियामक प्राधिकरण
टॉवर-एफ, एनबीसीसी वर्ल्ड ट्रेड सेंटर, नौरोजी नगर, नई दिल्ली-29
पंजीकरण सं. 969
20 MAY 2025
ई आफिस सं.

Subject: Seeking TRAI recommendations for the auction of RF spectrum in the frequency bands identified for International Mobile Telecommunications (IMT)

Sir,

In response to DoT's reference dated 02-08-2023 on auction of RF spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz and 37 – 37.5 GHz, 37.5 – 40 GHz and 42.5 –43.5 GHz bands, TRAI had provided its recommendations on 01-09-2023. Based on the TRAI recommendations dated 01-09-2023, the Government conducted auction of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands during June, 2024.

1.1 During this auction, a total of 10522.35 MHz spectrum in different band-LSA combinations worth Rs. 96238.45 crores (at Reserve Price) were made available for bidding. A total quantum of 141.40 MHz of spectrum worth Rs. 11340.79 crores were sold during this auction. Moreover, no bids were received in the 800 MHz, 2300 MHz, 3300 MHz and 26 MHz bands.

1.2 Further, as per the earlier TRAI recommendation, a comprehensive report analysing the outcomes of the above auction was also communicated to TRAI on 08-01-2025. Copy of the same is attached as **Annexure – I.**

2. The following developments took place after the last reference to TRAI, for the auctions held during June, 2024:

Administratively assigned spectrum released by TSPs:

2.1 M/s BSNL was assigned 02 MHz of paired spectrum in the 1800 MHz band in Kerala, Tamil Nadu and Odisha LSAs on 16-11-2023 and its right to use expired on 30-06-2024. Hence, this spectrum is now available for bidding in the next auction.

2.1.1 Also some of the Telecom Service Providers (TSPs) whose service licenses will be expiring during the year 2026-2027 are holding administratively assigned spectrum. Such spectrum will be available for bidding post expiry of these service licenses. The LSA-wise details of all such spectrum are attached as **Annexure – II.**

Spectrum reserved for M/s BSNL:

2.2. As per the approval of the Union Cabinet, the Department has reserved some spectrum to BSNL in some LSAs in various frequency bands. Details of such spectrum reserved for BSNL is attached as **Annexure – III.**

Spectrum available due to Re-farming/vacation:

2.3 Based on the proposal of DoT on the re-farming/vacation of spectrum, the Union Cabinet has taken the following decisions:

2.3.1 A total of **687 MHz** of spectrum is to be re-farmed for IMT based services as tabulated below:

Sl No.	Frequency band (MHz)	Quantum of spectrum for re-farming (MHz)	Timeline/Status for vacation of spectrum by existing users for IMT based services
1.	6725-7025#	300	31-12-2030
2.	6425-6725#	300	Immediately
3.	2500-2690*	20	Implemented
4.	1427-1518	67	31-12-2026
	TOTAL	**687**	

*#Protection with geographical separation will be provided to the feeder link and space operation of the existing/future satellite operations of Department of Space, at certain locations. The details of such locations as shared by the Department of Space is enclosed as **Annexure – IV**.*

** The 20 MHz of spectrum in the 2500 – 2690 MHz band has been re-farmed and allocated for IMT based services.*

2.3.2 Additionally, it was also decided that the frequency band from 27.5-28.5 GHz shall be used for satellite-based services in place of IMT/5G.

Indian Railways request for additional spectrum.

2.4 5 MHz of paired spectrum is presently assigned to Indian Railways (IR) for their safety and security networks. Besides this, IR has sought additional 5 MHz of paired spectrum in the 700 MHz band for national roll out of their indigenously developed Automatic Train Protection system. In this regard, TRAI had provided its recommendations on 20-12-2024, which is presently under examination in the DoT.

Auction of spectrum in 37- 40 GHz band:

2.5 Based on the DoT reference, TRAI gave its recommendations on 04-02-2025 for the auction of RF spectrum in the 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands, which is under consideration in the Department.

Auction of spectrum in 600 MHz band:

2.6 In the auction held in 2024, 600 MHz (612-652/663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. In the ITU Radio Regulations also, this

band has not been identified at the regional or global level for International Mobile Telecommunication. It was also decided that fresh consultations with TRAI may be taken before putting up this band for auction.

2.6.1 In view of the above, there is a need to re-examine and seek fresh recommendations for the auction of spectrum in the 600 MHz band.

3. Further, it may be noted that out of the total 700 MHz spectrum in the 6 GHz frequency band (6425-7125 MHz), only 400 MHz spectrum in two fragmented chunks at 6425-6725 MHz (300 MHz) and 7025-7125 MHz (100 MHz) are immediately available for auction and the remaining 300 MHz in the frequency band 6725-7025 MHz will be available by December 2030.

3.1 Presently, the IMT ecosystem in the 6 GHz band is at a nascent stage and very few countries like China, South Korea, UAE, and Saudi Arabia, have assigned this band for IMT based services.

3.2 In view of the above, appropriate time for the auction of this band is required to be explored considering the less developed ecosystem and availability of only 400 MHz spectrum in a fragmented manner.

4. The Department of Economic Affairs, while approving the auction results for the Auction 2024 has observed the following, among others:

"Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply."

5. Considering the above-mentioned facts, the LSA-wise quantum of the spectrum available with the Government in the existing and new IMT bands, excluding the spectrum reserved for BSNL and spectrum released due to expiry of the service licenses during 2026-2027 are attached as **Annexure-V.** The details of the spectrum released due to expiry of the service licenses during 2026-2027 are attached as **Annexure-II.**

5.1 Any other spectrum, which might be available due to any re-farming etc. in these bands before the start of the auction, will also be made part of the auction process.

6. Further, as part of the reforms in the telecom sector, the Government has decided to hold spectrum auctions in the last quarter of every financial year.

7. In view of the above, under the terms of clause 11 (1)(a) of TRAI Act, 1997, as amended by TRAI Amendment Act 2000, TRAI is requested to:

(a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.

(b) explore the possibilities of auction and timing of auction for the newly identified 6425-6725 MHz & 7025-7125 MHz bands. Accordingly, provide recommendations on timing of auction, applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in these bands.

(c) re-examine and provide fresh recommendations for the auction of spectrum in the 600 MHz band.

(d) provide any other recommendations deemed fit for the purpose of spectrum auction in these frequency bands, including the regulatory/ technical requirements as enunciated in the relevant provisions of the latest NFAP/Radio Regulations of the ITU.

7.1 Further, while providing its recommendations, TRAI may also take into account the observations of Department of Economic Affairs as mentioned in para 4 above.

This issues with the approval of the competent authority.

(M Revathi)
Joint Wireless Adviser

Enclosures:

i) **Annexure - I:** A comprehensive report analysing the outcomes of the auction held during June 2024

ii) **Annexure - II:** LSA-wise quantum of the administratively assigned spectrum released due to expiry of service licenses during the year 2026-2027.

iii) **Annexure - III:** Details of the spectrum reserved for BSNL in various bands.

iv) **Annexure - IV:** Details of locations where protection is required for the Department of Space in the 6475-7025 MHz band.

v) **Annexure - V:** LSA-wise quantum of spectrum available with the Government in the various frequency bands excluding the spectrum reserved for BSNL and spectrum released due to expiry of service licenses in 2026-2027.

Annexure - I

Department of Telecommunications

Report on Spectrum Auction Results – 2023-24

20th December, 2024

Sanchar Bhawan
Ashoka Road
New Delhi - 110001

Contents

1. Introduction

1.1 The Department of Telecommunications (DoT), through its letter dated 2nd August 2023, requested the Telecom Regulatory Authority of India (TRAI) to provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz bands for IMT.

1.2 Consequently, TRAI gave its recommendations vide its letter no. C-15/2/(2)/2023-NSL-II dated 01.09.2023. TRAI stated that

"*TRAI reiterates its recommendation at para 6.42(II) of the Recommendations on 'Auction of Spectrum in frequency bands identified for IMT/5G' dated 11.04.2022 on the reserve price. All available spectrum in the existing bands viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz in the referred LSAs may be put to auction with the same band plan, block size and associated conditions.*

The Government may put to auction the spectrum in the existing bands viz. 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz without waiting for the Authority's recommendations for the new bands viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz."

1.3 Considering the equipment ecosystem in the 600 MHz band, it was decided to seek fresh recommendations from TRAI for this band. Accordingly, after the approval of the Union Cabinet, DoT issued Notice Inviting Application (NIA) for auction of Spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500MHz, 3300 MHz and 26 GHz bands on 08.03.2024.

1.4 The auction of the spectrum started on 25.06.2024 and ended on 26.06.2024 i.e., after seven rounds of bidding over two days. A total of three bidders participated and won the spectrum in the auction viz. M/s Bharti Airtel Limited (M/s BAL), M/s Vodafone Idea Limited (M/s VIL) and M/s Reliance Jio Infocomm Limited (M/s RJIL).

2. Recommendation of TRAI on "Auction of Spectrum in frequency bands identified for IMT/5G"

2.1 In one of its recommendations i.e., #6.41 (Para 3.38) given by Telecom Regulatory Authority of India (TRAI) dated 11.04.2022 on "Auction of Spectrum in frequency bands identified for IMT/5G", it was stated that:

"The Authority recommends that DoT shall prepare a comprehensive report analysing critically the outcomes of each forthcoming auction to be shared with the Authority within 90 days of conclusion of the auction."

2.2 Since the auction of spectrum concluded on 26.06.2024, as per TRAI recommendation stated above, DoT has prepared this comprehensive report after analyzing the results of spectrum auction 2023-24.

3. Snapshot of Spectrum Auction 2023-24

3.1 The data pertaining to auction results of spectrum auction 2023-24 is available at **Annexures** attached to this document. Three bidders viz. M/s Bharti Airtel Ltd (BAL), M/s Vodafone Idea Limited (M/s VIL) and M/s Reliance Jio Infocomm Ltd (RJIL) had participated in the auction. All the three bidders were categorized as existing licensee. The bidders had bid for a total bid amount of Rs. 11,340.7940 Cr which comprises the bids of each bidder as Rs. 6,856.7660 Cr by M/s BAL, Rs. 3,510.40 Cr by M/s VIL and Rs. 973.6280 Cr by M/s RJIL.

3.2 The Band-wise quantum of spectrum sold and auction proceeds for Spectrum Auction 2023-24 is as follows:

Table 1: Band-wise quantum of spectrum sold and auction proceeds

Band	Quantum Put to Auction (in MHz)	Value at Reserve Price (in Cr.)	Quantum sold (in MHz)	Auction Proceeds (in Cr.)
800 MHz	118.75	21,341.25	0	0
900 MHz	117.20	15,619.60	60.8	7,066.60
1800 MHz	221.40	21,752.40	50.6	3,579.19
2100 MHz	125.00	11,810.00	20	545.00
2300 MHz	60.00	4,430.00	0	0
2500 MHz	70.00	2,300.00	10	150.00
3300 MHz	1110.00	16,251.20	0	0
26 GHz	8700.00	2,734.00	0	0
Total	**10522.35**	**96238.45**	**141.40**	**11340.79**

3.3 The Bidder-wise details of quantum of spectrum acquired in the auction is as follows:

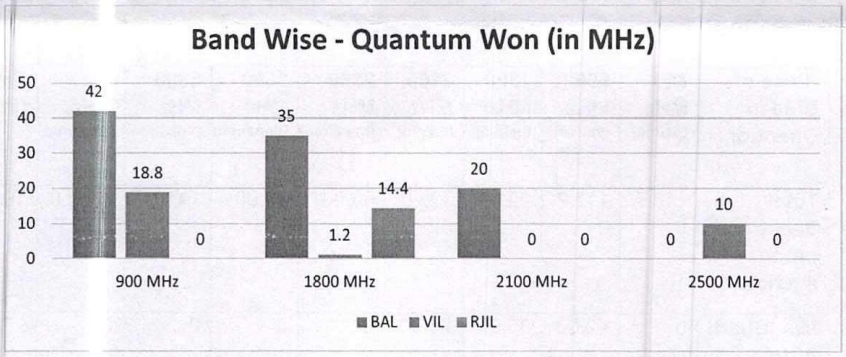
Table 2: Bidder-wise details of quantum of spectrum acquired in the auction

	Band								
Name of Bidder/ Operator	**800 MHz** (paired)	**900 MHz** (paired)	**1800 MHz** (paired)	**2100 MHz** (paired)	**2300 MHz** (unpaired)	**2500 MHz** (unpaired)	**3300 MHz** (unpaired)	**26 GHz** (unpaired)	**Total (in MHz)**
Total Spectrum put to auction	118.75	117.20	221.40	125.00	60.00	70.00	1110.00	8700.00	10522.35
M/s Bharti Airtel Limited	0	42.00	35.00	20.00	0	0	0	0	97.00
M/s Vodafone Idea Limited	0	18.80	1.20	0	0	10.00	0	0	30.00

M/s Reliance Jio Infocomm Limited	0	0	14.40	0	0	0	0	0	14.40
Total Spectrum bid for	0	60.80	50.60	20.00	0	10.00	0	0	141.40
% Spectrum bid for	0.00	51.88	22.85	16.00	0.00	14.29	0.00	0.00	1.34

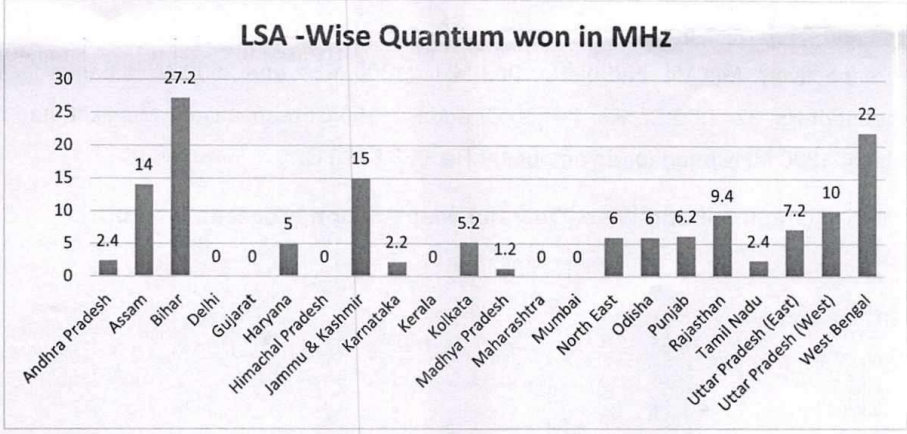
3.3.1 The below graph shows the band-wise quantum won (in MHz) by each of the three operators viz. M/s BAL, M/s VIL and M/s RJIL.

Graph 1: Band wise Quantum won by all TSPs (in MHz)



3.3.2 The below graph shows the LSA-wise quantum won (in MHz) by all the three operators viz. M/s BAL, M/s VIL and M/s RJIL cumulatively.

Graph 2: LSA wise Quantum won by all TSPs (in MHz) cumulatively



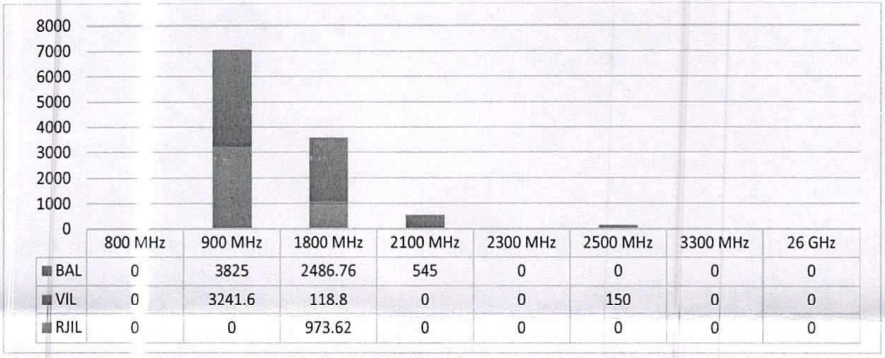
3.4 The Bidder-wise details of amount payable for the quantum of spectrum acquired in the auction is as follows:

Table 3: Bidder-wise details of amount payable for the quantum of spectrum acquired in the auction

	Band				
Name of Bidder/ Operator	**900 MHz (in Rs. Cr)**	**1800 MHz (in Rs. Cr)**	**2100 MHz (in Rs. Cr)**	**2500 MHz (in Rs. Cr)**	**Total (in Rs. Cr)**
M/s Bharti Airtel Limited	3825	2486.7660	545.0000	0	6856.7660
M/s Vodafone Idea Limited	3241.60	118.8000	0	150.00	3510.40
M/s Reliance Jio Infocomm Limited	0	973.6280	0	0	973.6280
Total (in Rs. Cr)	7066.6000	3579.1940	545.0000	150.0000	11340.7940

3.4.1 The Auction proceeds of 2023-24 are split into band-wise and operator-wise in the graph shown below. In this, it can be seen that M/s BAL had bid for 900 MHz, 1800 MHz and 2100 MHz bands for an amount of Rs.3825 Cr, Rs. 2486.7660 Cr and Rs.545 Cr respectively. M/s VIL had bid for 900 MHz, 1800 MHz and 2500 MHz bands for an amount of Rs. 3241.60 Cr, Rs. 118.80 Cr and Rs. 150 Cr respectively. M/s RJIL had bid only for 1800 MHz band for an amount of Rs. 973.6280 Cr.

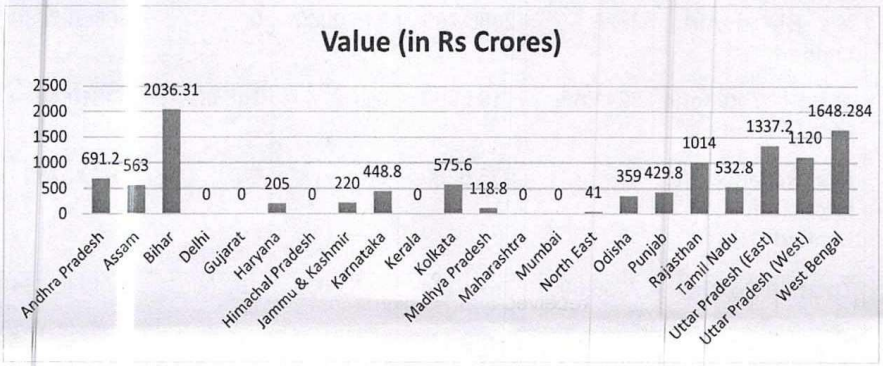
Graph 3: Band-Wise -Operator wise Auction proceeds (in Rs.Cr)



	800 MHz	900 MHz	1800 MHz	2100 MHz	2300 MHz	2500 MHz	3300 MHz	26 GHz
BAL	0	3825	2486.76	545	0	0	0	0
VIL	0	3241.6	118.8	0	0	150	0	0
RJIL	0	0	973.62	0	0	0	0	0

3.4.2 The below graph shows the LSA-wise auction proceeds (in Rs Crs) by all the three operators viz. M/s BAL, M/s VIL and M/s RJIL cumulatively.

Graph 4: LSA-Wise Auction proceeds (in Rs. crores) by all the TSPs cumulatively



3.5 A summary of the band wise auction result details are as follows:

S.No.	Band	Remarks
1.	800 MHz	1. Total LSA : 19 2. Total Quantum put to auction : 118.75 3. Total Value at RP : 21,341.25 Cr 4. Total Quantum won : 0 5. Total Value of Realization : 0 Cr 6. Total value of Quantum Won at RP : 0 Cr 7. Total LSA where bid received : 0 8. No bid received in : 19 9. No of LSA where bid received for full quantity : 0 10. Total No. of LSA where bid received at price higher that RP : 0
2.	900 MHz	1. Total LSA : 22 2. Total Quantum put to auction : 117.20 3. Total Value at RP : 15619.60 Cr 4. Total Quantum won : 60.80 5. Total Value of Realization : 7066.60 Cr 6. Total value of Quantum Won at RP : 7066.60 Cr 7. Total LSA where bid received : 14 8. No bid received in : 8 9. No of LSA where bid received for full quantity : 4 10. Total No. of LSA where bid received at price higher that RP : 0
3.	1800 MHz	1. Total LSA : 22 2. Total Quantum put to auction : 221.40 3. Total Value at RP : 21,752.40 Cr 4. Total Quantum won : 50.60 5. Total Value of Realization : 3579.1940 Cr 6. Total value of Quantum Won at RP : 1944.80 Cr 7. Total LSA where bid received : 10 8. No bid received in : 12 9. No of LSA where bid received for full quantity : 4 10. Total No. of LSA where bid received at price higher that RP : 2

4.	2100 MHz	1. Total LSA	:	15
		2. Total Quantum put to auction	:	125.00
		3. Total Value at RP	:	11810.00 Cr
		4. Total Quantum won	:	20.00
		5. Total Value of Realization	:	545.00 Cr
		6. Total value of Quantum Won at RP	:	545.00 Cr
		7. Total LSA where bid received	:	4
		8. No bid received in	:	11
		9. No of LSA where bid received for full quantity	:	3
		10. Total No. of LSA where bid received at price higher that RP	:	0
5.	2300 MHz	1. Total LSA	:	6
		2. Total Quantum put to auction	:	60.00
		3. Total Value at RP	:	4430.00 Cr
		4. Total Quantum won	:	0.00
		5. Total Value of Realization	:	0 Cr
		6. Total value of Quantum Won at RP	:	0 Cr
		7. Total LSA where bid received	:	0
		8. No bid received in	:	6
		9. No of LSA where bid received for full quantity	:	0
		10. Total No. of LSA where bid received at price higher that RP	:	0
6.	2500 MHz	1. Total LSA	:	5
		2. Total Quantum put to auction	:	70.00
		3. Total Value at RP	:	2300.00 Cr
		4. Total Quantum won	:	10.00
		5. Total Value of Realization	:	150.00 Cr
		6. Total value of Quantum Won at RP	:	150.00 Cr
		7. Total LSA where bid received	:	1
		8. No bid received in	:	4
		9. No of LSA where bid received for full quantity	:	1
		10. Total No. of LSA where bid received at price higher that RP	:	0

7.	3300 MHz	1. Total LSA	:	22
		2. Total Quantum put to auction	:	1110.00
		3. Total Value at RP	:	16251.20 Cr
		4. Total Quantum won	:	0.00
		5. Total Value of Realization	:	0 Cr
		6. Total value of Quantum Won at RP	:	0 Cr
		7. Total LSA where bid received	:	0
		8. No bid received in	:	22
		9. No of LSA where bid received for full quantity	:	0
		10. Total No. of LSA where bid received at price higher that RP	:	0
8.	26 GHz	1. Total LSA	:	21
		2. Total Quantum put to auction	:	8700.00
		3. Total Value at RP	:	2734.00 Cr
		4. Total Quantum won	:	0.00
		5. Total Value of Realization	:	0 Cr
		6. Total value of Quantum Won at RP	:	0 Cr
		7. Total LSA where bid received	:	0
		8. No bid received in	:	21
		9. No of LSA where bid received for full quantity	:	0
		10. Total No. of LSA where bid received at price higher that RP	:	0

3.6 The bidders participated in 29 LSA-Band combinations and various details regarding the combinations are as follows:

S. No	Band	LSA	Quantum Put to Auction (in MHz)	Quantum Sold (in MHz)	If Total Spectrum put to Auction was sold	If Spectrum is sold above Reserve Price
1	900	Andhra Pradesh	4.4	2.4	-	-
2		Assam	6.8	5	-	-
3		Bihar	11.8	7	-	-
4		Jammu & Kashmir	13.4	10	-	-

5		Karnataka	4.6	2.2	-	-
6		Kolkata	2.8	0.2	-	-
7		North East	4.4	1	-	-
8		Odisha	8.4	5	-	-
9		Punjab	1.2	1.2	Yes	-
10		Rajasthan	4.4	4.4	Yes	-
11		Tamilnadu	8.4	2.4	-	-
12		Uttar Pradesh (East)	6.2	6.2	Yes	-
13		Uttar Pradesh (West)	11.8	5	-	-
14		West Bengal	8.8	8.8	Yes	-
15	1800	Assam	8.6	4	-	-
16		Bihar	10.2	10.2	Yes	Yes
17		Haryana	28.4	5	-	-
18		Kolkata	18.6	5	-	-
19		Madhya Pradesh	1.2	1.2	Yes	-
20		Odisha	8.8	1	-	-
21		Punjab	9.8	5	-	-
22		Rajasthan	7	5	-	-
23		Uttar Pradesh (East)	1	1	Yes	-
24		West Bengal	13.2	13.2	Yes	Yes
25	2100	Assam	5	5	Yes	-
26		Jammu & Kashmir	5	5	Yes	-
27		North East	5	5	Yes	-
28		Uttar Pradesh (West)	10	5	-	-
29	2500	Bihar	10	10	Yes	-
Total			**239.2**	**141.4**		

4. Observations on Spectrum Auction Results 2023-24

4.1 The 9th Spectrum Auction held in June 2024, was primarily conducted to maintain continuity of services by giving opportunity to TSPs to replenish the spectrum which was expiring in 2024 and to incrementally augment the existing mobile services. Government

of India had put 10,522.35 MHz spectrum to auction, of which 141.40 MHz (1.34% of the total) has been sold with bid amounting to Rs. 11,340.7940 Cr.

4.2 Auction 2023-24 saw bidding only in 900MHz, 1800 MHz, 2100 MHz and 2500 MHz bands and there was no bidding in 700MHz, 2300 MHz, 3300 MHz and 26 GHz bands.

4.3 Further, it may be noted that out of 132 LSA Band Combinations which was put to auction, bidding was seen only in 29 LSA Band Combinations. It is seen that Spectrum was sold at a price higher than reserve price in only two LSA Band combination (1800 MHz band in Bihar and West Bengal).

4.4 LSA Wise spectrum won by the three bidders in each of the bands are as below:

Quantum of Spectrum won by TSP (in MHz) in Spectrum Auction 2023-24							
Band	**900**		**1800**			**2100**	**2500**
LSA	**BAL**	**VIL**	**BAL**	**VIL**	**RJIL**	**BAL**	**VIL**
Andhra Pradesh		2.4					
Assam	5		4			5	
Bihar	7		5.2		5		10
Delhi							
Gujarat							
Haryana			5				
Himachal Pradesh							
Jammu & Kashmir	10					5	
Karnataka		2.2					
Kerala							
Kolkata		0.2	5				
Madhya Pradesh				1.2			
Maharashtra							
Mumbai							
North East	1					5	
Odisha	5		1				
Punjab		1.2	5				
Rajasthan	4	0.4	5				
Tamil Nadu		2.4					
Uttar Pradesh (East)	5	1.2	1				
Uttar Pradesh (West)		5.0				5	

West Bengal	5	3.8	3.8		9.4		
Total	**42**	**18.8**	**35**	**1.2**	**14.4**	**20**	**10**
Band Wise Total	**60.8**		**50.6**			**20**	**10**
Grand Total	**141.4**						

4.5 Demand Note to successful bidders were issued on 16.07.2024. Summary of demand note issued to bidders is as follows:

Name of the Operator	**Total Winning Amount Payable (in Rs.)**	**Minimum upfront Payment (in Rs.) (Option 1- minimum 2 years)**	**Annual instalment (in Rs.) (Option 2 - 20 equal instalments)**
M/s Bharti Airtel Ltd. (BAL)	68,56,76,60,000	6,85,67,66,000	6,74,17,66,660
M/s Vodafone Idea Ltd. (VIL)	35,10,40,00,000	3,51,04,00,000	3,45,15,24,769
M/s Reliance Jio Infocomm Ltd. (RJIL)	9,73,62,80,000	97,36,28,000	95,72,98,643
Total	**1,13,40,79,40,000**		

4.6 A total of 1,003.23 Crores are received as initial payments from the TSPs in FY 2024-25. The payments received from the various TSPs are as under:

Name of the Operator	**Upfront Amount (part of bid amount) (Option1) Amount Received (INR)**	**First Annual Instalment (Option 2 -20 equal Instalment Amount) Amount Received (INR)**	**Date of payment**
M/s Bharti Airtel Ltd. (BAL)		*589,33,91,660	25.07.2024
M/s Vodafone Idea Ltd. (VIL)		*316,53,18,467	26.07.2024

M/s Reliance Jio Infocomm. Ltd. (RJIL)	97,36,28,000		26.07.2024
Total	**97,36,28,000**	**905,87,10,127**	
Grand Total	**1003,23,38,127**		

* M/s BAL and M/s VIL have opted for Option 2 and have adjusted amount of Rs. 84,83,75,000/- and Rs. 28,62,06,302/- (one-time adjustment) respectively from their 1st instalment amount against the payment made for provisional assignment.

REFERENCES

The following Reports are taken into consideration from the website of DoT i.e., https://dot.gov.in/spectrum :

1. Notice Inviting Applications of Spectrum Auction 2023-24
2. Provisional Result and Frequency Assignment-Spectrum Auction 2023-24 https://dot.gov.in/sites/default/files/Auction_2024_Provisional_FAR.pdf

Annexure-II

Details of the administratively assigned spectrum released due to expiry of licenses during the year 2026-2027

Frequency Band	LSA	TSP/Licensee	Quantum of Spectrum held (in MHz)	Date of Expiry of Service License
1800 MHz	Andhra Pradesh	Aircel	4.40	04-12-2026
	Assam	Vodafone Idea (Erstwhile Vodafone)	4.40	04-12-2026
	Bihar	Vodafone Idea (Erstwhile Vodafone)	4.40	04-12-2026
		Vodafone Idea(Erstwhile Idea)	4.40	05-12-2026
	Delhi	Aircel	4.40	04-12-2026
		Reserved for Aircel*	1.80	04-12-2026
	Himachal Pradesh	Vodafone Idea (Erstwhile Vodafone)	4.40	04-12-2026
	Jammu & Kashmir	Vodafone Idea(Erstwhile Vodafone)	4.40	04-12-2026
	Karnataka	Aircel	4.40	04-12-2026
	Kerala	Aircel	4.40	13-12-2026
	Kolkata	Reserved for Aircel*	1.80	13-12-2026
		Aircel	4.40	13-12-2026
	Madhya Pradesh	Vodafone Idea(Erstwhile Vodafone)	4.40	19-03-2027
	Mumbai	Vodafone Idea Erstwhile Idea)	4.40	04-12-2026
		Aircel	4.40	05-12-2026
		Reserved for Aircel*	1.80	05-12-2026
	North East	Vodafone Idea(Erstwhile Vodafone)	4.40	04-12-2026
	Odisha	Vodafone Idea(Erstwhile Vodafone)	4.40	04-12-2026
	Punjab	Aircel	4.40	13-12-2026
	Rajasthan	Reserved for Aircel*	1.80	04-12-2026
		Aircel	4.40	04-12-2026
	Uttar Pradesh (East)	Reserved for Aircel*	1.80	13-12-2026
		Aircel	4.40	13-12-2026

* 1.8 MHz of paired spectrum was kept reserved for Aircel/Dishnet in the 1800 MHz band in view of the court cases 5783/2014 and 5961/2014 pending in Hon'ble Supreme Court. This reserved spectrum will be put to auction on the expiry of the service license as done during the Auction 2024 in other LSAs

Annexure - III

Details of RF Spectrum reserved for BSNL/MTNL		
Band (A)	**LSA (B)**	**Quantum of Spectrum (MHz) (C)**
900 MHz	Delhi	6.4
	Mumbai	6.4
3300 MHz	Andhra Pradesh	70
	Bihar	70
	Delhi	70
	Gujarat	70
	Himachal Pradesh	70
	Jammu & Kashmir	70
	Kolkata	70
	Madhya Pradesh	70
	Maharashtra	70
	Mumbai	70
	North East	70
	Odisha	70
	Punjab	70
	Rajasthan	70
	Uttar Pradesh (East)	70
	Uttar Pradesh (West)	70
	West Bengal	70
26 GHz	Andhra Pradesh	800
	Assam	800
	Bihar	800
	Delhi	800
	Gujarat	800
	Haryana	800
	Himachal Pradesh	800
	Jammu & Kashmir	800
	Karnataka	800
	Kerala	650
	Kolkata	800
	Madhya Pradesh	800
	Maharashtra	800
	Mumbai	800
	North East	800
	Odisha	800
	Punjab	800
	Rajasthan	800
	Tamilnadu	800
	Uttar Pradesh (East)	800
	Uttar Pradesh (West)	800
	West Bengal	800

Annexure - IV

भारत सरकार
अन्तरिक्ष विभाग
उपग्रह संचार कार्यक्रम कार्यालय
अन्तरिक्ष भवन, न्यू बी. ई.एल.रोड,
बेंगलूर – 560 231, भारत
दूरभाष : +91-80 -2341 5301
फैक्स : +91-80 -2341 2141

सत्यमेव जयते

Government of India
Department of Space
SATELLITE COMMUNICATION
PROGRAMME OFFICE
Antariksh Bhavan, New BEL Road,
Bangalore - 560 231, India
Telphone : +91-80-2341 5301
Fax : +91-80-2341 2141

DIRECTOR

SATCOM PO/F.DOT/ 2025 March 04, 2025

Sub: Details of the geographical separation and location of earth stations for the co-existence between IMT and space-based service-Reg.

Ref: (i) WPC letter No.L-14040/03/2025-IMT dated 17/02/2025.
(ii) ISRO letter No. SATCOM PO/F.DOT/2024 dated 01/11/2024

With reference to the communication from WPC vide Ref-(i), the following are the details of the services operating in 6425-7025 MHz which co-exist with the IMT. The Analysis was shared vide Ref-(ii).

Services	Frequency Band (MHz)	No. of Earth station	Locations
TT&C	6425-6435 (10 MHz) 7010-7025 (15 MHz)	3	1. Hassan 2. Bhopal 3. Shillong
MSS Feeder Link*	6450-6485 (35 MHz)	20	At the user premises of 1. Fisheries, 2. Railways & 3. Defense and 4. ISRO centers (SAC-Ahmedabad, DES-Delhi, MCF- Hassan & Bhopal)
Antarctica Uplink	6600-6640 (40 MHz)	2	1. Hyderabad 2. Goa
GAGAN (AAI)	6664-6725 (61 MHz)	3	1. Bengaluru 2. Delhi 3. Mumbai
NavIC CDMA	6700-6725 (25 MHz)	6	1. Hassan 2. Bhopal 3. Shillong 4. Jodhpur 5. Port Blair 6.Trivandrum

* Location Information available with user agency

2. Studies done by ISRO indicates that the noise floor degradation of satellite payloads in 6425 - 7025MHz band is expected to be within 4.3 dB (worst case scenario) due to IMT deployments. Hence the Satellite Earth Station EIRP has to be increased to compensate the degradation of satellite receive system G/T accordingly.

3. The required EIRP density of Hub/Feeder/TTC Earth stations for all services are provided below:

Services	Uplink max. EIRP density
Tele-command	86 dBW / 500 kHz
MSS Feeder Link	85 dBW / 3 MHz
Antarctica link	90 dBW / 36 MHz
GAGAN	85 dBW / 18 MHz
NavIC CDMA	84 dBW / 2 MHz

4. The Satellite Earth Stations used for the above mentioned applications have the uplink in the frequency band 6425-7025MHz. These services will be operational on 24/7 basis for existing/ future satellites. Considering the transmission from these stations, the IMT stations are likely to be impacted with the in-band interference.

5. Therefore, based on the Satellite Earth Station Uplink EIRP density provided in above table, IMT/terrestrial service providers may compute their keep-out zone of the base station taking into account the actual deployment scenario and technical characteristics of IMT BS & UE. While computing the keep-out zone, I/N criteria of -6 dB is recommended to be used.

6. WPC is requested to share the analysis of IMT/terrestrial service providers with DOS for further discussions. Any inputs or support for this will be extended from our side.

(H. Rayappa)
Director, SATCOM-PO

To:
Smt. M Revathi
Joint Wireless Advisor, WPC/DOT
Sanchar Bhavan, 20, Ashoka Road,
New Delhi-110 001

Copy:
Wireless Advisor, WPC/DOT

Copy also to:
Chairman, ISRO/ Secretary, DOS

Annexure-V (page 1/2)

LSA-wise quantum of spectrum available with the Government in various frequency bands excluding the spectrum reserved for BSNL and spectrum released due to expiry of the service licenses in 2026/2027.

Sl. No.	Service area	600 MHz band (paired)	700 MHz band (paired)	800 MHz band (paired)	900 MHz band (paired)	1800 MHz band (paired)	2100 MHz band (paired)	2300 MHz band (unpaired)	2500 MHz band (unpaired)	3300 MHz band (unpaired)	6 GHz band (unpaired)	26 GHz band (unpaired)
		663-703/ 612-652 MHz	703-748/ 758-803 MHz	824-844/ 869-889 MHz	890-915/ 935-960 MHz	1710-1785/ 1805-1870 MHz	1919-1979/ 2109-2169 MHz	2300-2400 MHz	2535-2555 and 2615-2655 MHz	3300-3670 MHz	6425-6725& 7025-7125 MHz	24250 – 27500 MHz
1	Andhra Pradesh	40.00	0	10.00	2.00	9.00	15.00	10.00	20.00	50.00	400.00	400.00
2	Assam	40.00	0	0.00	1.80	4.60	0.00	0.00	20.00	100.00	400.00	650.00
3	Bihar	40.00	0	10.00	4.80	0.00	0.00	0.00	20.00	50.00	400.00	650.00
4	Delhi	40.00	0	6.25	0.80	11.00	10.00	10.00	20.00	50.00	400.00	450.00
5	Gujarat	40.00	0	3.75	1.60	4.00	5.00	0.00	20.00	50.00	400.00	100.00
6	Haryana	40.00	0	3.75	4.60	23.40	0.00	0.00	20.00	50.00	400.00	250.00
7	Himachal Pradesh	40.00	0	7.50	3.40	13.20	15.00	0.00	30.00	70.00	400.00	650.00
8	Jammu & Kashmir	40.00	0	2.50	3.40	6.00	0.00	0.00	30.00	70.00	400.00	650.00
9	Karnataka	40.00	0	6.25	2.40	4.80	5.00	10.00	40.00	20.00	400.00	400.00
10	Kerala	40.00	0	6.25	1.40	25.40	0.00	0.00	20.00	20.00	400.00	0.00
11	Kolkata	40.00	0	5.00	2.60	13.60	10.00	10.00	20.00	50.00	400.00	450.00
12	Madhya Pradesh	40.00	0	5.00	4.40	0.00	10.00	0.00	20.00	20.00	400.00	250.00
13	Maharashtra	40.00	0	5.00	2.80	2.40	5.00	0.00	20.00	50.00	400.00	250.00

14	Mumbai	40.00	0	5.00	0.80	18.40	10.00	10.00	20.00	50.00	400.00	350.00
15	North East	40.00	0	0.00	3.40	2.20	0.00	0.00	20.00	70.00	400.00	650.00
16	Odisha	40.00	0	8.75	3.40	7.80	10.00	0.00	20.00	100.00	400.00	650.00
17	Punjab	40.00	0	7.50	0.00	4.80	5.00	0.00	20.00	50.00	400.00	350.00
18	Rajasthan	40.00	0	5.00	0.00	2.00	0.00	0.00	20.00	20.00	400.00	300.00
19	Tamil Nadu	40.00	0	6.25	6.00	3.40	0.00	10.00	40.00	50.00	400.00	300.00
20	Uttar Pradesh (East)	40.00	0	10.00	0.00	0.00	0.00	0.00	20.00	50.00	400.00	400.00
21	Uttar Pradesh (West)	40.00	0	0.00	6.80	14.80	5.00	0.00	20.00	20.00	400.00	300.00
22	West Bengal	40.00	0	5.00	0.00	0.00	0.00	0.00	20.00	50.00	400.00	250.00
Total		**880.00**	**0**	**118.75**	**56.40**	**170.80**	**105.00**	**60.00**	**500.00**	**1110.00**	**8800.00**	**8700.00**

Annexure - 1.2: DoT Response letter dated 14.08.2025

(Without Annexure-I and Annexure-VII)

Government of India
Ministry of Communications
Department of Telecommunications
Wireless Planning & Coordination (WPC) Wing

6th floor, Sanchar Bhawan,
20, Ashoka Road, New Delhi – 110001

No.: L-14006/01/2025-IMT **Date:** 14.08.2025

To,

The Secretary
Telecom Regulatory Authority of India
Tower-F, World Trade Centre,
Nauroji Nagar, New Delhi -110029

Subject: Clarifications/Information to TRAI on DoT Reference Regarding Auction of RF Spectrum in IMT-Identified Frequency Bands

Reference: TRAI letter No. C-15/2/(1)/2025-NSL-II dated 19-06-2025

Sir,

The undersigned is directed to refer TRAI letter cited above, wherein TRAI has sought some clarifications/information on the DoT reference related to auction of RF spectrum in the frequency bands identified for IMT.

2. In this regard, para wise reply for on the clarifications/ information sought is as under:

2.1 Details of spectrum assigned to TSPs/other users/vacant, vacant spectrum in each frequency band proposed to be auctioned, the TSP-wise allocation of spectrum in each band, quantum of spectrum being shared among TSPs and details of any ongoing spectrum sharing and trading proposals under examination.

DoT response: The information requested by TRAI is enclosed at **Annexure-I** to **Annexure-V** respectively.

2.2 Clarification on inclusion of 02 MHz of paired spectrum in the 1800 MHz band assigned to BSNL in Kerala, Tamil Nadu and Odisha LSAs for which the right to use spectrum was expired on 30.06.2024 in the last auction held in June 2024.

DoT response: The spectrum was put to auction in the last spectrum auction held in June 2024.

2.3 Clarification on putting spectrum which will be released due to expiry of service license during the year 2026-2027 in the forthcoming auction.

DoT response: Details of availability of spectrum due to expiry of service licenses during the year 2026-2027 has already been provided. TRAI is requested to provide

its recommendations after considering the availability of such spectrum also. However, these spectrum blocks, if sold in the auction, will be assigned only after expiry of such service licenses.

2.4 Information on the outcome of the analysis and keep-out distance determined by DoT for IMT/terrestrial services as recommended by DoS for the frequency bands 6425-6725 MHz and 6725-7025 MHz.

DoT response: In the 6 GHz band, satellite-based services (uplink) are co-existing with IMT-based services. The determination of keep-out distances for satellite uplink stations shall be worked out by the TSPs in coordination with the DoS, based on the technical specifications of the base transceiver stations (BTS). At present, the technical details of IMT base stations operating in the 6 GHz band are not available. Once any technical analysis is carried out by the TSPs and DoS, the outcome will be duly communicated to TRAI.

2.5 Clarification on assignment of spectrum to any other users apart from the Department of Space in the 6425-6725 MHz range along with the protection requirements for such systems.

DoT response: No protection is required for terrestrial users currently operating in this band. The incumbent users in this band will be relocated to another frequency band in due course of time.

2.6 Information on not seeking recommendations for the auction of the spectrum in the frequency band 1427-1518 MHz from TRAI through the Reference

DoT response: Out of the total 91 MHz spectrum in the 1427-1518 MHz band, 67 MHz has been identified for IMT, while 24 MHz is reserved for assignment to a government user. This band will be refarmed for IMT-based services only after 2026 and band plan is also not finalised, therefore, it is not included in the upcoming auction. Hence, TRAI is requested to recommend a possible band plan for the 67 MHz spectrum between 1427-1518 MHz considering the need to assign a contiguous 24 MHz block to the Government user.

2.7 Relevant information/reports/documents related to the device ecosystem in the 6 GHz band for IMT based services may be shared.

DoT response: GSMA's report published in February 2025 on "Spectrum Policy Trends 2025" (Reference: GSMA-Spectrum-Policy-Trends-2025-1.pdf[1]) mentioned that:

[1] https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/GSMA-Spectrum-Policy-Trends-2025-1.pdf

'Hong Kong, concluded the world's first IMT auction of the upper 6 GHz band, and the UAE is assigning the full upper 6 GHz to its operators. Meanwhile, Sri Lanka, Indonesia, Thailand, Bangladesh and Cambodia have added it to their spectrum roadmaps and India is also progressing the use of 6 GHz for mobile'.

China has also allocated this band for IMT service (Reference: China allocates 6 GHz spectrum band for 5G, 6G services[2]). Further, USA, Canada, South Korea and Saudi Arabia etc. implemented this band for Wi-Fi application (Reference: Spectrum Needs of Wi-Fi 7[3]). Extract of these references are attached at **Annexure-VI**.

2.8 Information on the Department of Economic Affairs, observation on "Examine the demand & supply dynamics and explore possibility of enhancing competition and mitigating over-supply."

DoT response: The Office Memorandum dated 15.07.2024 from Department of Economic Affairs is enclosed at **Annexure-VII** and TRAI may keep this in mind while finalising its recommendations.

This issues with the approval of the competent authority.

Enclosures: As Above.

(M. Revathi)
Joint Wireless Adviser

[2] https://www.rcrwireless.com/20230629/featured/china-allocates-6-ghz-spectrum-band-for-5g-6g-services

[3] https://www.intel.com/content/dam/www/central-libraries/us/en/documents/spectrum-needs-wi-fi-7-whitepaper.pdf

Table-2.1: Details of vacant frequencies in 600 MHz band Annexure-II

LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)
All LSAs	663	703	612	652	40.0

Table-2.2: Details of vacant frequencies in 700 MHz band Annexure-II

LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)
NIL					

Table-2.3: Details of vacant frequencies in 800 MHz band Annexure-II

Sl. No.	LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	834.00	844.00	879.00	889.00	10.00
2	Bihar	834.00	844.00	879.00	889.00	10.00
3	Delhi	835.25	841.50	880.25	886.50	6.25
4	Gujarat	837.75	841.50	882.75	886.50	3.75
5	Haryana	840.25	844.00	885.25	889.00	3.75
6	Himachal Pradesh	836.50	844.00	881.50	889.00	7.50
7	Jammu & Kashmir	841.00	843.50	886.00	888.50	2.50
8	Karnataka	835.25	841.50	880.25	886.50	6.25
9	Kerala	835.25	841.50	880.25	886.50	6.25
10	Kolkata	836.50	841.50	881.50	886.50	5.00
11	Madhya Pradesh	839.00	844.00	884.00	889.00	5.00
12	Maharashtra	839.00	844.00	884.00	889.00	5.00
13	Mumbai	839.00	844.00	884.00	889.00	5.00
14	Odisha	835.25	844.00	880.25	889.00	8.75
15	Punjab	836.50	844.00	881.50	889.00	7.50
16	Rajasthan	839.00	844.00	884.00	889.00	5.00
17	Tamilnadu	825.25	831.50	870.25	876.50	6.25
18	Uttar Pradesh (East)	834.00	844.00	879.00	889.00	10.00
19	West Bengal	836.50	841.50	881.50	886.50	5.00

Table-2.4: Details of vacant frequencies in 900 MHz band Annexure-II

Sl. No.	LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	890.1	892.1	935.1	937.1	2.0
2	Assam	890.1	891.9	935.1	936.9	1.8
3	Bihar	890.1	894.9	935.1	939.9	4.8
4	Delhi	912.5	913.3	957.5	958.3	0.8
5	Gujarat	905.3	906.9	950.3	951.9	1.6
6	Haryana	902.3	906.9	947.3	951.9	4.6
7	Himachal Pradesh	905.1	908.5	950.1	953.5	3.4
8	Jammu & Kashmir	890.1	893.5	935.1	938.5	3.4
9	Karnataka	890.1	892.5	935.1	937.5	2.4
10	Kerala	907.1	908.5	952.1	953.5	1.4
11	Kolkata	890.1	892.7	935.1	937.7	2.6
12	Madhya Pradesh	902.5	906.9	947.5	951.9	4.4
13	Maharashtra	904.1	906.9	949.1	951.9	2.8
14	Mumbai	906.1	906.9	951.1	951.9	0.8
15	North East	890.1	893.5	935.1	938.5	3.4
16	Odisha	890.1	893.5	935.1	938.5	3.4
17	Tamilnadu	890.1	896.1	935.1	941.1	6.0
18	Uttar Pradesh (West)	890.1	891.3	935.1	936.3	1.2
19	Uttar Pradesh (West)	901.3	906.9	946.3	951.9	5.6

Table-2.5: Details of vacant frequencies in 1800 MHz band Annexure-II

Sl. No.	LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)	Remarks
1	Andhra Pradesh	1751.5	1754.7	1846.5	1849.7	3.20	
2	Andhra Pradesh	1759.1	1764.9	1854.1	1859.9	5.80	
3	Assam	1760.3	1764.9	1855.3	1859.9	4.60	
4	Delhi	1737.7	1740.1	1832.7	1835.1	2.40	
5	Delhi	1741.7	1745.1	1836.7	1840.1	3.40	
6	Delhi	1747.9	1753.1	1842.9	1848.1	5.20	
7	Gujarat	1760.9	1764.9	1855.9	1859.9	4.00	
8	Haryana	1751.5	1764.9	1846.5	1859.9	13.40	
9	Haryana	1764.9	1774.9	1859.9	1869.9	10.00	Entire LSA except Sirsa and Fatehbad
10	Himachal Pradesh	1751.7	1764.9	1846.7	1859.9	13.20	
11	Jammu & Kashmir	1757.1	1757.3	1852.1	1852.3	0.20	
12	Jammu & Kashmir	1759.1	1764.9	1854.1	1859.9	5.80	
13	Karnataka	1755.7	1756.9	1850.7	1851.9	1.20	
14	Karnataka	1761.3	1764.9	1856.3	1859.9	3.60	
15	Kerala	1750.1	1750.5	1845.1	1845.5	0.40	
16	Kerala	1754.9	1779.9	1849.9	1874.9	25.00	
17	Kolkata	1755.1	1768.7	1850.1	1863.7	13.60	
18	Maharashtra	1762.5	1764.9	1857.5	1859.9	2.40	
19	Mumbai	1745.9	1746.3	1840.9	1841.3	0.40	
20	Mumbai	1750.7	1758.7	1845.7	1853.7	8.00	
21	Mumbai	1764.9	1774.9	1859.9	1869.9	10.00	
22	North East	1760.9	1761.1	1855.9	1856.1	0.20	
23	North East	1762.9	1764.9	1857.9	1859.9	2.00	
24	Odisha	1772.1	1779.9	1867.1	1874.9	7.80	
25	Punjab	1755.7	1760.5	1850.7	1855.5	4.80	
26	Rajasthan	1756.7	1758.7	1851.7	1853.7	2.00	
27	Tamilnadu	1761.5	1764.9	1856.5	1859.9	3.40	
28	Uttar Pradesh (West)	1750.1	1764.9	1845.1	1859.9	14.80	

Table-2.6: Details of vacant frequencies in 2100 MHz band Annexure-II

Sl. No.	LSA	Uplink From	Uplink To	Downlink From	Downlink To	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	1944	1959	2134	2149	15.0
2	Delhi	1939	1944	2129	2134	5.0
3	Delhi	1969	1974	2159	2164	5.0
4	Gujarat	1939	1944	2129	2134	5.0
5	Himachal Pradesh	1939	1949	2129	2139	10.0
6	Himachal Pradesh	1964	1969	2154	2159	5.0
7	Karnataka	1974	1979	2164	2169	5.0
8	Kolkata	1939	1949	2129	2139	10.0
9	Madhya Pradesh	1944	1949	2134	2139	5.0
10	Madhya Pradesh	1974	1979	2164	2169	5.0
11	Maharashtra	1974	1979	2164	2169	5.0
12	Mumbai	1949	1959	2139	2149	10.0
13	Odisha	1944	1954	2134	2144	10.0
14	Punjab	1959	1964	2149	2154	5.0
15	Uttar Pradesh (West)	1974	1979	2164	2169	5.0

Table-2.7: Details of vacant frequencies in 2300 MHz band Annexure-II

Sl. No.	LSA	Start Frequency	End Frequency	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	2370	2380	10.0
2	Delhi	2370	2380	10.0
3	Karnataka	2370	2380	10.0
4	Kolkata	2370	2380	10.0
5	Mumbai	2370	2380	10.0
6	Tamilnadu	2370	2380	10.0

Table-2.8: Details of vacant frequencies in 2500 MHz band Annexure-II

Sl. No.	LSA	Start Frequency	End Frequency	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	2635	2655	20.0
2	Assam	2635	2655	20.0
3	Bihar	2635	2655	20.0
4	Delhi	2635	2655	20.0
5	Gujarat	2545	2555	10.0
6	Gujarat	2645	2655	10.0
7	Haryana	2635	2655	20.0
8	Himachal Pradesh	2625	2655	30.0
9	Jammu & Kashmir	2625	2655	30.0
10	Karnataka	2615	2625	40.0
11	Kerala	2635	2655	20.0
12	Kolkata	2635	2655	20.0
13	Madhya Pradesh	2635	2655	20.0
14	Maharashtra	2545	2555	10.0
15	Maharashtra	2645	2655	10.0
16	Mumbai	2635	2655	20.0
17	North East	2635	2655	20.0
18	Odisha	2635	2655	20.0
19	Punjab	2635	2655	20.0
20	Rajasthan	2635	2655	20.0
21	Tamilnadu	2615	2655	40.0
22	Uttar Pradesh (East)	2635	2655	20.0
23	Uttar Pradesh (West)	2635	2655	20.0
24	West Bengal	2635	2655	20.0

Table-2.9: Details of vacant frequencies in 3300 MHz band Annexure-II

Sl. No.	LSA	Start Frequency	End Frequency	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	3300	3350	50.0
2	Assam	3300	3400	100.0
3	Bihar	3300	3350	50.0
4	Delhi	3300	3350	50.0
5	Gujarat	3300	3350	50.0
6	Haryana	3300	3350	50.0
7	Himachal Pradesh	3300	3370	70.0
8	Jammu & Kashmir	3300	3370	70.0
9	Karnataka	3300	3320	20.0
10	Kerala	3300	3320	20.0
11	Kolkata	3300	3350	50.0
12	Madhya Pradesh	3300	3320	20.0
13	Maharashtra	3300	3350	50.0
14	Mumbai	3300	3350	50.0
15	North East	3300	3370	70.0
16	Odisha	3300	3400	100.0
17	Punjab	3300	3350	50.0
18	Rajasthan	3300	3320	20.0
19	Tamilnadu	3300	3350	50.0
20	Uttar Pradesh (East)	3300	3350	50.0
21	Uttar Pradesh (West)	3300	3320	20.0
22	West Bengal	3300	3350	50.0

Table-2.10: Details of vacant frequencies in 6 GHz band Annexure-II

LSA	Start Frequency	End Frequency	Quantum of Spectrum held (in MHz)
All LSAs	6425	6725	300
All LSAs	7025	7125	100

Table-2.11: Details of vacant frequencies in 26 GHz band Annexure-II

Sl. No.	LSA	Start Frequency	End Frequency	Quantum of Spectrum held (in MHz)
1	Andhra Pradesh	25050	25450.0	400.0
2	Assam	25050	25700.0	650.0
3	Bihar	25050	25700.0	650.0
4	Delhi	25050	25500.0	450.0
5	Gujarat	25050	25150.0	100.0
6	Haryana	25050	25300.0	250.0
7	Himachal Pradesh	25050	25700.0	650.0
8	Jammu & Kashmir	25050	25700.0	650.0
9	Karnataka	25050	25450.0	400.0
10	Kolkata	25050	25500.0	450.0
11	Madhya Pradesh	25050	25300.0	250.0
12	Maharashtra	25050	25300.0	250.0
13	Mumbai	25050	25400.0	350.0
14	North East	25050	25700.0	650.0
15	Odisha	25050	25700.0	650.0
16	Punjab	25050	25400.0	350.0
17	Rajasthan	25050	25350.0	300.0
18	Tamilnadu	25050	25350.0	300.0
19	Uttar Pradesh (East)	25050	25450.0	400.0
20	Uttar Pradesh (West)	25050	25350.0	300.0
21	West Bengal	25050	25300.0	250.0

Table-3.1: TSP-wise quantum of spectrum (in MHz) assigned

Band- 600 MHz		
Ser No.	LSA	Name of TSP
NIL		

Table-3.2: TSP-wise quantum of spectrum (in MHz) assigned

Band- 700 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh		10		10	
2	Assam		10		10	
3	Bihar		10		10	
4	Delhi		10		10	
5	Gujarat		10		10	
6	Haryana		10		10	
7	Himachal Pradesh		10		10	
8	Jammu & Kashmir		10		10	
9	Karnataka		10		10	
10	Kerala		10		10	
11	Kolkata		10		10	
12	Madhya Pradesh		10		10	
13	Maharashtra		10		10	
14	Mumbai		10		10	
15	North East		10		10	
16	Odisha		10		10	
17	Punjab		10		10	
18	Rajasthan		10		10	
19	Tamilnadu		10		10	
20	Uttar Pradesh (East)		10		10	
21	Uttar Pradesh (West)		10		10	
22	West Bengal		10		10	

Table-3.3: TSP-wise quantum of spectrum (in MHz) assigned

Band- 800 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh				10	
2	Assam				10	
3	Bihar				10	
4	Delhi				10	
5	Gujarat				10	
6	Haryana	5			10	
7	Himachal Pradesh				10	
8	Jammu & Kashmir				10	
9	Karnataka				10	
10	Kerala				10	
11	Kolkata				10	
12	Madhya Pradesh	5			10	
13	Maharashtra	5			10	
14	Mumbai				15	
15	North East				10	
16	Odisha				10	
17	Punjab				10	
18	Rajasthan		5		10	
19	Tamilnadu				10	
20	Uttar Pradesh (East)				10	
21	Uttar Pradesh (West)	5			10	
22	West Bengal				10	

Table-3.4: TSP-wise quantum of spectrum (in MHz) assigned

Band- 900 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	9	6.4			7.4
2	Assam	15	6.4			
3	Bihar	12	6.4			
4	Delhi	6		6.4		10
5	Gujarat	4.2	6.4			11
6	Haryana		6.4			12.2
7	Himachal Pradesh	10	6.4			
8	Jammu & Kashmir	15	6.4			
9	Karnataka	8.8	6.4			7.2
10	Kerala	4.6	6.4			12.4
11	Kolkata	7	6.4			7.2
12	Madhya Pradesh		6.4			7.4
13	Maharashtra		6.4			14
14	Mumbai	5		6.4		11
15	North East	15	6.4			
16	Odisha	10	6.4			5
17	Punjab	10	6.4			6.8
18	Rajasthan	10	6.4			6.8
19	Tamilnadu	5	6.4			7.4
20	Uttar Pradesh (East)	10	6.4			6.8
21	Uttar Pradesh (West)		6.4			10
22	West Bengal	10	6.4			6.8

Table-3.5: TSP-wise quantum of spectrum (in MHz) assigned

Band- 1800 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	21.4			10	10
2	Assam	15.05			10	25
3	Bihar	20.2			15	17.8
4	Delhi	7		10	10	10.6
5	Gujarat	10			20	20.8
6	Haryana	15			10	15.8
7	Himachal Pradesh	20			10.4	11.2
8	Jammu & Kashmir	15			10	17
9	Karnataka	20			10	15
10	Kerala	10			10	20
11	Kolkata	20			10	15
12	Madhya Pradesh	15			20	19.8
13	Maharashtra	20			20	12.4
14	Mumbai	15			10	14.6
15	North East	10			10	25.8
16	Odisha	20			20	17
17	Punjab	20			10	15
18	Rajasthan	15			20	10
19	Tamilnadu	20			10	11.4
20	Uttar Pradesh (East)	16.8			20	10
21	Uttar Pradesh (West)	15			10	15
22	West Bengal	12			20	21.6

Table-3.6: TSP-wise quantum of spectrum (in MHz) assigned

Band- 2100 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	5	10			5
2	Assam	15	10			5
3	Bihar	15	10			5
4	Delhi	15		5		5
5	Gujarat	15	10			10
6	Haryana	15	10			15
7	Himachal Pradesh	5	10			5
8	Jammu & Kashmir	15	10			5
9	Karnataka	10	10			10
10	Kerala	15	10			10
11	Kolkata		10			10
12	Madhya Pradesh	10	10			5
13	Maharashtra	10	10			15
14	Mumbai	5		10		10
15	North East	15	10			5
16	Odisha	5	10			5
17	Punjab	5	10			10
18	Rajasthan	15	5			15
19	Tamilnadu	10	10			15
20	Uttar Pradesh (East)	5	10			20
21	Uttar Pradesh (West)	15	10			10
22	West Bengal	15	10			5

Table-3.7: TSP-wise quantum of spectrum (in MHz) assigned

Band- 2300 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	30			40	
2	Assam	40			40	
3	Bihar	40			40	
4	Delhi	30			40	
5	Gujarat	40			40	
6	Haryana	40			40	
7	Himachal Pradesh	40			40	
8	Jammu & Kashmir	40			40	
9	Karnataka	30			40	
10	Kerala	30			40	10
11	Kolkata	30			40	
12	Madhya Pradesh	30			40	10
13	Maharashtra	30			40	10
14	Mumbai	30			40	
15	North East	40			40	
16	Odisha	40			40	
17	Punjab	40			40	
18	Rajasthan	40			40	
19	Tamilnadu	30			40	
20	Uttar Pradesh (East)	40			40	
21	Uttar Pradesh (West)	40			40	
22	West Bengal	40			40	

Table-3.8: TSP-wise quantum of spectrum (in MHz) assigned

Band- 2500 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh		20			20
2	Assam		20			20
3	Bihar		20			20
4	Delhi		20			20
5	Gujarat		10			30
6	Haryana		20			20
7	Himachal Pradesh		20			10
8	Jammu & Kashmir		20			10
9	Karnataka		20			
10	Kerala		20			20
11	Kolkata		20			20
12	Madhya Pradesh		20			20
13	Maharashtra		10			30
14	Mumbai		20			20
15	North East		20			20
16	Odisha		20			20
17	Punjab		20			20
18	Rajasthan		20			20
19	Tamilnadu		20			
20	Uttar Pradesh (East)		20			20
21	Uttar Pradesh (West)		20			20
22	West Bengal		20			20

Table-3.9: TSP-wise quantum of spectrum (in MHz) assigned

Band- 3300 MHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	100	70		100	50
2	Assam	100	70		100	
3	Bihar	100	70		100	50
4	Delhi	100	70		100	50
5	Gujarat	100	70		100	50
6	Haryana	100	70		100	50
7	Himachal Pradesh	100	70		130	
8	Jammu & Kashmir	100	70		130	
9	Karnataka	100	70		130	50
10	Kerala	100	70		130	50
11	Kolkata	100	70		100	50
12	Madhya Pradesh	100	70		130	50
13	Maharashtra	100	70		100	50
14	Mumbai	100	70		100	50
15	North East	100	70		130	
16	Odisha	100	70		100	
17	Punjab	100	70		100	50
18	Rajasthan	100	70		130	50
19	Tamilnadu	100	70		100	50
20	Uttar Pradesh (East)	100	70		100	50
21	Uttar Pradesh (West)	100	70		130	50
22	West Bengal	100	70		100	50

Table-3.10: TSP-wise quantum of spectrum (in MHz) assigned

Band- 6 GHz		
Ser No.	LSA	Name of TSP
NIL		

Table-3.11: TSP-wise quantum of spectrum (in MHz) assigned

Band- 26 GHz						
Ser No.	LSA	Name of TSP				
		Bharti Airtel	BSNL	MTNL	Reliance Jio	Vodafone Idea
1	Andhra Pradesh	850	800		1000	200
2	Assam	800	800		1000	
3	Bihar	800	800		1000	
4	Delhi	800	800		1000	200
5	Gujarat	900	800		1000	150
6	Haryana	800	800		1000	400
7	Himachal Pradesh	800	800		1000	
8	Jammu & Kashmir	800	800		1000	
9	Karnataka	850	800		1000	200
10	Kerala	800	650		1000	800
11	Kolkata	800	800		1000	200
12	Madhya Pradesh	800	800		1000	400
13	Maharashtra	800	800		1000	400
14	Mumbai	900	800		1000	200
15	North East	800	800		1000	
16	Odisha	800	800		1000	
17	Punjab	800	800		1000	300
18	Rajasthan	850	800		1000	300
19	Tamilnadu	850	800		1000	300
20	Uttar Pradesh (East)	800	800		1000	250
21	Uttar Pradesh (West)	800	800		1000	350
22	West Bengal	800	800		1000	400

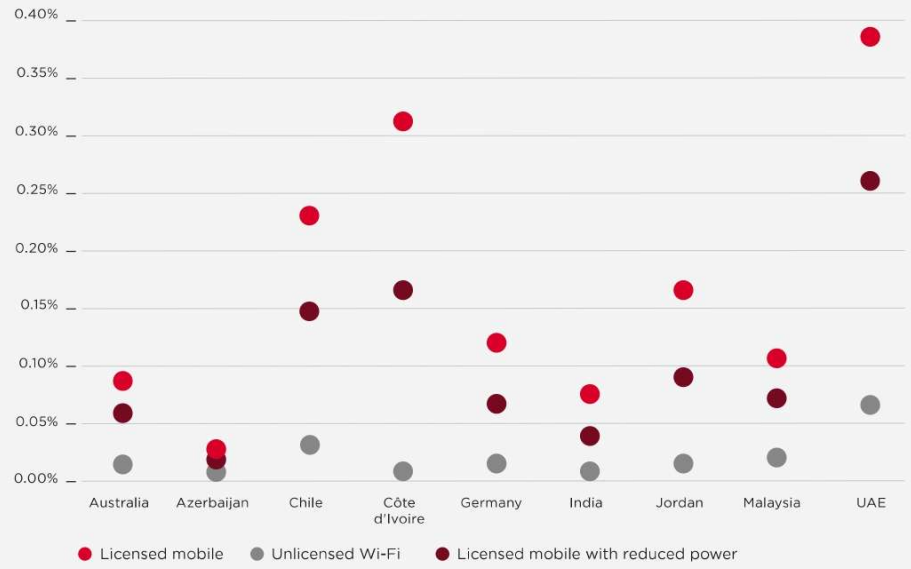
Table 4: LSA-wise details of spectrum being shared by TSPs

Names of the TSPs sharing the spectrum		Name of the LSAs where spectrum is being shared	Spectrum band in which spectrum is being shared	Amount of shared spectrum	
TSP1	TSP2			TSP1	TSP2
NIL					

Table 5: LSA-wise details of the spectrum sharing and trading proposals under examination

Ser No.	Names of the TSPs		LSA	Quantum of spectrum (in MHz)		Proposal Type (Sharing/Trading)
	TSP1	TSP2		TSP1	TSP2	
NIL						

The economic benefits of the three scenarios in nine countries
Proportion of expected GDP in 2035



Source: GSMA Intelligence
Note: The results represent the net present value (NPV) of economic benefits during 2023-2035, expressed as a proportion of expected GDP in 2035 for each country

What to expect in the year ahead

Hong Kong recently concluded the world's first IMT auction of the upper 6 GHz band, and the UAE is assigning the full upper 6 GHz to its operators. Meanwhile, Sri Lanka, Indonesia, Thailand, Bangladesh and Cambodia have added it to their spectrum roadmaps and India is also progressing the use of 6 GHz for mobile.

In 2024, Australia, Brazil, Chile and Mexico moved away from dedicating the entire band for unlicensed use and identified the upper part of the band to IMT in the countries' table of frequency allocations. In 2025, many more nations will make 6 GHz available for IMT. Countries across APAC, the Gulf region and Latin America will help accelerate these regional trends.

These developments confirm 6 GHz as the harmonised home for the future of mid-band capacity. Using 6 GHz to deliver a clear roadmap towards future connectivity can provide fast, affordable mobile broadband, lower the usage gap and narrow the digital divide.

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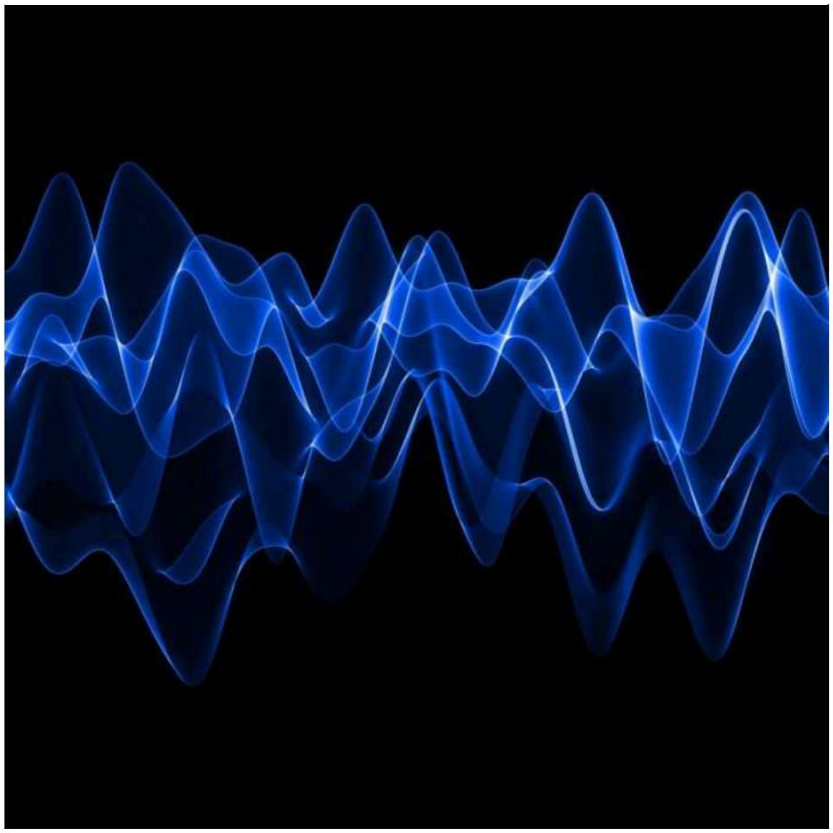

Image: 123RF

China allocates 6 GHz spectrum band for 5G, 6G services

By **Juan Pedro Tomás** June 29, 2023

Spectrum | 5G

In China, the 6 GHz spectrum has been identified as the only high-quality resource with large bandwidth in the mid-band

The Chinese government allocated spectrum in the 6 GHz frequency band for 5G and 6G services, the country's Ministry of Industry and Information Technology (MIIT) said in a statement.

The 6 GHz spectrum is the only high-quality resource with large bandwidth in the mid-band, taking into account its coverage and capacity advantages, the ministry said, noting that the 6 GHz range is particularly suitable for the deployment of 5G systems or 6G systems in the future.

MIIT noted that the allocation of the 6 GHz band at this time is "conducive to stabilizing the expectations of the 5G/6G industry."

The ministry also said it expected the decision to promote the "global or regional division of 5G/6G spectrum resources and provide the groundwork to promote mobile communications and industrial developments."

The Chinese authorities also confirmed that the decree reserving the allocation of the 6 GHz band will enter into force at the beginning of July.

In a blog published during MWC23 Shanghai, GSMA's head of spectrum Luciana Camargos highlighted the fact that China had identified the upper part of the 6 GHz band for International Mobile Telecommunications (IMT) systems.

"China's efforts towards the 6 GHz band don't come as a surprise. Conducive spectrum policies for the mid-bands, especially the 2.6 GHz and 3.5 GHz, have helped China to deploy the world's largest 5G networks with over 2.7 million 5G base stations by the end of April 2023 and to be on track to become the first country to reach 1 billion 5G connections in 2025," Camargo said.

A previous study by GSMA Intelligence concluded that mid-band spectrum will drive an increase of more than $610 billion in global GDP in 2030, producing almost 65% of the overall socio-economic value generated by 5G. According to the analysis, up to 40% of the expected benefits of mid-band 5G could be lost if no additional mid-band spectrum is assigned to mobile services in the near future.

6 GHz spectrum is the largest remaining contiguous block of mid-band spectrum that can be allocated to licensed mobile in most m… …6 GHz spectrum could therefore provide more… …rmance. At the same time, the broad contiguous c… …ld reduce the

need for network densification, helping governments to speed up access to 5G services, the body added.

Three APs with 75% overlap – SC pair (c3), linear topology
CDF of delay with 3, 6 and 9 streams

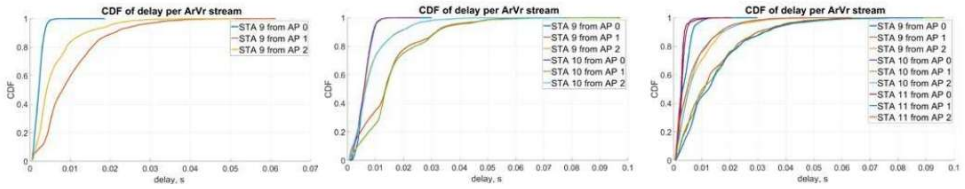

Figure B-4. Statistics of delay for SC pair (c3) with three APs sharing a single 320 MHz channel with 50% and 75% spectral overlap

Furthermore, to simulate deployment scenario d), three APs are placed in three adjacent rooms, with 20 m x 20 m x 3 m size, in an L-shape topology. In this deployment scenario, channelization configuration 3 is being simulated with three overlapping 320 MHz channels, all within the 480 MHz spectrum from 5945 MHz to 6425 MHz.

Figure B-5 compares CDFs of delay measured in downlink direction at each AR/VR client associated with its respective AP.

Three APs with 75% overlap – SC pair (d3), L-shape topology
CDF of delay with 3, 6 and 9 streams

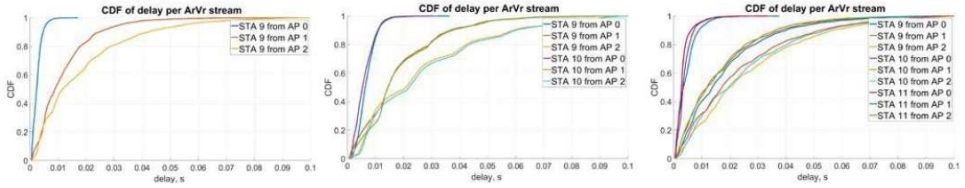

Figure B-5. Statistics of delay for SC pair (d3) with three APs sharing a single 320 MHz channel with 50% and 75% spectral overlap

As can be seen from the provided graphs, unlike in the baseline case, a 75% overlap of three 320 MHz channels significantly affects each BSS operation. The number of AR/VR streams with 99.9-percentile delay below 10 ms drops to one stream and can only be maintained in BSS of AP0 placed in room 1. AP1 and AP2 cannot provide a sufficient level of service even for a single AR/VR client maintaining 99.9-percentile delay below 10ms.

B.4 Deployment with Three Non-Overlapping Channels

In this section, we consider deployments in countries such as the United States, Korea, Canada, Brazil, Saudi Arabia, etc., where the entire 1200 MHz (5925-7125 MHz) is available to unlicensed operation. The availability of 1200 MHz of the spectrum makes it possible to deploy three non-overlapping 320 MHz carriers in the band. In this case, due to minimal out-of-band interference, it is reasonable to consider that performance of each of the three non-overlapping 320 MHz channels resembles that of the single 320 MHz channel analyzed in the baseline case, namely Configuration 1 in deployment scenario a), as described in Figure B-1, with the added benefit of significant increase in the overall capacity delivered by the deployment.

Concerning other deployment scenarios featuring the hidden nodes problem, Configuration 4 was tried in combination with deployment scenario c), namely three adjacent rooms arranged linearly, with each of three APs (one in each room) running one of the three non-overlapping 320 MHz channels (SC pair (c4)).

Annexure 3.1: Status of Sale of Spectrum in Past Auctions

(i) 2022 Auction

	600MHz		700 MHz		800 MHz		900 MHz		1800 MHz		2100 MHz		2300 MHz		2500 MHz		3300 MHz		26 GHz	
LSA	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**
Andhra Pradesh	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	27%	D<S	0%		0%	No Bid	33%	D<S	76%	D<S	72%	D<S
Assam	0%	No Bid	40%	D<S	100 %	D=S	86%	D<S	0%	No Bid	0%						61%	D<S	63%	D<S
Bihar	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	100 %	D=S			0%	No Bid	76%	D<S	63%	D<S
Delhi	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	33%	D<S	0%	No Bid	0%	No Bid	76%	D<S	70%	D<S
Gujarat	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	71%	D<S	50%	D<S			0%	No Bid	76%	D<S	82%	D<S
Haryana	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	100 %	D=S					76%	D<S	77%	D<S
Himachal Pradesh	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	27%	D<S	0%				0%	No Bid	70%	D<S	63%	D<S
Jammu & Kashmir	0%	No Bid	40%	D<S	100 %	D=S	81%	D<S	0%	No Bid	0%				0%	No Bid	70%	D<S	63%	D<S
Karnataka	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	50%	D<S	0%	No Bid	0%	No Bid	85%	D<S	72%	D<S
Kerala	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	100 %	D=S					85%	D<S	91%	D<S
Kolkata	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	21%	D<S	0%		0%	No Bid	0%	No Bid	76%	D<S	70%	D<S
Madhya Pradesh	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	89%	D<S	0%						85%	D<S	77%	D<S

	600MHz		700 MHz		800 MHz		900 MHz		1800 MHz		2100 MHz		2300 MHz		2500 MHz		3300 MHz		26 GHz	
LSA	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**
Maharashtra	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	86%	D<S	0%				0%	No Bid	76%	D<S	77%	D<S
Mumbai	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	18%	D<S	0%		0%	No Bid	0%	No Bid	76%	D<S	74%	D<S
North East	0%	No Bid	40%	D<S	100 %	D=S	100 %	D=S	0%	D<S	0%						70%	D<S	63%	D<S
Orissa	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	**100 %**	**D>S**	0%						61%	D<S	63%	D<S
Punjab	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	0%				100 %	D=S	76%	D<S	74%	D<S
Rajasthan	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	59%	D<S							85%	D<S	75%	D<S
Tamilnadu	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid			0%	No Bid	0%	No Bid	76%	D<S	75%	D<S
U. P. (East)	0%	No Bid	40%	D<S	0%	No Bid		No Bid	**100 %**	**D>S**							76%	D<S	72%	D<S
U.P. (West)	0%	No Bid	40%	D<S	100 %	D=S	0%	No Bid	0%	No Bid	0%						85%	D<S	75%	D<S
West Bengal	0%	No Bid	40%	D<S	0%	No Bid	0%	No Bid	0%	No Bid	100 %	D=S					76%	D<S	77%	D<S

(ii) <u>2024 Auction</u>

	800 MHz		900 MHz		1800 MHz		2100 MHz		2500 MHz		3300 MHz		26 GHz	
LSA	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**
Andhra Pradesh			55%	D<S										
Assam			74%	D<S	47%	D<S	100%	D=S						
Bihar			59%	D<S	**100%**	**D>S**			67%	D<S				
Delhi														
Gujarat														
Haryana					18%	D<S								
Himachal Pradesh														
Jammu and Kashmir			75%	D<S			100%	D=S						
Karnataka	0%	No Bid	48%	D<S							0%	No Bid	0%	No Bid
Kerala														
Kolkata			7%	D<S	50%	D<S								
Madhya Pradesh					100%	D=S								
Maharashtra														
Mumbai														
North East			23%	D<S			100%	D=S						
Odisha			60%	D<S	11%	D<S								
Punjab			100%	D=S	51%	D<S								
Rajasthan			100%	D=S	71%	D<S								
Tamilnadu			29%	D<S										

	800 MHz		900 MHz		1800 MHz		2100 MHz		2500 MHz		3300 MHz		26 GHz	
LSA	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**	**% of spectrum sold**	**D & S of spectrum**
Uttar Pradesh (East)			100%	D=S	100%	D=S								
Uttar Pradesh (West)			42%	D<S			50%	D<S						
West Bengal			92%	D<S	**100%**	**D>S**								

Annexure 3.2: Methodologies and Approaches previously used for Spectrum Valuation

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum
1800 MHz	Producer Surplus Model	Annexure 4.2 of September 2013 Recommendations Para 3.38 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
	Production Function Approach	Annexure 4.3 of September 2013 Recommendations Para 3.32 of October 2014 Recommendations Para 3.32 of January 2016 Recommendations Para 3.31 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
	Revenue Surplus Model	Annexure 3.3 of October 2014 Recommendations Para 3.36 of January 2016 Recommendations Para 3.34 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
	Use of Last auction determined price	Para 3.64 and Annexure 4.4 of September 2013 Recommendations Para 3.26 of January 2016 Recommendations Para 3.24 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
	Market Data Analysis: Single variable correlation (Trend Line) or multiple regression	Para 4.2 to 4.10 and Annexure 4.1 of September 2013 Recommendations Para 3.41 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
800 MHz	Producer Surplus Model	Annexure 3.2 of February 2014 Recommendations Annexure A of Authority's response of 27 November 2014 to reference received from DoT on February 2014 Recommendations

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum
	Technical Efficiency Approach	Para 3.1 to 3.4 of December 2013 Consultation Paper Para 3.22 of August 2018 Recommendations Annexure 3.9 of April 2022 Recommendations
	Use of last auction determined prices	Para 3.29 of August 2018 Recommendations Annexure 3.9 of April 2022 Recommendations
	Potential Growth in Data Services	Annexure 3.3 of February 2014 Recommendations Annexure A of Authority's response of 27 November 2014 to reference received from DoT on February 2014 Recommendations
	Use of Auction Determined Prices of 900 MHz in valuation of 800 MHz band	Para 3.68 of February 2014 Recommendations Para 3.42 of January 2016 Recommendations
	Market Data Analysis: Single variable correlation or multiple regression	Annexure 4.1 of September 2013 Recommendations Para 3.16 of January 2016 Recommendations Annexure 3.9 of April 2022 Recommendations
900 MHz	Technical Efficiency Approach	Para 4.45 to 4.47 of September 2013 Recommendations Para 3.45 of August 2018 Recommendations Annexure 3.8 of April 2022 Recommendations
	Economic Efficiency Approach	Annexure 4.5 of September 2013 Recommendations Annexure 3.5 of October 2014 Recommendations Para 3.45 of August 2018 Recommendations Annexure 3.8 of April 2022 Recommendations
	Use of Auction Determined Prices of	Para 3.42 of January 2016 Recommendations Para 3.45 of August 2018 Recommendations

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum
	800 MHz in valuation of 900 MHz band	Annexure 3.8 of April 2022 Recommendations
	Market Data Analysis: Single variable correlation or multiple regression	Annexure 4.1 of September 2013 Recommendations Para 3.16 of January 2016 Recommendations
2100 MHz	Technical Efficiency Approach	Para 3.8 to 3.10 of December 2014 Recommendations Para 3.6 and 3.7 of December 2014 Consultation Paper Para 3.22 of August 2018 Recommendations Annexure 3.10 of April 2022 Recommendations
	Data Usage Growth Model	Para 3.20 - 3.21 December 2014 Consultation Paper Annexure 3.4 of December 2014 Recommendations Para 3.49 of January 2016 Recommendations
	Producer Surplus Model	Annexure 3.3 of December 2014 Recommendations
	Use of Last auction determined price	Para 3.5 - 3.7 of December 2014 Recommendations Para 3.26 - 3.28 of January 2016 Recommendations Para 3.29 of August 2018 Recommendations Annexure 3.10 of April 2022 Recommendations
700 MHz	Use of Reserve Price of 1800 in valuation of 700 MHz band	Para 3.75 of January 2016 Recommendations Para 3.98 of August 2018 Recommendations Annexure 3.13 of April 2022 Recommendations
2300 MHz	Indexation of last available auction prices	Para 3.80 to 3.81 of January 2016 Recommendations Para 3.71 of August 2018 Recommendations

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum
		Annexure 3.11 of April 2022 Recommendations
	Equal to last recommended Reserve Price	Para 3.71 of August 2018 Recommendations
	Market Data Analysis: Single variable correlation or multiple regression	Annexure 3.11 of April 2022 Recommendations
2500 MHz	Equal to recommended Reserve Price of 2300 MHz	Para 3.85 of January 2016 Recommendations Annexure 3.12 of April 2022 Recommendations
	Indexation of last available auction prices	Para 3.80 of August 2018 Recommendations Annexure 3.12 of April 2022 Recommendations
	Equal to last recommended Reserve Price	Para 3.80 of August 2018 Recommendations Annexure 3.12 of April 2022 Recommendations
3300 - 3600 MHz	Technical efficiency approach	Para 3.129 to 3.130 of August 2018 Recommendations Annexure 3.15 of April 2022 Recommendations
mmWave	International benchmarking	Annexure 3.16 of April 2022 Recommendations

Annexure 3.3 International Auction-Determined Prices

Country	Spectrum Band	Details
Hong Kong	6 GHz (6570-7025 MHz)	The Minimum Fee (reserve price)-HK$40 million.[85] Per 20MHz block equivalent to HK$ 2 million per MHz Total spectrum Sold -300 MHz Total proceeds from auction – HK$630 million Auction determined price per MHz – HK$ 2.1 million[86]
USA	600 MHz	Total spectrum Sold- 84 MHz Total proceeds from auction – US$ 19.8 Bn Auction determined price per MHz per pop- US$ 0.93[87]
Canada	600 MHz	Total spectrum Sold- 35 MHz Total proceeds from auction – CAD 3.47Bn (US$ 2.61Bn)[88]

[85] https://www.ofca.gov.hk/filemanager/ofca/en/content_1713/6_7_ghz_band_auction_IM.pdf

[86] https://www.info.gov.hk/gia/general/202411/29/P2024112900425.htm

[87] Cullen International Database

[88] Cullen International Database

LIST OF ACRONYMS

1G	First Generation
2G	Second Generation
3GPP	3rd Generation Partnership Project
4G	Fourth Generation
5G	Fifth Generation
5G-NR	5G-New Radio
6G	Sixth Generation
A&N	Andaman and Nicobar Islands
ACMA	Australian Communications and Media Authority
ADP	Auction Determined Prices
AI	Artificial Intelligence
ANATEL	Agência Nacional de Telecomunicações
ANP	Access Network Providers
APAC	Asia-Pacific
APT	Asia-Pacific Telecommunity
AT&T	American Telephone and Telegraph Company
AWG	Asia Pacific Telecommunity Wireless Group
BHQ	Block Headquarters
BIPT	Belgian Institute for Postal Services and Telecommunications
BS	Base Station
BSC	Base Station Controller
BSNL	Bharat Sanchar Nigam Limited
BTS	Base Transceiver Stations
BWA	Broadband Wireless Access
CAPEX	Capital Expenditure
CCA	Combinatorial Clock Auctions
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications Administrations
CII	Cost Inflation Index

CMTS	Cellular Mobile Telephone Service
CST	Communications, Space and Technology Commission
CTN	Cloud Hosted Telecom Network
CTNaaS	Cloud-Hosted Telecommunication Network-as-a-Service
DCIP	Digital Connectivity Infrastructure Provider
DHQ	District Headquarters
DoS	Department of Space
DoT	Department of Telecommunications
EB	Exabyte
EC	European Commission
EDGE	Enhanced Data rates for GSM Evolution
EIRP	Effective Isotropic Radiated Power
ETCS	European Train Control System
FCC	Federal Communications Commission
FDD	Frequency Division Duplexing
FDI	Foreign Direct Investment
FS	fixed service
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GAGAN	GPS Aided GEO Augmented Navigation
GDP	Gross domestic product
GHz	Giga Hertz
GPRS	General Packet Radio Service
GSA	Global Mobile Suppliers Association
GSDP	Gross State Domestic Product
GSM	Global System for Mobile
GSMA	Global System for Mobile Communications Association
HF	High Frequency
HPB	Hierarchical Package Bidding
Hz	Hertz
IBS	In-Building Solution

IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
IR	Indian Railways
ISP	Internet Service Provider
ITU	International Telecommunication Union
ITU-R	ITU - Radiocommunication
ITU-RR	ITU Radio Regulations
Kg	Kilogram
KHz	Kilo Hertz
LIPD	Low Interference Potential Devices
LSA	Licensed Service Area
LTE	Long Term Evolution
M2M	Machine to Machine
MCLR	Marginal Cost of Funds based Lending Rates
MCPTT	Mission-Critical Push-To-Talk
MFCNSDL	Mobile/ Fixed Communications Networks Supplemental Downlink
MHz	Mega Hertz
mmWave	Millimeter Wave
MSS	Mobile Satellite Service
MTNL	Mahanagar Telephone Nigam Limited
mW	Milliwatt
NCRTC	National Capital Region Transport Corporation
NDCP	National Digital Communication Policy
NFAP	National Frequency Allocation Plan
NIA	Notice Inviting Application
NPV	Net Present Value
NR	New Radio
NSA	Non-Standalone
OEM	Original Equipment Manufacturer
OFCA	Office of the Communications Authority

Ofcom	Office of Communications
OPEX	Operating expense
PSU	Public Sector Undertaking
RAN	Radio Access Network
RF	Radio Frequency
RLAN	Radio Local Area Networks
RP	Reserve Price
RR	Radio Regulations
RRTS	Regional Rapid Transit System
RSM	Radio Spectrum Management
RSPG	Radio Spectrum Policy Group
SA	Standalone
SAA	Simultaneous Ascending Auction
SBO	Services Based Operator
SDCA	Short Distance Charging Area
SDL	Supplementary Downlink
SMRA	Simultaneous Multiple-Round Auction
SMS	Short Message Service
STC	Saudi Telecommunication Company
SUC	Spectrum Usage Charge
SUL	Supplementary Uplink
TDD	Time Division Duplex
TDRA	Telecommunications and Digital Government Regulatory Authority
TRAI	Telecom Regulatory Authority of India
TSP	Telecom Service Provider
TT&C	Telemetry Tracking And Command
UAE	United Arab Emirates
UASL	Unified Access Service License
UL	Unified License
US	United States
VNO	Virtual Network Operator

WAWBB	Wide Area Wireless Broadband
WCDMA	Wideband Code Division Multiple Access
WiMax	Worldwide Interoperability for Microwave Access
WPC	Wireless Planning & Coordination
WPI	Wholesale Price Index
WRC	World Radiocommunication Conference