



भारतीय दूरसंचार विनियामक प्राधिकरण  
Telecom Regulatory Authority of India



**Recommendations on  
The Auction of Radio Frequency Spectrum in the Frequency Bands  
Identified for International Mobile Telecommunications (IMT)**

New Delhi, India  
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## Chapter I: Introduction and Background

### A. Background

- 1.1 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:

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

#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."*

- 1.2 Hereinafter, the afore-mentioned letter dated 15.05.2025 will also be referred to as "the Reference dated 15.05.2025".
- 1.3 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 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."*

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

1.5 In short, through the Reference dated 15.05.2025, DoT had 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, and 26 GHz bands. DoT had also requested TRAI to explore the possibility of auction and the timing of auction for 6425-6725 MHz and 7025-7125 MHz bands. Besides, through the Letter dated 14.08.2025, DoT had requested TRAI 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. These aspects have been examined in detail in Chapter II and Chapter III of these Recommendations. As a prelude, the following section provides the background information on the frequency bands identified for IMT.

## **B. Background Information on the Frequency Bands identified for IMT**

### **(1) The 600 MHz band**

1.6 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 held in 2022. However, no bids were received for this spectrum in the spectrum auction. Thus, the entire 40 MHz (paired) spectrum in the 600 MHz band is vacant. Through the Reference dated 15.05.2025, DoT 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"*.

## **(2) The 700 MHz band**

- 1.7 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 the 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.
- 1.8 Thereafter, in October 2019, considering the importance for Indian Railways to have the latest standards of train signalling 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 the 700 MHz band was put to auction in each LSA. However, the entire spectrum remained unsold.

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

**Table 1.1: Present Utilization of the 700 MHz Band**

<b>S. No.</b>	<b>Uplink Frequency (MHz)</b>	<b>Downlink Frequency (MHz)</b>	<b>Quantum of spectrum (MHz)</b>	<b>TSP/ User</b>
1.	703 - 713	758 - 768	10	Government User
2.	713 - 718	768 - 773	5	Indian Railways
3.	718 - 723	773 - 778	5	NCRTC/ RRTS
4.	723 - 733	778 - 788	10	Reliance Jio
5.	733 - 738	788 - 793	5	Vacant
6.	738 - 748	793 - 803	10	BSNL

1.10 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**

1.1 Earlier, the 800 MHz (band 5), 900 MHz (band 8) and 1800 MHz (band 3) bands were primarily used for circuit-switched voice services on 2G (CDMA/GSM) networks. Today, these bands are predominantly utilized for high-speed data services on 4G (LTE). 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 1.2: Spectrum auctioned and sold in 800 MHz, 900 MHz, and 1800 MHz bands since 2012**

<b>S. No.</b>	<b>Year</b>	<b>Spectrum band</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
1.	2012	800 MHz	95 MHz	No bidder
		1800 MHz	295 MHz	127.5 MHz

<b>S. No.</b>	<b>Year</b>	<b>Spectrum band</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
2.	2013	800 MHz	95 MHz	30 MHz
		900 MHz	46 MHz (Delhi, Mumbai and Kolkata)	No bidder
		1800 MHz	57.5 MHz (Delhi, Mumbai, Karnataka and Rajasthan)	No bidder
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)
		900 MHz	9.4 MHz (Bihar, Gujarat, UP-East, UP-West)	No bidder
		1800 MHz	221.6 MHz (All LSAs except	174.8 MHz (in 19 LSAs)

<b>S. No.</b>	<b>Year</b>	<b>Spectrum band</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
			Tamil Nadu)	
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)

1.11 The spectrum that remained unsold in the June 2024 auction, along with administratively assigned spectrum in the 1800 MHz band expected to be released upon licence expiry in 2026–27, will be available for the upcoming auction.

#### **(4) The 2100 MHz Band**

1.12 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 allotted one block of 5 MHz (paired) spectrum in all 22 LSAs to the PSU operators at the winning price achieved in the respective LSAs.

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.

1.13 Till date, 40 MHz (paired) spectrum has been made available in the 2100 MHz band for commercial mobile services, and six auctions have been conducted for this band. The spectrum that remained unsold in the June 2024 auction will be available in the forthcoming auction. A summary of the spectrum awarded in the 2100 MHz band through various auctions is given in the following table:

**Table 1.3: Spectrum auctioned and sold in the 2100 MHz band since 2010**

<b>S. No.</b>	<b>Year</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
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)

1.14 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**

1.15 For the spectrum in the 2300 MHz band, 3GPP band 40 has been adopted in India. At present, this band is being used mainly 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.

1.16 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 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 1.4: Spectrum auctioned and sold in the 2300 MHz band since 2010**

<b>S. No.</b>	<b>Year</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
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

1.17 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**

1.18 In India, 3GPP band 41 has been adopted for the 2500 MHz band. Currently, this band is being used for providing 4G services. In 2009, the Government allotted one 20 MHz (unpaired) block per LSA, MTNL received assignments in Delhi and Mumbai, and BSNL in the remaining 20 LSAs, priced at the 2300 MHz band's 2010 auction rate. Subsequently, MTNL surrendered its spectrum in both LSAs, and BSNL surrendered spectrum in six LSAs (Kolkata, Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu, and Karnataka).

1.19 The 2500 MHz band was first auctioned in October 2016. 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 1.5: Spectrum auctioned and sold in the 2500 MHz band since 2016**

<b>S. No.</b>	<b>Year</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
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

<b>S. No.</b>	<b>Year</b>	<b>Amount of spectrum put to auction (total for 22 LSAs)</b>	<b>Amount of spectrum sold (total for 22 LSAs)</b>
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)

- 1.20 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**

- 1.21 In India, for the spectrum in the 3300 MHz band, TDD-based duplexing scheme has 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.
- 1.22 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**

1.23 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 7025-7125 MHz bands.

1.24 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). The recent developments with respect to the lower 6 GHz band are given below:

- (a) TRAI has, based on a reference from DoT, issued its recommendations dated 10.12.2025 on the subject "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".
- (b) On 20.01.2026, DoT has notified the Rules<sup>1</sup> on "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, 2026".

1.25 The newly identified 6425-6725 MHz and 7025-7125 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

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<sup>1</sup> <https://www.dot.gov.in/static/uploads/2026/02/88f0ac8c74eb6f6907934d17d0015ab5.pdf>

assigned the frequency band number 'n104' for 5G-NR to this band. The 3GPP has defined<sup>2</sup> the Time Division Duplex (TDD) configuration for this band.<sup>3</sup> Earlier, in 2020, 3GPP Release 16 had standardized band n96, which covers the entire 6 GHz range from 5925–7125 MHz.

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

- 1.26 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 were not deliberated in the consultation paper.

### **(10) The 26 GHz band**

- 1.27 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/

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<sup>2</sup> Source: <https://www.yolegroup.com/industry-news/3gpp-officially-completed-the-specification-of-the-upper-6ghz-licensed-band-for-5g>

<sup>3</sup> With respect to the upper 6 GHz band, the GSMA, in its paper<sup>3</sup> 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 available for IMT. Countries across APAC, the Gulf region and Latin America will help accelerate these regional trends.*"

August 2022. Notably, the frequency spectrum range 27.5-28.5 GHz was not put in that auction.

- 1.28 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.
- 1.29 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.
- 1.30 Through the 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. In the NFAP 2025, subsequently released by the Government on 30.12.2025, 27.5-28.5 GHz frequency range has been removed from the list of frequency bands or parts thereof, identified for the implementation of International Mobile Telecommunications.

### **C. TRAI's Consultation Paper dated 30.09.2025**

- 1.31 In this context, the Authority issued a consultation paper on ` the Auction of Radio Frequency Spectrum in the Frequency Bands Identified for International Mobile Telecommunications (IMT) dated 30.09.2025 (hereinafter, also referred to as, "the Consultation Paper dated

30.09.2025") to solicit comments of stakeholders on specific issues related to the Auction of Radio Frequency Spectrum in the Frequency Bands Identified for IMT. Initially, the last dates for furnishing comments and counter-comments were kept as 28.10.2025 and 11.11.2025, respectively. However, upon requests from some stakeholders, the last dates for furnishing comments and counter-comments were extended up to 04.11.2025 and 18.11.2025, respectively.

- 1.32 In response to the Consultation Paper dated 30.09.2025, the Authority received comments from 19 stakeholders and counter-comments from 12 stakeholders. The comments and counter-comments received from stakeholders were placed on the TRAI's website. An Open House Discussion (OHD) on the Consultation Paper dated 30.09.2025 was held on 12.12.2025 with stakeholders, through online mode.

#### **D. The Present Recommendations**

- 1.33 Based on the comments and counter-comments received from stakeholders during the consultation process, and further analysis, the Authority has arrived at the present recommendations. The recommendations comprise four chapters. This chapter provides an introduction and background to the subject. Chapter II provides a brief description of the issues related to the terms and conditions for the auction of spectrum in the frequency bands identified for IMT, a summary of stakeholders' comments, and the Authority's analysis and recommendations thereupon. Chapter III provides analysis and recommendations on issues related to valuation and reserve price. Chapter IV provides a summary of the recommendations.

## Chapter II: Auction Related Issues

- 2.1 Through the Reference dated 15.05.2025 and Letter dated 14.08.2025, DoT had 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) 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.
  - (e) 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 In this regard, the Authority released the Consultation Paper dated 30.09.2025 to solicit comments from stakeholders on the subject. Through the Consultation Paper dated 30.09.2025, broad questions were raised on a range of issues, which have been examined in the subsequent sections.

## **A. Aspects related to the auction of the existing bands**

### **(1) Availability of the spectrum in the existing bands**

2.3 This sub-section provides broad-level information on the LSA-wise 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, and 26 GHz bands.

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

2.4 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.

2.5 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.

2.6 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
<b>Total</b>	<b>425</b>	<b>306.25</b>	<b>118.75</b>

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

- 2.7 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).
- 2.8 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.
- 2.9 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	
<b>Total</b>	<b>523.2</b>	<b>466.8</b>	<b>56.4</b>

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

# Includes 6.4 MHz reserved for BSNL

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

- 2.10 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.
- 2.11 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, the 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

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
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	-	-	-
<b>Total</b>	<b>1265.6</b>	<b>1094.8</b>	<b>170.8</b>	<b>88.2</b>	<b>259</b>

2.12 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 a 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.

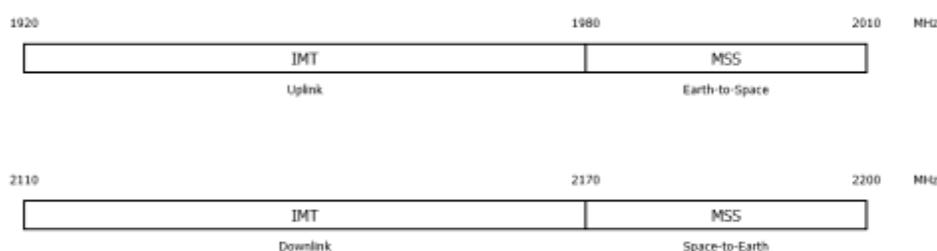
**The 2100 MHz Band (Uplink: 1920-1980 MHz, Downlink: 2110-2170 MHz)**

2.13 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<sup>4</sup>, 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 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.

2.14 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:

<sup>4</sup> 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

**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
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	-
<b>Total</b>	<b>880</b>	<b>775</b>	<b>105</b>

\* Available in two non-contiguous chunks

## The 2300 MHz Band (2300-2400 MHz)

- 2.15 India has adopted TDD configuration based 3GPP band 40 for the 2300 MHz band. This band consists of 100 MHz (unpaired) of spectrum, out of which 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.
- 2.16 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	-

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
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	-
<b>Total</b>	<b>1760</b>	<b>1700</b>	<b>60</b>

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

- 2.17 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.
- 2.18 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
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

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers	Total Vacant Spectrum
	A	B	C = A-B
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
<b>Total</b>	<b>1320</b>	<b>820</b>	<b>500</b>

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

### **The 3300 MHz Band (3300-3670 MHz)**

- 2.19 India has adopted TDD duplexing scheme 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.
- 2.20 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
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

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers*	Total Vacant Spectrum
	A	B	C = A-B
<b>Total</b>	<b>8140</b>	<b>7030</b>	<b>1110</b>

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

### **The 26 GHz band (24.25 to 27.5 GHz)**

- 2.21 India has adopted TDD duplexing scheme 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.
- 2.22 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

LSA	Total Spectrum earmarked for IMT	Total Spectrum already assigned to Access Service Providers*	Total Vacant Spectrum
	A	B	C = A-B
<b>Total</b>	<b>71500</b>	<b>62800</b>	<b>8700</b>

\* 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**

2.23 In the preceding section, LSA-wise availability of spectrum in existing bands has been detailed. Through para 5.1 of the Reference dated 15.05.2025, DoT stated that “[a]ny 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.”. Further, DoT, through 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."*

2.24 In this background, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of stakeholders on Q1**

2.25 A broad summary of the comments of stakeholders in response to Q1, with respect to the measures that should be taken to enhance competition and mitigate over-supply of the spectrum in various frequency bands in the forthcoming auction, is given below:

(a) Majority of the stakeholders have opined that the concerns over potential “over-supply” of spectrum and limited competition are misplaced. The stakeholders further submitted that the restriction of supply will be akin to spectrum hoarding to drive the prices up. The stakeholders are also of the opinion that the availability of ‘adequate spectrum’ at the ‘right price’ is central to the growth of the telecom sector.

- (b) One stakeholder stated that the auction framework requires reforms to ensure fair competition and greater market diversity, as smaller players, such as Category B/C ISPs and M2M providers, struggle to compete with larger operators. Their participation can be encouraged through relaxed eligibility criteria, reduced rollout obligations, smaller service areas, and a dedicated category with reserved spectrum blocks to ensure equitable access. However, another stakeholder, while countering this proposal, submitted that carving out spectrum for only a subset of bidders could adversely impact competition and lead to fragmentation; such spectrum may become unusable outside small licensed service areas, such as an individual city or factory, reducing its overall utility.
- (c) One stakeholder has suggested that reserve prices should align with actual market demand and valuation, offering lower or optimized spectrum quantum in bands with limited interest, and the auction of the 6 GHz band may be deferred. Flexible or staggered payment terms and realistic rollout obligations should be considered for select frequency bands. Further, existing block sizes and minimum bid quantities should be reviewed to enable meaningful competition.

### **Comments of stakeholders on Q2**

2.26 A broad summary of the comments of stakeholders in response to Q2 is given below:

- (a) Most stakeholders are of the view that the entire available spectrum in the existing bands should be put to auction in the forthcoming auction.
- (b) One of the stakeholders submitted that, considering massive unsold inventory put to auction in 2024 and zero demand in four key bands (800 MHz, 2300 MHz, 3300 MHz, and 26 GHz), 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 bands, should not be put to auction in the forthcoming auction. Auctioning a lower quantum/ volume of spectrum may create a better supply-demand balance and the market at potentially revised/ lower reserve prices.

### **Analysis of the issues raised through Q1 and Q2**

2.27 As mentioned above, DoT, in the Reference dated 15.05.2025, stated 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."*

2.28 Apparently, the main concern of the Department of Economic Affairs is to ensure effective competition in the auction process. The various aspects brought out by the Department of Economic Affairs (DEA) have been examined in the subsequent paras. Before examining the aspects brought out by DEA, it will be appropriate to provide a background about radio frequency spectrum and its management.

(i) About Radio Frequency spectrum and its management

2.29 Radio frequency spectrum refers to the range of electromagnetic frequencies used for wireless transmission and reception of signals, which are allocated to various radiocommunication services such as

telecommunications, broadcasting, space services, defence, railways, and other critical applications. 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 and growing demand for spectrum from multiple sectors. Since spectrum is a scarce and finite resource, this aggregate demand from various sectors limits the availability of spectrum for the telecommunication services sector.

2.30 Radio frequency spectrum is a finite and shared natural resource that requires coordinated management at both international and national levels to ensure efficient, interference-free, harmonised, and equitable use. The International Telecommunication Union (ITU) and national administrations play complementary roles in this regard.

2.31 At the international level, the ITU, through its Radiocommunication Sector (ITU-R), is responsible for the global management of spectrum and satellite orbits. ITU-R develops technical standards and recommendations, undertakes studies on spectrum requirements and sharing, and maintains the Radio Regulations, which provide the international framework for spectrum use. The World Radiocommunication Conference (WRC), convened by the ITU, reviews and revises the Radio Regulations and identifies frequency bands for various radiocommunication services, thereby facilitating global and regional harmonisation, minimising cross-border interference, and enabling economies of scale in equipment manufacturing.

2.32 At the national level, spectrum management is the responsibility of national administrations and regulators, which implement the ITU framework in accordance with domestic requirements and policy

objectives. National authorities plan, allocate, and assign spectrum to different services and users, prescribe technical and licensing conditions, and ensure efficient utilisation and interference management. While ITU decisions provide guidance and a harmonised reference, national regulators retain flexibility to address country-specific considerations such as market demand, legacy usage, national security, and socio-economic priorities.

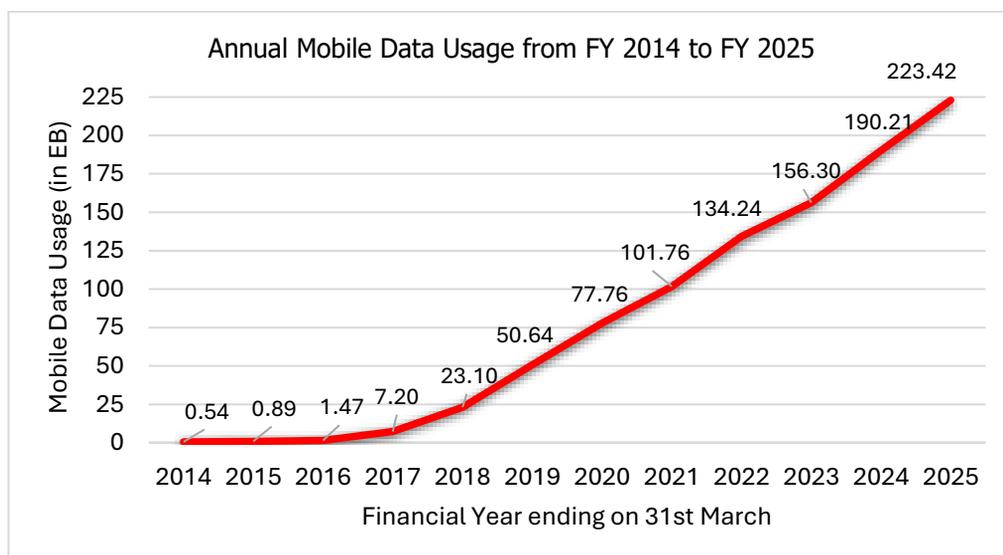
- 2.33 In India, the national administration for spectrum management is the Department of Telecommunications (DoT), which discharges these functions through the Wireless Planning and Coordination (WPC) Wing.
- 2.34 ITU in its Report<sup>5</sup> ITU-R SM.2012-4 (06/2014) on the subject 'Economic aspects of spectrum management' has mentioned, *inter-alia*, that -  
*"The frequency spectrum is a limited and, in some cases, scarce resource. The main objectives of the manager are to secure both optimum spectrum occupancy and effective frequency utilization."*

### **Growing demand for spectrum for IMT services**

- 2.35 Spectrum is the lifeline for mobile services. India is a mobile-first country, where most of the telephony and broadband services are delivered and consumed over cellular mobile networks. International Mobile Telecommunications (IMT) services form the backbone of modern mobile broadband communications, supporting voice, data, and a rapidly expanding range of digital applications. Mobile data traffic in India has exhibited a distinct "hockey-stick" growth pattern, characterized by a phase of modest growth followed by a sudden and steep increase. The growth in mobile data traffic can be seen from the figure given below:

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<sup>5</sup> [https://www.itu.int/dms\\_pub/itu-r/opb/rep/R-REP-SM.2012-4-2014-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-SM.2012-4-2014-PDF-E.pdf)



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

2.36 The rapid escalation in mobile traffic can be attributed to accelerated digitalisation, widespread adoption of smartphones, affordable data tariffs, and deployment of advanced mobile technologies. Mobile networks today function as a foundational backbone for multiple industry verticals by providing ubiquitous connectivity, enabling digital transformation, and fostering innovation across sectors such as education, healthcare, agriculture, manufacturing, transport, and financial services. Consequently, the demand for spectrum continues to increase in line with expanding digital usage and evolving service requirements.

2.37 Adequate availability of spectrum is essential to ensure high data throughput, low latency, network reliability, and improved quality of service. Spectrum scarcity may lead to network congestion, sub-optimal utilisation of infrastructure, and increased cost of service delivery. Timely identification and assignment of harmonised spectrum bands for IMT are therefore necessary to meet present and future capacity requirements and to support efficient and cost-effective network deployment.

2.38 The National Frequency Allocation Plan (NFAP)-2025 released by the Government of India on 30<sup>th</sup> December 2025 recognises this growing importance of spectrum for IMT and other emerging technologies. The Foreward of the NFAP 2025 notes that:

*"As technologies like IMT and satellite communications become more integral to our daily lives, their impact will be felt far beyond the ICT sector. Education, healthcare, agriculture, manufacturing, and other critical areas stand to benefit immensely, creating new opportunities and delivering tangible socioeconomic outcomes for the users and citizens."*

2.39 Further, the Preface of NFAP-2025 highlights the need to proactively address future spectrum requirements, stating that:

*"NFAP-2025 introduces several revisions to address the growing spectrum demands of next-generation technologies. The identification of the 6425-7125 MHz band for IMT holds enormous potential to accelerate 5G and 5G Advanced and pave the way toward future 6G, supporting a new wave of applications -from smart cities and immersive augmented/virtual reality to precision agriculture, autonomous transport, and real-time industrial automation."*

### **Demand - Supply dynamics and mitigating oversupply of spectrum**

2.40 It is a globally acknowledged fact that the demand for radio spectrum has been steadily increasing, which has led to identification of additional frequency bands for IMT by ITU. Spectrum supply in auctions is determined by the availability of globally harmonized IMT bands, while demand is driven by market forces and shaped by economic and technological conditions. Global experiences show that auction outcomes vary widely depending on contextual factors, both policy-related and external. While participating in the spectrum auction, the TSPs consider

several factors such as development of ecosystem in a frequency band, existing deployment(s), frequency band propagation characteristics based on coverage/ capacity requirement, capacity utilization in different frequency bands, demand projections, future plans, availability of finances, competitors' behavior, etc. Further, in addition to the existing TSPs with appropriate service authorisation, any new entity fulfilling the eligibility criteria, is also allowed to participate in the spectrum auction, which can later on acquire appropriate service authorisation. Thus, it is not possible to *a priori* predict the actual demand in each frequency band.

- 2.41 It is important that adequate frequency spectrum should be made available in globally harmonized frequency bands for IMT to meet the increasing demand for radio spectrum. At the same time, it is equally important that mobile operators are provided clarity and freedom so that they can decide when to obtain additional spectrum as per their specific requirements, taking into account network capacity utilization across different frequency bands and the technologies deployed/ planned by them. Recognising this need, the Central Government, as part of the telecom reforms announced in 2021, decided to establish a predictable auction calendar, with spectrum auctions to be conducted normally in the last quarter of each financial year. In this regard, the Department of Telecommunications (DoT), vide Office Memorandum No. L-14047/08/2021-NTG dated 08.10.2021 communicated, inter alia, that spectrum auctions would ordinarily be held in the last quarter of every financial year, while retaining the flexibility to conduct auctions at shorter intervals whenever necessary.
- 2.42 The transparency and flexibility provided by the Government through conducting regular spectrum auctions and putting all available spectrum to auction are the key steps taken to enable the TSPs to plan their spectrum acquisition as per their requirements. Thus, it may not be

correct to judge the success of the auction by the quantity sold as a percentage of total spectrum put to auction.

- 2.43 Given the rapid expansion of mobile usage, the future uptake of 5G and 6G, and innovations such as AI driving data consumption, any restriction on spectrum supply could limit operators' ability to meet demand, leaving valuable spectrum idle. Since broadband in India is predominantly wireless and telecom demand is surging with digitization, spectrum availability must be evaluated based on national data consumption needs rather than solely on bidder participation levels in any single auction.
- 2.44 Further, once a frequency range is identified for IMT services, the same cannot be assigned for any other purpose, barring some exceptions where a service/ usage can coexist with IMT. Thus, even if some quantum of spectrum is not put to auction, the same cannot be put to use for any other purpose, i.e., it will remain idle and unutilized.
- 2.45 Further, creating an artificial scarcity for the sole purpose of increasing the selling price above the reserve price may not only escalate prices but also deter the TSPs from acquiring spectrum despite their network becoming congested, resulting in compromised Quality of Service (QoS) and Quality of Experience (QoE). Furthermore, it is likely to result in reduction in competition, due to which digitalization goals and innovations may also be negatively affected. It may be worth mentioning here that from a perusal of the objectives of the Auction, contained in section 1.2 of respective NIAs for spectrum auctions conducted so far, it can be seen that from year 2022 onwards, the Government has clearly moved away from the objective to "*Maximise revenue proceeds from the Auctions within the set parameters*" to the objective "*to arrive at optimal price of spectrum to ensure sustainable and affordable access to Digital Communications*".

- 2.46 Periodic spectrum auctions with entire available spectrum put to auction give freedom to the TSPs to decide the timing of acquisition of additional spectrum as per the actual need, and not hurriedly acquire spectrum at an artificially escalated price and not use it until the capacity crunch is felt at a large number of sites. Holding back spectrum and thus creating artificial scarcity would not only act as an entry barrier for any new player but may also result in reduction of competition. Further, TSPs who may be intending to augment their capacity in the existing bands may be left with a restricted supply. Thus, any reduction in the quantum of spectrum to be put to auction may prove to be counter-productive. Having said that, in case a new frequency band lacks the availability of device ecosystem, it may not generally be appropriate to put the same to auction. The Authority, in the past, has recommended to not to include certain frequency bands to auction due to the non-availability of device ecosystem.
- 2.47 In view of the foregoing discussion, the Authority is of the view that it may not be appropriate to label the requirement of a steady and transparent supply of spectrum to meet the increasing demand of spectrum as 'oversupply of spectrum'. Therefore, the Authority is of the opinion that the entire available spectrum in the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands should be put to auction in the forthcoming auction.
- 2.48 At this stage, it is worth mentioning that the Authority has also taken note of the suggestion of a few stakeholders to set aside certain spectrum for smaller players such as ISP and M2M providers. This aspect has been dealt with separately in these recommendations in a subsequent section on eligibility conditions.

2.49 While examining the availability of spectrum in various frequency bands, the Authority has taken note of the following aspects:

- (a) Upon perusal of the information on frequency spectrum assigned to various service providers provided by DoT, through its letter dated 14.08.2025, it has been observed that spectrum in many frequency bands is currently held by Reliance Communications Limited (RCOM)/ Reliance Telecom Limited (RTL) and Aircel, which are engaged in corporate insolvency resolution process under Insolvency and Bankruptcy Code, 2016. A brief summary of access spectrum assigned to Aircel and RTL/ RCOM is given in the tables given below:

**Table 2.9: Spectrum holdings of Aircel (in MHz)**

<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 1800 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Bihar	Aircel	1.8	9-Nov-2036
Delhi	Aircel	1.6	4-Dec-2026
Delhi	Aircel	2.8	4-Dec-2026
Delhi	RESERVED FOR AIRCEL (TDSAT ORDER)	1.80	4-Dec-2026
Jammu & Kashmir	Aircel	1.80	7-Sep-2034
Karnataka	Aircel	4.40	4-Dec-2026
Kerala	Aircel	4.40	13-Dec-2026
Kolkata	Aircel	4.40	13-Dec-2026
Kolkata	RESERVED FOR AIRCEL (TDSAT ORDER)	1.80	13-Dec-2026
Mumbai	Aircel	4.40	5-Dec-2026
Mumbai	RESERVED FOR AIRCEL (TDSAT ORDER)	1.80	5-Dec-2026
North East	Aircel	1.80	7-Sep-2034
Punjab	Aircel	4.40	13-Dec-2026
Rajasthan	Aircel	1.6	7-Sep-2034

Rajasthan	Aircel	4.4	4-Dec-2026
Rajasthan	RESERVED FOR AIRCEL (TDSAT ORDER)	1.80	4-Dec-2026
Tamilnadu	Aircel	10.00	26-May-2035
Uttar Pradesh (East)	Aircel	1.8	7-Sep-2034
Uttar Pradesh (East)	Aircel	4.4	13-Dec-2026
Uttar Pradesh (East)	RESERVED FOR AIRCEL (TDSAT ORDER)	1.80	13-Dec-2026
West Bengal	Aircel	1.2	7-Sep-2034

<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 2100 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Andhra Pradesh	Aircel	5.0	31-08-2030
Assam	Aircel	5.0	31-08-2030
Bihar	Aircel	5.0	31-08-2030
Jammu & Kashmir	Aircel	5.0	31-08-2030
Karnataka	Aircel	5.0	31-08-2030
Kerala	Aircel	5.0	31-08-2030
Kolkata	Aircel	5.0	31-08-2030
North East	Aircel	5.0	31-08-2030
Odisha	Aircel	5.0	31-08-2030
Punjab	Aircel	5.0	31-08-2030
Tamilnadu	Aircel	5.0	31-08-2030
Uttar Pradesh (East)	Aircel	5.0	31-08-2030
West Bengal	Aircel	5.0	31-08-2030

**Table 2.10: Spectrum holdings of RCOM and RTL (in MHz)**

<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 800 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Assam	Reliance Telecom	2.5	27-May-2035
Assam	Reliance Telecom	2.5	11-Dec-2035
Delhi	Reliance Communications	1.25	29-Apr-2033
Delhi	Reliance Communications	2.5	29-Apr-2033
Gujarat	Reliance Communications	1.25	29-Apr-2033
Gujarat	Reliance Communications	2.5	27-May-2035
Gujarat	Reliance Communications	2.5	29-Apr-2033
Haryana	Reliance Communications	1.25	27-May-2035
Himachal Pradesh	Reliance Communications	2.5	27-May-2035
Jammu & Kashmir	Reliance Communications	2.5	27-May-2035
Karnataka	Reliance Communications	1.25	29-Apr-2033
Karnataka	Reliance Communications	2.5	29-Apr-2033
Kerala	Reliance Communications	1.25	29-Apr-2033
Kerala	Reliance Communications	2.5	29-Apr-2033
Kolkata	Reliance Communications	1.25	29-Apr-2033
Kolkata	Reliance Communications	1.25	20-Dec-2035
Kolkata	Reliance Communications	2.5	29-Apr-2033
North East	Reliance Telecom	2.5	27-May-2035
North East	Reliance Telecom	2.5	11-Dec-2035

Odisha	Reliance Communications	1.25	27-May-2035
Punjab	Reliance Communications	1.25	20-Dec-2035
Punjab	Reliance Communications	1.25	27-May-2035
Tamilnadu	Reliance Communications	1.25	29-Apr-2033
Tamilnadu	Reliance Communications	2.5	29-Apr-2033
Uttar Pradesh (West)	Reliance Communications	1.25	29-Apr-2033
Uttar Pradesh (West)	Reliance Communications	1.25	27-May-2035
Uttar Pradesh (West)	Reliance Communications	2.5	29-Apr-2033
West Bengal	Reliance Communications	1.25	29-Apr-2033
West Bengal	Reliance Communications	1.25	27-May-2035
West Bengal	Reliance Communications	2.5	29-Apr-2033
<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 900 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Himachal Pradesh	Reliance Telecom	5.0	11-12-2035
Madhya Pradesh	Reliance Telecom	5.0	11-12-2035
<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 1800 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Haryana	Reliance Communications	0.60	26-05-2035
Jammu & Kashmir	Reliance Communications	5.00	09-11-2036

Karnataka	Reliance Communications	0.60	26-05-2035
Mumbai	Reliance Communications	0.60	07-09-2034
North East	Reliance Telecom	5.00	11-12-2035
Odisha	Reliance Telecom	5.00	11-12-2035
Punjab	Reliance Communications	0.60	26-05-2035
<b>LSA</b>	<b>TSP/Licensee</b>	<b>Quantum of Spectrum held in 2100 MHz band (in MHz)</b>	<b>Date of Expiry</b>
Assam	Reliance Telecom	5.0	31-08-2030
Bihar	Reliance Telecom	5.0	31-08-2030
Delhi	Reliance Communications	5.0	31-08-2030
Himachal Pradesh	Reliance Telecom	5.0	31-08-2030
Jammu & Kashmir	Reliance Communications	5.0	31-08-2030
Kolkata	Reliance Telecom	5.0	31-08-2030
Madhya Pradesh	Reliance Telecom	5.0	31-08-2030
Mumbai	Reliance Communications	5.0	31-08-2030
North East	Reliance Telecom	5.0	31-08-2030
Odisha	Reliance Telecom	5.0	31-08-2030
Punjab	Reliance Communications	5.0	31-08-2030
Rajasthan	Reliance Communications	5.0	31-08-2030
West Bengal	Reliance Telecom	5.0	31-08-2030

- (b) Through the Reference dated 15.05.2025, DoT provided information on the administratively assigned spectrum to be released due to expiry of service licenses during the year 2026-27. This spectrum includes the spectrum assigned to (or reserved for) Aircel, which will be released due to expiry of service licenses during the year 2026-27. [Remarks: At present, Aircel is engaged in corporate insolvency resolution process.] In respect of the spectrum which will be released due to expiry of service

license during the year 2026-27, DoT, through the Letter dated 14.08.2025, clarified that *"these spectrum blocks, if sold in auction, will be assigned only after expiry of such service licenses."*

- (c) On 13.02.2026<sup>6</sup>, the Hon'ble Supreme Court of India has held that *"Spectrum allocated to TSPs and shown in their books of account as an 'asset' cannot be subjected to proceedings under Insolvency and Bankruptcy Code, 2016."* Specifically, in para 63 of the Judgement dated 13.02.2026, the Hon'ble Supreme Court of India has held as below:

*"63. In conclusion, the framework of IBC is clear in excluding assets over which the corporate debtor has no ownership rights. Mere recognition of spectrum licensing rights as an intangible asset by TSPs in the Financial Statements is not conclusive of their ownership, as it only represents control over future economic benefits. Even assuming that licensing of spectrum rights is one among the bundle of rights, in the absence of transfer of title over the spectrum, no ownership rights are created in TSPs either in the spectrum or in its right to use as governed by licensing conditions. Hence, under the IBC framework, spectrum licensing rights is not a part of the pool of assets for insolvency or liquidation."*

2.50 Considering the above, the Authority is of the view that DoT should immediately initiate action for taking back the spectrum held with the telecom service providers, which are engaged in corporate insolvency resolution process under Insolvency and Bankruptcy Code, 2016, and such spectrum should be put to auction in the forthcoming spectrum auction.

2.51 In view of the above, **the Authority recommends that –**

**(a) Entire available spectrum in the existing frequency bands**

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<sup>6</sup> [https://api.sci.gov.in/supremecourt/2021/11612/11612\\_2021\\_6\\_1501\\_68374\\_Judgement\\_13-Feb-2026.pdf](https://api.sci.gov.in/supremecourt/2021/11612/11612_2021_6_1501_68374_Judgement_13-Feb-2026.pdf)

**viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands should be put to auction in the forthcoming auction.**

- (b) DoT should immediately initiate action for taking back the spectrum held with the telecom service providers, which are engaged in corporate insolvency resolution process under Insolvency and Bankruptcy Code, 2016, and such spectrum should be put to auction in the forthcoming spectrum auction.**

### **Possibility of enhancing competition**

2.52 Currently, only access service providers are permitted to participate in the auctions for frequency bands identified for IMT. To enhance competition, one approach could be to allow other categories of service providers, that may require IMT spectrum, to participate in auctions for IMT spectrum. Another option is to create a more enabling regulatory framework to lower entry barriers, encouraging new entities to acquire access service licenses and bid for IMT spectrum. TRAI has previously provided recommendations on both aspects. The National Digital Communication Policy (NDCP) 2018 includes a strategy under the Propel India Mission to reform licensing and regulatory regimes by enabling unbundling of layers, such as infrastructure, network, services, and applications through differential licensing. In line with this, TRAI issued recommendations on 'Enabling Unbundling of Different Layers Through Differential Licensing' on 19.08.2021. 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)*

2.53 Through the recommendations dated 19.08.2021 on 'Enabling Unbundling of Different Layers Through Differential Licensing', TRAI proposed a separate license authorisation for Access Network Providers

(ANPs), enabling them to establish access networks, acquire spectrum through auctions, and provide wholesale network infrastructure to VNOs. However, the Government has not implemented these recommendations. The Authority is of the considered view that introducing ANP authorisation could strengthen competition in spectrum auctions, and effectively, consumers will also get more choices. Therefore, the Authority is of the view that the Government should reconsider TRAI's recommendations dated 19.08.2021.

2.54 Furthermore, 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 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.

2.55 Deploying a mobile access network requires huge investments apart from permissions from local bodies. The Authority is of the view that introducing DCIP and CTN Provider authorisations would allow access

service providers to procure access and core networks from specialised entities instead of making heavy investments in building them. This would lower entry barriers by lowering network deployment cost, and attract new players into the mobile market, increasing competition in access services segment, and consequently enhancing competition in future IMT spectrum auctions. DoT, in its back-reference dated 03.07.2025 on the TRAI's Recommendations on the Terms and Conditions of Network Authorisations to be Granted Under the Telecommunications Act, 2023 dated 17.02.2025 has expressed that DoT is of the view that these recommendations may be accepted. Subsequently, on 09.10.2025, DoT has issued draft "Telecommunications (Authorisation for Telecommunication Network) Rules, 2025" for public consultation. In these rules, DoT has proposed to introduce DCIP authorisation and CTN Provider Authorisation. The Authority is of view that these authorisations should be introduced expeditiously to reap the benefits arising out of such authorisations.

2.56 In view of the above, **the Authority recommends that -**

**(a) TRAI's earlier recommendations w.r.t. creation of a separate authorization under Unified License for Access Network Provider (network layer) to provide network services on a wholesale basis, recommended through the Recommendations dated 19.08.2021 on "Enabling Unbundling of Different Layers Through Differential Licensing", should be reconsidered for strengthening competition.**

**(b) Digital Connectivity Infrastructure Provider (DCIP) authorisation and Cloud-hosted Telecom Network (CTN) Provider authorisations, proposed by DoT in the draft "Telecommunications (Authorisation for Telecommunication Network) Rules, 2025" dated**

**09.10.2025 should be expeditiously introduced under the Telecommunications Act, 2023.**

**(3) Band Plans for the Existing Bands**

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

**Table 2.11: Band Plans for the Existing Bands**

<b>Band</b>	<b>3GPP Band Plan Number</b>	<b>Duplexing Scheme</b>	<b>Uplink (MHz)</b>	<b>Downlink (MHz)</b>
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	

2.58 As the band plans adopted for India have been chosen after due deliberations and are functioning well, the Authority proposed to continue to use the respective band plans adopted for the existing bands. In this

context, the Authority solicited comments from stakeholders on the following question:

*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.*

### **Comments of stakeholders on Q3**

2.59 The stakeholders are of the view that 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. The stakeholders further submitted that the auctioned spectrum bands are already in use for existing commercial services; any changes to the band plan in these bands would seriously jeopardize the existing services to the consumers, as well as the cost of operations.

### **Analysis of the issues raised through Q3**

2.60 It is noted that the band plans to be adopted for various frequency bands have been chosen at different times as and when the frequency bands were opened up for the first time in India for IMT. The band plans adopted for India have been chosen after due deliberations and are functioning well. Therefore, the Authority had proposed to continue with the already adopted band plans.

2.61 The Authority also noted that some of the stakeholders have submitted that any changes to the band plan(s) in the frequency bands already in

use for commercial services would seriously jeopardize the existing services to the consumers, as well as the cost of operations. The Authority concurs with the views of the stakeholders.

- 2.62 In view of the above, **the Authority recommends that the band plans already adopted for the existing frequency bands, viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in India, should be continued in the forthcoming auction.**

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

- 2.63 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.
- 2.64 DoT, through its earlier reference dated 13.09.2021, had 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.*"
- 2.65 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."*

- 2.66 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]*

- 2.67 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.
- 2.68 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.

- 2.69 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.
- 2.70 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.
- 2.71 In this context, the Authority solicited comments from stakeholders on the following question:

*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.*

#### **Comments of stakeholders on Q4**

- 2.72 A broad summary of the comments of stakeholders in response to Q4, with respect to 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 and if no, what should be the area, and validity period of spectrum assignment in the

existing bands, is given below:

(i) Service area

- (a) Majority of the stakeholders opined that spectrum should continue to be auctioned only on a Telecom Circle/Metro basis. The present access licensing and spectrum assignment framework is LSA-based; hence, the network designing, planning, and deployments are at the LSA level only. Any departure from LSA based framework is expected to bring inefficiencies as well as a non-level playing field.
- (b) One of the stakeholders further submitted that for smaller players such as ISPs and M2M providers, the spectrum LSA should be at the district/ town level.

(ii) Validity period

- (a) Some of the stakeholders submitted that the spectrum should be auctioned for a period of 20 years, with a provision to extend it for a further period of 10-20 years without any auction. One of such stakeholders submitted that the spectrum charges for the extended period should be based on inflation-linked indexation. Another stakeholder submitted that the extension of spectrum should be based on the original acquisition price or the last auction price, whichever is lower, without any indexation.
- (b) A Few stakeholders suggested to auction these bands with a 20-year validity period as a baseline, while also providing MNOs the option to choose a longer validity period of 40 years. In short, the maximum validity period should be 40 years, and successful bidders can be provided with two options.
  - a. The successful bidder may opt for a 20-year tenure, with a right to extend the spectrum tenure for 40 years by opting to pay the same annual payment for the next 20 years.
  - b. The successful bidder may opt for a 40-year tenure with 1.2

times the valuation for 20 years (taking into account the time value of money at 8%) to protect the annualized payment of spectrum for the extended period.

#### **Analysis of the issues raised through Q4**

- 2.73 With regard to the service area for the auction of spectrum, most of the stakeholders have opined that frequency spectrum should be auctioned on Telecom Circle/ Metro Area basis. One of stakeholders has suggested that for smaller players such as ISPs and M2M providers, the spectrum LSA should be at the district/ town level.
- 2.74 It may be worth mentioning here that in 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, the Authority had noted that in some countries such as USA, UK, and Canada have considered a smaller licensed service area for mmWave bands. However, after detailed examination, the Authority, observed that *“LSA-based spectrum assignments may nudge the service providers to utilize the spectrum in the maximum part of the LSA, including in remote and rural areas. It may also help in the development of new use cases.”*, and recommended that *“the frequency spectrum in the band n260 (37-40 GHz) should be auctioned on LSA (Telecom Circle/ Metro) basis”*.
- 2.75 Considering that the assignment of spectrum on LSA-basis has worked well in the past, the Authority is of the view that it would be appropriate to continue with LSA-based spectrum assignment in the forthcoming auction as well.
- 2.76 Regarding the validity period for the auction of spectrum, a few stakeholders have opined that spectrum should be auctioned for a period

of 20 years, with a provision to extend it for a further period of 10-20 years without any auction. A few stakeholders have also suggested to auction spectrum in the frequency bands with a 20-year validity period as a baseline, while also providing MNOs the option to choose a longer validity period of 40 years.

2.77 As regards the suggestion to auction spectrum with a longer validity period or providing an option for further extension of the validity period without auction, it is noted that the lifespan of mobile technologies is getting shorter. Thus, making projections for a longer validity period may be challenging. Further, with an even longer validity period, entry of any new player may become more difficult as the spectrum in prime bands will be occupied by the existing players.

2.78 A few stakeholders have contended 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. This aspect was examined by 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. In the recommendations dated 04.02.2025, that the Authority noted that "*spectrum validity should provide adequate time for ecosystem penetration, network planning and deployments, and substantial period for providing commercial services; telecom is capital intensive sector and shorter validity periods may not provide sufficient time to recoup investments; and longer validity periods enable technological development.*"

2.79 *Considering the above*, the Authority is of the view that a validity period of 20 years is long enough to provide adequate time for ecosystem penetration, network planning and deployments, and sufficient time to recoup investments. Accordingly, the Authority is of the view that the

validity period of the assignment of spectrum should be kept as 20 years in the forthcoming auction.

2.80 In view of the above, **the Authority recommends that the access spectrum in the existing frequency 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.**

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

2.81 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.

2.82 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 2.12: 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 <sup>7</sup>
800 MHz	1.25	1.25	5, 3.75 (where only 3.75

<sup>7</sup> Existing UASL/UL with Access Services authorization licensees are treated as 'New Entrant' in

Spectrum band	Block Size (MHz)	Minimum bid quantity (MHz)	
		For existing licensees	For new entrants <sup>7</sup>
	(Paired)		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
2500 MHz	10 (unpaired)	10	10
3300 MHz	10 (unpaired)	10	10
26 GHz	50 (unpaired)	50	50

2.83 The block sizes and minimum bid quantities mentioned above for various bands have been chosen to provide sufficient flexibility to bidders. The minimum spectrum that a new entrant can bid ensures meaningful business operations and is in line with past policy. In this context, the

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those LSA(s) for the frequency bands in which they do not presently hold spectrum.

Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of stakeholders on Q5**

2.84 A broad summary of the comments of stakeholders in response to Q5, with respect to 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 is given below:

(a) Most stakeholders submitted that the block size and minimum quantity for bidding should be kept the same in the forthcoming auction as those in the June 2024 auction.

(b) A stakeholder has opined that for the frequency bands that went entirely unsold (800 MHz, 2300 MHz, 3300 MHz, and 26 GHz) in the previous spectrum auction, the minimum bid quantity should be reduced with a view to lowering the entry barriers. The stakeholder has suggested that the block size for the 2300 MHz band should be reduced from 10 MHz to 5 MHz. However, another stakeholder has opposed the proposal to reduce the block size for 2300 MHz band, citing the following reasons:

(i) 10 MHz is the internationally adopted block size for TDD broadband deployments (3GPP Band 40), supporting efficient carrier aggregation and high-capacity LTE/ 5G services.

- (ii) Allocating 10 MHz blocks minimizes fragmentation and enables operators to acquire meaningful, contiguous bandwidth - critical for supporting high-throughput scenarios and maximizing spectral efficiency.
- (iii) The block size is large enough to deter trivial bids and speculative fragmentation yet small enough to allow operators of varying scales to participate, maintaining auction competitiveness and flexibility.

### **Analysis of the issues raised through Q5**

2.85 Most of the stakeholders are of the view that the block size and minimum quantity for bidding should be kept the same in the forthcoming auction as those in the June 2024 auction. On the other hand, one stakeholder has suggested reducing the block size for the bands that went entirely unsold. The stakeholder has suggested to reduce the block size from 10 MHz to 5 MHz for 2300 MHz band. However, another stakeholder opposed the suggestion to reduce the block sizes any further as it would lead to fragmentation of spectrum.

2.86 At present the block size for 2300 MHz and 2500 MHz bands is 10 MHz (unpaired). Worldwide, the eco-system for 10 MHz channel size is well-developed. The Authority is of the view that 5 MHz (unpaired) spectrum may not be sufficient to provide meaningful mobile broadband services through 4G/ 5G technologies. Considering that the present block size of 10 MHz has been working well, the Authority is of the view that block size for 2300 MHz and 2500 MHz bands should be retained as 10 MHz (unpaired).

2.87 For mmWave bands (including 26 GHz and 37-40 GHz bands), it is noted that while the 3GPP specifications support a 50 MHz single carrier in

mmWave bands, at present the technology is not optimised for this bandwidth<sup>8</sup> in mmWave bands; globally deployments and ecosystem in mmWave bands are based on minimum channel size of 100 MHz. Accordingly, the Authority is of the view that while the block size for the 26 GHz band should be continued as 50 MHz in the forthcoming auction, the minimum bid quantity for new entrants should be kept as 100 MHz considering the aspect that globally deployments and ecosystem in mmWave bands are based on minimum channel size of 100 MHz. For the existing licensees, minimum bid quantity of the 26 GHz band may be retained as 50 MHz.

2.88 For the remaining frequency bands (800 MHz, 900 MHz, 1800 MHz, 2100 MHz, and 3300 MHz bands), the Authority concurs with the view of the stakeholders that the existing block sizes may be continued. However, the Authority is of the view that, in line with the minimum bid quantities for new entrants in the 900 MHz and 1800 MHz bands, the minimum bid quantity (minimum amount of spectrum that a bidder is required to bid) for the new entrant in the 800 MHz band may be kept as 5 MHz and 1.25 MHz (where less than 5 MHz is available).

2.89 In view of the above, **the Authority recommends that for existing bands the block size and minimum amount of spectrum that a bidder is required to bid for should be prescribed as given below:**

Spectrum Band	Block Size (MHz)	Minimum amount of spectrum that a bidder is required to bid for	
		Existing licensees (MHz)	New Entrants (MHz)
800 MHz	1.25 (Paired)	1.25	5, 1.25 (where less

<sup>8</sup> [https://www.accc.gov.au/system/files/Optus\\_31.pdf](https://www.accc.gov.au/system/files/Optus_31.pdf)

			<b>than 5 MHz is available)</b>
<b>900 MHz</b>	<b>0.20 (paired)</b>	<b>0.2</b>	<b>5, 0.2 (where less than 5 MHz is available)</b>
<b>1800 MHz</b>	<b>0.20 (paired)</b>	<b>0.2</b>	<b>5, 0.2 (where less than 5 MHz is available)</b>
<b>2100 MHz</b>	<b>5 (paired)</b>	<b>5</b>	<b>5</b>
<b>2300 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>2500 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>3300 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>26 GHz</b>	<b>50 (unpaired)</b>	<b>50</b>	<b>100</b>

**Note: Any existing Access Service authorisation holder should be treated as 'New Entrant' in the LSA(s) for the frequency bands in which it does not presently hold spectrum.**

## **(6) Eligibility Conditions for Participation in Auction**

2.90 As per the NIA 2024<sup>9</sup> 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*

<sup>9</sup> <https://www.dot.gov.in/ministry/our-division/details/wpc-and-spectrum-management-QTMzMTMtQWa>

*(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. ...”*

2.91 Main conditions under Associated Eligibility Conditions as per the NIA 2024<sup>10</sup> for the spectrum auction held in June 2024 were as below:

*(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.*

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<sup>10</sup> <https://www.dot.gov.in/ministry/our-division/details/wpc-and-spectrum-management-QTMzMTMtQWa>

*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.*

*(iii) Companies whose licenses & Spectrum is expiring in the calendar year 2024 and does not hold spectrum bought through previous auctions in that LSA and band will also be treated as "New Entrants" for this auction.*

*...*

*(vii) 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 & 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 700/ 800/ 900/ 1800/ 2100/ 2300/ 2500/ 3300 MHz & 26 GHz bands).*

*(viii) The requirement of net worth (100 crores/ 50 crores) is to be shown per LSA (and not band) for such LSAs in such bands, where that bidder is a new entrant. Therefore, a bidder, who is a new entrant in all of the bands (800, 1800/900, 2100, 2300, 2500, 3300 MHz, & 26 GHz) in a LSA will need to show a net worth of 100 crores (or 50 crores in case of NE, J&K) for bidding in all/any of the bands.*

2.92 In this context, the Authority solicited comments from stakeholders on the following question:

*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.*

### **Comments of stakeholders on Q6**

2.93 A broad summary of the comments of stakeholders in response to Q6, with respect to 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, is given below:

- (a) Many stakeholders submitted that the eligibility criteria and associated conditions should remain the same as those applied in the 2024 spectrum auction and should also incorporate the new authorisation framework for access services under the Telecommunication Act, 2023.
- (b) One of the stakeholders suggested that for the 26 GHz (mm-Wave) band, eligibility should be expanded to include ISPs and M2M service providers. Net Worth condition and eligibility to non-Access Service Providers like ISPs, must be re-defined.
- (c) One stakeholder suggested that the weaker and smaller players (ISPs, M2M SPs etc ) are unlikely to be able to compete with the stronger and larger TSPs. Special provision (change in eligibility conditions viz. networth criteria, reduced rollout obligations, applicable to a town/district service area, etc. to cater to these new and smaller entrants)

is required to deal with this anti-competitive aspect. A block of spectrum may be carved out for such players.

- (d) Another stakeholder submitted to allow ISPs and other licensed entities to be eligible for participation in the IMT spectrum auction with liberal usages terms and prices for B2B services.
- (e) According to a stakeholder, the eligibility criteria defined in the NIA 2024 already provide sufficient flexibility to all service providers. Allowing entities with lower entry-fee authorisations to participate in spectrum auctions will not enhance competition or sectoral growth. Currently, there are no entry barriers for availing access service authorization under the Telecommunications Act 2023, and applicants desirous of obtaining spectrum in the Auction should not be wary of taking a suitable authorization.

### **Analysis of the issues raised through Q6**

- 2.94 At present, the entities authorised to provide access service [i.e. the licensees holding Unified Access Service License or Unified Service (Access Service Authorisation)] are eligible to participate in the auction for IMT spectrum. In addition, any entity that fulfils the eligibility criteria for obtaining service authorisation for access services, can participate in the auction for IMT spectrum with a condition that it has to acquire authorisation to provide access service within a prescribed time period.
- 2.95 The Authority examined the comments received from stakeholders on *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*. Many stakeholders have expressed a view that the existing eligibility criteria should be continued. On the other hand, a few other stakeholders have submitted that even ISPs and M2M providers require

spectrum in the frequency bands identified for IMT for providing the services authorised to them; however, such smaller players viz. ISPs and M2M providers, would not be able to compete with Access service providers; the participation of ISPs and M2M providers can be encouraged through relaxed eligibility criteria, reduced rollout obligations, and a dedicated category with reserved spectrum blocks to ensure equitable access. A few stakeholders have also requested to set aside some spectrum for CNPNs. Such stakeholders have expressed a view that CNPNs would not be able to proliferate in the country if spectrum is not made available to CNPNs directly.

2.96 In this regard, the Authority has taken note of the following aspects:

- (i) While ISPs and M2M providers generally deploy their network based on wireline infrastructure (predominantly based on OFC) and delicensed spectrum, they often require licensed spectrum for providing carrier-grade services to their customers. However, their network deployments are generally localized and seldom require street level coverage like cellular mobile telephone services.
- (ii) Recognizing that (a) the economic growth likely to be achieved by the implementation of Industry 4.0 has the potential to substantially catalyze the overall growth of the country, and (b) spectrum is the foremost requirement for deploying 5G based captive wireless private networks, TRAI through its recommendations dated 11.04.2022 on "Auction of spectrum in frequency bands identified for IMT/5G", recommended, *inter-alia*, that "[c]ertain spectrum be earmarked for Captive Wireless Private Network to be assigned directly by DoT to captive wireless private network permission holders/ licensees."<sup>11</sup>

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<sup>11</sup> It is noteworthy that in addition to the option for direct spectrum assignment for CNPNs, TRAI had through its recommendations dated 11.04.2022 on "Auction of spectrum in frequency bands identified for IMT/5G", had also recommended that to open up other means such as leasing of spectrum, network slicing, and TSPs deploying isolated captive networks for enterprises. While DoT has permitted such means, CNPN has not picked up in India.

While making these recommendations, TRAI had taken note of the international practices on the matter and had observed that many countries have already earmarked certain quantum of spectrum in one or a few of the 2300 MHz / 2500 MHz/ 3300 MHz/ 26 GHz/ 28 GHz bands for captive private networks. Through the recommendations dated 11.04.2022, TRAI also recommended that DoT should carry out demand assessment of spectrum for captive private networks. TRAI further stated that the demand assessment would provide the demand factor for direct spectrum assignment from DoT for establishment of private captive network; with such empirical assessment and DoT's decision on the spectrum bands in which spectrum could be earmarked for private networks, TRAI would provide its recommendations on quantum of spectrum, block size, etc. In this regard, it is noteworthy that neither the outcome of the demand assessment nor the DoT's decision on the spectrum bands in which spectrum can be earmarked for private network has been shared with TRAI so far.

- (iii) The Authority, in its recommendation dated 17.02.2025 on "terms and conditions of network authorisations to be granted under the Telecommunications Act 2023" recommended, *inter-alia*, as below:
- "There is a need for introducing Captive Non-Public Network (CNPN) Provider Authorisation under Section 3(1)(b) of the Telecommunications Act, 2023 with the scope of establishing, maintaining, operating, and expanding CNPN networks for enterprises. In case the Central Government accepts this recommendation, it may seek the recommendations of TRAI on detailed terms and conditions for such an authorisation."* DoT through its back-reference dated 03.07.2025 on the aforementioned recommendations expressed that the above recommendation may be accepted "*subject to identification of appropriate spectrum for CNPN. Further, this authorisation may be*

*granted under Section 3(1)(a) to the eligible entities to provide CNPN as a service to users. The Government also proposes for change in the name of this authorisation to clearly differentiate this authorisation from CNPN Service authorisation recommended under Section 3(1)(a).” In this regard, TRAI through its response to the back-reference dated 03.07.2025, stated, *inter-alia*, that “the Authority takes note of the DoT’s view that a new authorisation for providing CNPN as a service to users may be granted under Section 3(1)(a) of the Telecommunications Act, 2023 subject to the identification of appropriate spectrum for CNPN. The Authority has examined the views of DoT on this aspect and has made the following observations:*

- (a) *CNPN services have not picked up in India even after three years when the licensing framework for captive non-public network (CNPN) was introduced in the country. In this context, DoT’s proposal for the introduction of a new authorisation for providing CNPN as a service to users under Section 3(1)(a) appears to be a welcome step. Essentially, DoT has proposed for introducing a new service authorisation for providing private wireless network-as-a-service to enterprises. It is expected that a well-designed regulatory framework for this purpose would encourage the adoption of Industry 4.0 in a wide range of industries such as automotives, textiles, pharmaceuticals, steel, heavy industries, and micro, small, and medium enterprises (MSMEs).*
- (b) *The successful adoption of the proposed private wireless network-as-a-service to enterprises would hinge on the identification of appropriate spectrum for this service segment. While identifying the frequency range for the said service, the aspects related to the eco-system (viz. availability, maturity, and potential for development of the eco-system in the chosen frequency range) for network and devices would require to be carefully evaluated.*

(c) *At the stage of both the identification of frequency spectrum, and thereafter the assignment of spectrum to the entities holding the authorisation for providing private wireless network-as-a-service to enterprises, the plurality of service providers would require to be ascertained. In other words, total quantum of frequency spectrum, block size, and the method of assignment would require to be chosen in a manner to ensure a sufficient competition in the service segment.”*

2.97 Considering the above, the Authority is of the opinion that there is an unambiguous requirement of licensed spectrum for ISPs, M2M providers and CNPNs. Besides, there is a need for differentiated treatment in terms of assignment of spectrum to such entities as compared to access service providers. Accordingly, the Authority is of the considered view that it would be proper to set aside certain quantum of spectrum in IMT bands for ISPs, M2M providers and CNPNs. Considering the data-focused usage of spectrum by ISPs, M2M providers and CNPNs, the Authority is of the view that it would be appropriate to earmark IMT spectrum in only TDD-based frequency bands, both in Frequency range 1 (FR1) and Frequency range 2 (FR2) categories<sup>12</sup>. In other words, amongst the frequency bands identified for IMT under consideration, only the spectrum in 2300 MHz/ 2500 MHz/ 3300 MHz/ 26 GHz/ 37-40 GHz bands should be considered for this purpose. After identification of suitable IMT frequency band(s) to be set aside for ISPs, M2M providers and CNPNs, DoT should send a reference for seeking recommendations on the terms and conditions including reserve price for such spectrum to be separately assigned to ISPs, M2M providers and CNPNs.

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<sup>12</sup> For 5G New Radio (5G NR), frequency bands have been separated into two different frequency ranges viz. Frequency Range 1 (FR1), and Frequency Range 2 (FR2). FR1 covers several frequency bands in the 410 MHz to 7125 MHz range. FR2 covers several frequency bands in the 24.25 GHz to 71 GHz range.

[5G NR is the air interface or radio access technology of the 5G mobile networks.]

2.98 As far as the eligibility criteria for the forthcoming auction is concerned, the Authority is of the view that the eligibility criteria for participation in the forthcoming spectrum auction should be kept the same as that prescribed in NIA 2024 i.e. the entities authorised to provide access service should be eligible to participate in access spectrum auction. In addition, any entity that fulfils the eligibility criteria for obtaining service authorisation for access services, can participate in the auction for IMT spectrum with a condition that it has to acquire authorisation to provide access service within a prescribed time period. This eligibility criteria should apply to all IMT frequency bands including 37-40 GHz band. It is worth mentioning that 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). As the Authority, through the present recommendations, is recommending to set aside certain quantum of spectrum in TDD bands such as 2300 MHz/ 2500 MHz/ 3300 MHz/ 26 GHz/ 37-40 GHz bands (identified for IMT) for ISPs, M2M providers and CNPNs, it would be proper that the eligibility criteria for the participation in the forthcoming auction of spectrum in all IMT frequency bands including 37-40 GHz band should remain unchanged.

2.99 In view of the above, **the Authority recommends that-**

**(a) The eligibility conditions for participation in the forthcoming spectrum auction as prescribed in Notice Inviting Application (NIA) 2024, should be continued for all IMT frequency bands put to auction (including 37-40 GHz**

**band) i.e. authorisation to provide access service.**

- (b) Certain quantum of spectrum in Time Division Duplexing (TDD)-based frequency bands (identified for IMT such as 2300 MHz/ 2500 MHz/ 3300 MHz/ 26 GHz/ 37-40 GHz bands should be set aside for Internet Service Providers (ISPs), Machine-to-Machine (M2M) providers and Captive Non-Public Networks (CNPNS).**
- (c) After identification of suitable IMT frequency band(s) to be set aside for ISPs, M2M providers and CNPNS, DoT should send a reference to TRAI for seeking recommendations on the terms and conditions including reserve price for assignment of such spectrum.**

2.100 The Authority proceeds to examine any need for the review of net-worth requirement for bidders. As per NIA 2024 for the spectrum auction held in June 2024, the net worth requirement for the bidder was as below:

*"(vii) 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 & 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 700/ 800/ 900/ 1800/ 2100/ 2300/ 2500/ 3300 MHz & 26 GHz bands).*

*(viii) The requirement of net worth (100 crores/ 50 crores) is to be shown per LSA (and not band) for such LSAs in such bands, where that bidder is a new entrant. Therefore, a bidder, who is a new entrant in all of the bands (800, 1800/900, 2100, 2300, 2500, 3300 MHz, & 26 GHz) in a LSA*

*will need to show a net worth of 100 crores (or 50 crores in case of NE, J&K) for bidding in all/any of the bands.*

2.101 While evaluating the need for review of the net-worth of bidders, the Authority has taken note of the following developments:

(a) After considering TRAI's recommendations dated 17.02.2025, DoT has notified draft "Telecommunications (Authorisation for Telecommunication Network) Rules, 2025" for public consultation. In these rules, DoT has proposed to introduce DCIP authorisation and CTN Provider Authorisation. Through these draft rules, DoT has proposed to 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.

2.102 Furthermore, DoT has also proposed that the TSPs should be allowed to share all types of infrastructure (passive as well active) among themselves.

- 2.103 It is noted that the net-worth requirement is primarily to ascertain the financial capability of an entity to deploy network infrastructure. Considering that DoT has proposed to introduce enabling infrastructure sharing provisions in the authorisation framework, including DCIP and CTN provider authorisations under Section 3(1)(b) of the Telecommunications Act, 2023, the Authority is of the view that such provisions would allow access service providers to procure access and core networks from specialized entities instead of making heavy investments in building them; further they would also be able to share network infrastructure among themselves.
- 2.104 Considering the above aspects, the Authority is of the view that the net-worth requirement for the new entrants should be reduced from the existing Rs. 100 crore per Licensed Service Area (Rs. 50 crore each for Jammu & Kashmir and North East Service Areas) should be reduced to Rs. 50 crore per Licensed Service Area (Rs. 25 crore each for Jammu & Kashmir and North East Service Areas). As before, there should be no net-worth requirement for the existing licensees.
- 2.105 In view of the above, **the Authority recommends that for the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands, the net-worth requirement of Rs. 50 crore per Licensed Service Area (Rs. 25 crore each for Jammu & Kashmir and North East Licensed Service Areas) should be made applicable for new entrants in the forthcoming auction of IMT spectrum. Further, the same net-worth requirement should also be made applicable for the auction of spectrum in 37-40 GHz band.**

## **(7) Roll-out obligations for the existing bands**

2.106 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.

2.107 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 1<sup>st</sup> year and 90% coverage by the end of 2<sup>nd</sup> 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*

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

Non-Metro LSAs

<i>Time Period</i>	<i>Roll Out Obligations</i>
<i>By the end of 1<sup>st</sup> year</i>	<i>Commercial launch of services in at least 1 city in the LSA</i>
<i>By the end of 3<sup>rd</sup> Year</i>	<i>Cumulative number of sites to be deployed: Category A LSAs: 7000 Category B LSAs: 4600 Category C LSAs: 2600</i>
<i>By the end of 5<sup>th</sup> Year</i>	<i>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</i>

- (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

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

Non-Metro LSAs

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

- (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.*

2.108 After considering the TRAI's recommendations dated 11.04.2022, DoT, through NIA-2022 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**

<b>Roll out Phase</b>	<b>Roll Out Requirement</b>	<b>Time Period</b>
<b>Metro LSAs</b>		
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
<b>Non-Metro LSAs</b>		
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

<b>Roll out Phase</b>	<b>Roll Out Requirement</b>	<b>Time Period</b>
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:

<b>Roll out Phase</b>	<b>Roll Out Requirement</b>	<b>Time Period</b>
<b>Metro LSAs</b>	Coverage of 90% of the LSA	by the end of five years
<b>Non-Metro LSAs</b>		
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**

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

**Roll out obligations for the 3300 MHz band**

<b>Roll out Phase</b>	<b>Roll Out Requirement</b>			<b>Time Period</b>
<b>Metro LSAs</b>				
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: 280			By the end of 3rd Year
Phase-3	Cumulative number of sites to be deployed in each LSA: 920			By the end of 5th Year
<b>Non-Metro LSAs</b>				
Phase-1	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			By the end of 1st year
Phase-2	LSA Category	Cumulative number of sites to be	Minimum number of towns to be covered	By the end of 3rd Year

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

**Roll-out obligations for the 26 GHz band**

<b>Roll out Phase</b>	<b>Roll Out Requirement</b>	<b>Time Period</b>
<b>Metro LSAs</b>		
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

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

2.109 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.

2.110 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...”*

2.111 With respect to roll out obligations in the forthcoming auction for spectrum in IMT bands, the Authority solicited comments from stakeholders on the following question:

*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.*

### **Comments of stakeholders on Q7**

2.112 A broad summary of the comments of stakeholders in response to Q7 is given below:

(a) Most of the stakeholders suggested no change in the current roll-out obligations for spectrum. One of these stakeholders further submitted that rollout obligations for incumbents should be relaxed, allowing greater operational flexibility to address coverage and capacity gaps dynamically. New rollout obligations should be applied strictly to genuine long-term new entrants to incentivize network expansion and improve service availability. Another stakeholder suggested that the rollout obligation principles should be applied consistently across

spectrum bands, for instance, fulfilling rollout obligations for the n78 (3300 MHz) band should also allow re-certification of obligations for the n258 (26 GHz) band, for both new and existing allocations.

(b) One of the stakeholders submitted that the current system for sub-6 GHz bands have become outdated, as most operators have already fulfilled their initial coverage-based obligations. It suggested that all service providers should be mandated to deploy a minimum percentage of newly installed sites (for the 3300 MHz and 26 GHz bands), or an equivalent measure for the 800–2500 MHz bands, in rural SDCAs that currently lack 4G/5G services.

### **Analysis of the issues raised through Q7**

2.113 As mentioned earlier, Rollout 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.

2.114 NIA 2024 for Auction of Spectrum mentions the Objectives of Spectrum as auction, as reproduced below:

#### ***"1.2 Objectives of the Auction***

*The Government has set itself 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.”*

2.115 As can be seen from the above, one of the objectives of the spectrum auction is to ensure efficient use of spectrum and avoid hoarding. Rollout obligations is a key mechanism to meet this objective.

2.116 The stakeholders are generally of the view that there is no need to change the rollout obligations. One of the stakeholders has submitted that fulfilling rollout obligations for the n78 (3300 MHz) band should also allow re-certification of obligations for the n258 (26 GHz) band, for both new and existing allocations. In this regard, it may be worth mentioning that similar suggestion received from some stakeholders was examined by 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. The relevant para is reproduced below:

*"2.82 It is noted that many stakeholders suggested that there should be no separate roll-out obligations for such licensees who have already fulfilled roll-out obligations in the 26 GHz band and the present approach of prescribing no rollout obligations if an existing licensee has already met these obligations once using any technology in any band, should be continued. In this regard, it is noted that the NIA for auction of spectrum includes a clause that ‘the requirement of rollout obligation shall be treated as fulfilled once the required numbers of DHQs/ BHQs/ Rural SDCAs are covered by the licensees using any technology in any band’. It is also noted that similar clause was not made applicable for 3.5 GHz band and 26 GHz band, wherein the roll out obligations were not coverage-based but network deployment-based. Similarly, as mentioned above, for the spectrum band n260, the minimum roll-out obligations should be network deployment-based; therefore, there appears to be no merit in the stakeholder’s suggestion that there should be no separate roll-out*

*obligations for such licensees who have already fulfilled roll-out obligations in the 26 GHz band. Thus, the minimum roll-out obligations should be equally applicable for all the TSPs i.e., existing as well as the new TSPs.”*

2.117 One of the stakeholders has suggested that all service providers should be mandated to deploy a minimum percentage of newly installed sites (for the 3300 MHz and 26 GHz bands), or an equivalent measure for the 800-2500 MHz bands, in rural SDCAs that currently lack 4G/5G services. The suggestion was examined by the Authority, and it has been observed that in an auction, TSPs in different deployment cycles and based on their existing spectrum holding, participate with different objectives. While one TSP may participate to acquire a large chunk of spectrum to enhance its capacity, another TSP may want to augment a small quantum of spectrum to make its spectrum holding in that frequency band to an optimal block size. Imposing similar additional obligations on both the TSPs in this case may not be appropriate. Further, there will be cases of reacquiring of spectrum on its expiry. The Authority is cognizant of the fact that stringent rollout obligations have the potential to become an entry barrier for a new player.

2.118 Considering the foregoing discussion, the Authority is of the view that the rollout obligations for the existing frequency bands should be the same as those prescribed in the auction of IMT spectrum in 2024.

2.119 In view of the above, **the Authority recommends that the rollout obligations for the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be the same as those prescribed for respective frequency bands in the Notice Inviting Applications (NIA) 2024.**

2.120 Having said that, as mentioned in the consultation paper, the Authority has received complaints from consumers about no mobile coverage on (a) certain patches of highways and train routes, (b) certain pockets of urban areas including 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.

2.121 For instance, National Highway of India (NHAI), through its letter dated 24.12.2025, conveyed to TRAI that it has undertaken an exercise to identify and compile details of highway stretches affected by telecom blackout; as per the inputs received from field units, telecom blackout has been reported at 424 locations across the National Highway network, covering a total length of approximately 1,750 Kms; non-availability of mobile network connectivity (telecom blackout) on several stretches of National Highways, particularly on greenfield and remote sections, is adversely impacting highway operations and coordination with field units and enforcement agencies; such connectivity gaps are also affecting emergency response services, including ambulances and patrol vehicles, thereby posing risks to road user safety and timely assistance, and causing avoidable public inconvenience.

2.122 The Authority is of the view that the issue of insufficient mobile coverage on certain patches of highways and train routes, certain pockets of urban areas including residential and commercial areas, and certain segments of rural and remote areas has been festering for long. In the public interest, in general, and consumer interest, in particular, this issue requires to be resolved on priority. However, it would be important that the corrective step does not cause any undue burden on TSPs and also does not create any entry barrier for the new entrants. In this regard, the Authority is of the considered view that there is a need to create a scheme

under which TSPs are incentivized to expand their mobile network coverage in the patches of highways and train routes, pockets of urban areas including residential and commercial areas, and segments of remote areas suffering from no mobile coverage. The scheme should also include the tourist places which are so far unconnected and are not covered under the schemes of Universal Service Obligation Fund (USOF) [renamed as Digital Bharat Nidhi (DBN)].

2.123 Under the scheme, after the conclusion of the auction for IMT spectrum, a TSP may be permitted to opt for reduction in spectrum cost (0 to 10% reduction w.r.t. Auction Determined Price) for each frequency band/ LSA combination. In lieu of the reduction in the spectrum cost, the TSP should deploy new unique base stations to provide mobile broadband services (4G/ 5G) using the spectrum in any of its frequency bands (existing/ newly acquired) at the locations identified by DoT (coverage holes) within a specific period. In case a service area is found to have fewer coverage holes, the TSPs may be asked to deploy unique base station sites in another service area. For illustration, the following table illustrates a case in which a TSP has opted for reduction in spectrum cost for the 2100 MHz band in LSA#1:

<b>S. No.</b>	<b>Item</b>	<b>Legend</b>	<b>Value</b>	<b>Remarks</b>
1	Auction Determined Price (ADP) per MHz for 20 years for the spectrum in the 2100 MHz band in LSA#1	A	Rs. 100 crore	Assumption: In the forthcoming auction, the auction determined price per MHz for 20 years for the spectrum in the 2100 MHz band in LSA#1 is Rs. 100

				crore.
2	ADP for 10 MHz of spectrum in the 2100 MHz band for 20 years in LSA#1	$B=A * 10$	Rs. 1,000 crore	Assumption: In the forthcoming auction, the candidate TSP acquires 10 MHz of spectrum in the 2100 MHz band in LSA#1.
3	Discount of 10% on ADP for 10 MHz of spectrum in the 2100 MHz band for 20 years in LSA#1	$C=A * 10\%$	Rs. 100 crore	Assumption: After the forthcoming auction, the candidate TSP opts for a discount of 10% on ADP for spectrum in the 2100 MHz band in LSA#1.
4	Cost of deployment of a new unique base station site [inclusive of capital expenditure (CAPEX), and operating expenditure (OPEX) for five years]	D	Rs. 1 crore	Assumption: The cost of deployment of a new unique base station site (inclusive of CAPEX and OPEX for five years) is Rs. 1 crore.
5	Number of new unique base stations to be deployed	$E= C/D$	100	

2.124 In view of the above, **the Authority recommends that the following scheme should be launched so that access service providers are incentivized to expand their mobile network coverage in the**

**areas which have no mobile network coverage and are not covered under the schemes of Universal Service Obligation Fund (USOF) [renamed as Digital Bharat Nidhi (DBN)]. The broad contours of the scheme are given below:**

- (a) Once the spectrum auction is concluded, the successful bidders of the spectrum should be permitted to opt for a reduction in the spectrum cost [upto 10% of the auction determined price (ADP)]. This option should be available for all Licensed Service Areas and for all frequency bands.**
- (b) In lieu of the reduction in the spectrum cost, the TSP should deploy new unique base stations sites to provide mobile broadband services (using 4G/ 5G technologies) using the spectrum in any of its frequency bands (existing/ newly acquired) at the locations identified by DoT (coverage holes) within a specific period of say one year from the date of identification of such locations.**
- (c) The number of unique base station sites to be deployed may be worked out by dividing the reduction in the spectrum cost by the estimated cost of deploying a new base station site. For estimation of cost of deploying a new base station site, one of the options could be to consider the cost of site (capex + opex for five years) as estimated under the latest USOF (DBN) projects. In case DoT is of the view that the cost under USOF (DBN) projects is on a higher side, the same may be rationalized to make it more realistic for a pan-India scenario.**
- (d) For the sites so deployed, mandatory site sharing at a reasonable and non-discriminatory price should also be prescribed to ensure that coverage of multiple TSPs is available in such areas.**
- (e) In case a licensed service area is found to have fewer**

**coverage holes and thereby lower requirement of new base station sites in the licensed service area, telecom service providers should be asked to deploy unique base station sites at the locations identified by DoT in other licensed service areas.**

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

2.125 The 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.”*

2.126 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of stakeholders on Q8**

2.127 A broad summary of the comments of stakeholders in response to Q8, with respect to the need for reviewing 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 is given below:

- (a) Some stakeholders are of the view that there is no need to change the spectrum cap in the existing bands.
- (b) One of the stakeholders submitted that spectrum in sub-1 GHz bands should have a cap of 35%. Further, if the 600 MHz band is included in the auction, a combined cap of 35% should apply to the 600 MHz and 700 MHz bands.
- (c) Another stakeholder submitted that, considering the increased spectrum availability, particularly in sub-GHz bands, and the strategic importance of mid-band and mmWave frequencies, the existing spectrum cap should be reduced from 40% to 35% per service provider as per band grouped under NIA 2024 for the forthcoming auction. This adjustment will ensure fair competition, equitable spectrum access, and optimal utilization of this national resource.
- (d) A few stakeholders submitted that the apprehensions of monopolization of spectrum bands are misplaced in the Indian context, when a large amount of spectrum has remained unsold in recent auctions. Therefore, the spectrum caps should be completely abolished. However, without prejudice to the above, if spectrum caps are retained, they should be applied only to bands

with similar technical and propagation characteristics. Arbitrary aggregation of dissimilar bands distorts competition and undermines the policy intent of fairness. Accordingly, the following grouping and cap structure has been proposed:

- (i) Sub-1 GHz FDD bands (600 MHz, 700 MHz, 800 MHz and 900 MHz bands) - spectrum cap of 40%;
- (ii) Mid-Band FDD bands (1800 MHz and 2100 MHz bands) – spectrum cap of 40%;
- (iii) Mid-Band TDD bands (2300 MHz, 2500 MHz, 3300 MHz and 6 GHz) - a higher cap of 50% is suggested due to increased capacity requirements; and
- (iv) High-Band TDD bands (26 GHz, 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz bands) – spectrum cap of 50%.

2.128 However, a few stakeholders in their counter comments opposed these suggestions on the following grounds:

- (a) Spectrum caps are instrumental in maintaining a competitive equilibrium and preventing monopolistic control over limited resources. While caps must not be so restrictive as to leave spectrum unsold and underutilized, they must also be stringent enough to avoid market distortion.
- (b) TSPs have aligned their spectrum holdings and deployments with the current band categorization - Sub-1 GHz, Mid-band, 3300 MHz, and 26 GHz. Any change to this structure would create regulatory uncertainty, operational challenges, and impact ongoing network rollouts. Arbitrarily merging unrelated bands (e.g., 3300 MHz and 6 GHz, which have vastly different propagation characteristics and use cases) for spectrum cap purposes introduces regulatory uncertainty and forces costly, unnecessary re-engineering of existing operational networks. Further, there is no technical or commercial rationale for imposing separate spectrum caps based

on the duplexing method (Frequency Division Duplex, FDD, or Time Division Duplex, TDD). Both FDD and TDD spectrum contribute equally to an operator's network capacity and coverage. Treating them differently for the purpose of the cap creates an artificial constraint that unfairly penalizes operators who have strategically acquired both types of spectrum for efficient, hybrid network deployment.

### **Analysis of the issues raised through Q8**

2.129 It is noted that a few stakeholders suggested that the apprehensions of monopolization of spectrum bands are misplaced in the Indian context, when a large amount of spectrum has remained unsold in recent auctions; therefore, the spectrum caps should be completely abolished.

2.130 In this regard, the Authority noted that one of the objectives of spectrum auction, as mentioned in the last NIA for the spectrum auction held in 2024, includes, *inter-alia*, the following:

- *Obtain a market determined price of Spectrum through a transparent process;*
- *Ensure efficient use of spectrum and avoid hoarding;*
- *Stimulate competition in the sector*

2.131 It is worth mentioning that 'spectrum cap' is a regulatory limit on the maximum amount of spectrum any telecom service provider can hold in a frequency band or in a group of frequency bands. In general, spectrum caps are helpful for -

- (a) Preventing consolidation of spectrum by a few dominant players.
- (b) Allowing new entrants to participate meaningfully in auctions.
- (c) Maintaining healthy competition in the telecom sector.

2.132 Evidently, spectrum cap plays a crucial role in ensuring fair competition and efficient use of spectrum resources during auctions. Accordingly, it would not be proper to abolish the spectrum cap in the forthcoming auction of IMT spectrum.

2.133 One of the stakeholders has made a suggestion with respect to grouping of frequency bands and spectrum cap structure. The stakeholder has proposed the following grouping and cap structure:

- (a) Sub-1 GHz FDD bands (600 MHz, 700 MHz, 800 MHz and 900 MHz bands) - spectrum cap of 40%;
- (b) Mid-Band FDD bands (1800 MHz and 2100 MHz bands) – spectrum cap of 40%;
- (c) Mid-Band TDD bands (2300 MHz, 2500 MHz, 3300 MHz and 6 GHz) - a higher cap of 50% due to increased capacity requirements; and
- (d) High-Band TDD bands (26 GHz, 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz bands) – spectrum cap of 50%.

2.134 In this regard, it is worth mentioning that through the recommendations on Auction of Spectrum in various frequency bands identified for IMT/ 5G" dated 11.04.2022, TRAI had recommended, *inter-alia*, as below.

- (a) For sub-1 GHz bands: Considering the importance of sub-1 GHz bands for coverage and in-building penetration, the Authority recommended a combined spectrum cap of 40% for sub-1 GHz bands.
- (b) For 3300 MHz band and 26 GHz bands: Considering the global trend, the Authority noted that these bands are likely to be used for 5G. Further, 3300 MHz band, and 26 GHz band are quite different in terms of propagation characteristics. Therefore, the Authority recommended a separate band-specific caps of 40% for these bands.

- (c) Remaining frequency bands viz. 1800 MHz, 2100 MHz, 2300 MHz, and 2500 MHz bands: The Authority noted that *"there is very low inventory left in 2300 MHz TDD band, hence there seems no justifications of grouping 2300 MHz and 2500 MHz band for the want for spectrum cap"* and recommended a spectrum cap of 40% for the combined spectrum holding in 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands.

2.135 Subsequently, 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, deliberated on the issue of a combined cap for 26 GHz band and 37-40 GHz band and noted that – *"2.65 It is noted that the frequency band n260 (37-40 GHz) will be put to auction for the first time. In case a combined spectrum cap for mmWave frequency bands i.e., 26 GHz band and 37-40 GHz frequency ranges, is prescribed, there could be a possibility that a service provider or a few service providers may monopolize one of the spectrum bands in which the ecosystem is more developed, thereby giving them a competitive edge. Therefore, the Authority is of the view that for the purpose of spectrum cap, a combined cap of all mmWave bands i.e. including 26 GHz band, may not be prudent."*

2.136 As can be seen from the above, the Authority is of the view that some frequency bands are prime bands for a particular technology. Further, some frequency bands may be having better device ecosystem than the others. Combining such frequency bands with other frequency bands for the purpose of spectrum cap, may create a possibility that a service provider or a few service providers may monopolize one of the prime spectrum bands in which the ecosystem is more developed, thereby giving them a competitive edge. Therefore, the Authority is of the view that it may be prudent that the existing grouping of frequency bands for

the purpose of spectrum caps may be continued.

2.137 It is noted that a few stakeholders have suggested that the existing spectrum cap of 40% may be reduced to 35%. In this regard, it is noted that this aspect has been examined by the Authority in some of its earlier recommendations, where it was noted that in case, only the existing TSPs take part in the auction and spectrum cap of 35% is prescribed (as suggested by some of the stakeholders), auction may not result in a market clearing price for the spectrum. Having said that, the Authority examined the impact of keeping the spectrum cap of 40%, and found that despite having a spectrum cap of 40%, market-clearing prices have not been discovered in the past two spectrum auctions. On the contrary, 40% spectrum cap in a four-player market could have a potential to distort the market competition in long run as it allows 80% spectrum in the hands of two operators.

2.138 Further, the Authority in its recommendations dated 11.04.2022, had recommended, *inter-alia*, that for 3300-3670 MHz and 24.25-28.5 GHz bands, band-specific (intra-band) spectrum cap should be kept as 40% (rounded off considering the block size in each of these bands) of the total spectrum put to auction i.e. after excluding spectrum that the Government decides to reserve for the PSU operator. This recommendation was accepted and included in the NIA for the spectrum auction held in 2022. However, in the subsequent spectrum auction, the spectrum cap of 40% was applied on the total spectrum in each of these frequency bands. To explain, in NIA 2022 spectrum cap for 3300 MHz band was 130 MHz, which was raised to 150 MHz in NIA 2024. The Authority considers that the spectrum cap of 150 MHz per operator in a frequency band having a total of 370 MHz of spectrum (out of which 70 MHz has been reserved for PSU operator), could theoretically result in a situation that one of the operators may not be able to acquire any spectrum in the 3300 MHz band.

2.139 In view of the foregoing discussion, the Authority finds merit in the suggestion received from a few stakeholders that the spectrum cap should be reduced from 40% to 35%. Having said that, in line with the existing principle, in case a TSP has already acquired spectrum that exceeds the spectrum cap of 35%, the TSP should not be asked to surrender right to use of any spectrum which it already holds. Similarly, the spectrum cap should be kept as 35% for 37-40 GHz band also.

2.140 In view of the above, **the Authority recommends that-**

**(a) For the forthcoming auction, the spectrum caps for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, and 37-40 GHz bands should be kept as follows:**

- (i) A spectrum cap of 35% on the combined spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in the 700 MHz, 800 MHz and 900 MHz bands**
- (ii) A spectrum cap of 35% on the combined spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands**
- (iii) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access**

**services) in 3300 MHz band (rounded off considering the block size in this band)**

**(iv) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 26 GHz band (rounded off considering the block size in this band)**

**(v) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 37-40 GHz band (rounded off considering the block size in this band)**

**(b) In line with the provision of NIA 2024, in case a TSP has already acquired spectrum that exceeds the spectrum cap of 35%, the TSP should not be asked to surrender right to use of any spectrum which it already holds.**

**(9) Other inputs related to the auction of spectrum in the existing bands**

2.141 The Authority solicited comments from stakeholders on the following set of questions:

*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.*

2.142 Suggestions received from the stakeholders and analysis of the same are given below:

**Suggestion # 1:**

2.143 One of the stakeholders has suggested that as the spectrum assigned through auction is assigned at market-determined prices, such spectrum should continue to be permitted for deployment across diverse use cases in a technology-neutral manner - including Access, Backhaul, Integrated Access Backhaul (IAB), and other permissible applications; the use of such spectrum shall not be restricted or limited on account of the exclusion of certain use cases from the auction mandate as prescribed under Schedule I of the Telecommunication Act, 2023; furthermore, with the emergence of Non-Terrestrial Networks (NTN), the successful bidder should also be permitted to utilise the assigned spectrum for NTN operations.

**Analysis of Suggestion #1**

2.144 The spectrum assigned through auction is access spectrum. The term 'Access Spectrum' has been defined in the Unified License and also in the draft Telecommunications (Authorisation for Provision of Main Telecommunication Services) Rules, 2025, as given below:

- (a) The term 'Access Spectrum' as defined in the Unified License Agreement: *"ACCESS SPECTRUM means the Radio Frequency Spectrum allotted for use to carry voice or non-voice messages from subscriber terminal to the Base Station/designated point of aggregation."*
- (b) The term 'Access Spectrum' as defined in the draft Telecommunications (Authorisation for Provision of Main Telecommunication Services) Rules, 2025: *"access spectrum"*

*means the spectrum assigned to an authorised entity for conveyance of voice or non-voice messages between user terminal (UT) and base station;*

2.145 As can be seen from the above definitions, the access spectrum is assigned for the conveyance of voice and non-voice messages between the user terminal and base stations. In line with this definition, the Authority has been providing its recommendations for terms and conditions for the auction of access spectrum. Further, in line with the provisions of the Telecommunications Act, 2023, TRAI has recently made its recommendations on the terms and conditions for backhaul spectrum through its recommendations 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 10.12.2025.

2.146 As regards Integrated Access backhaul (IAB), it is noted that IAB standardized by 3GPP in Release 16 is aimed at enhancing 5G New Radio (NR) capabilities by permitting the wireless backhaul to share the same spectrum as access links. The IAB nodes provide wireless access services to mobile users and wireless backhauling to other IAB nodes as well. User equipment is able to access the network via intermediary nodes that facilitate extended connectivity. Furthermore, an IAB node is designed to use the same basic infrastructure to provide wireless access and backhaul service for UEs and other IAB nodes, respectively, which means that the IAB nodes can be deployed densely and more flexibly. It is noted that 5G NR IAB is designed to operate in band n41 (2496-2690 MHz), n77 (3300-4200 MHz), n78 (3300-3800 MHz), and n79 (4400-5000 MHz) of FR1, and mmWave (24250 MHz – 52600 MHz) bands. While, IAB has been standardized by 3GPP as part of 5G NR, global regulation and adoption need to be studied before concluding. Considering that this issue was neither a part of the DoT's reference nor TRAI's consultation paper, this

needs to be examined and consulted through a separate consultation process. Therefore, if required, DoT may send a separate reference to the Authority in this regard.

2.147 Regarding permitting NTN in IMT bands, it is observed that to facilitate direct-to-device services in IMT bands, FCC (USA) and ACMA (Australia) have permitted the use of some of the IMT bands for MSS. However, the responsibility of a harmful interference-free operation lies with the TSPs. In this regard, it may be worth mentioning that under WRC 2027, this issue is being studied under the agenda item 1.13 in the frequency range between 694/698 MHz and 2.7 GHz, as mentioned below:

*"Agenda item 1.13: to consider studies on possible new allocations to the mobile-satellite service for direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment to complement terrestrial IMT network coverage, in accordance with Resolution 253 (WRC-23)"*

2.148 It is worth mentioning that DoT sent a supplementary reference dated 17.10.2024 and conveyed to TRAI that *"keeping in view the increasing use of NTN (Non terrestrial networks) including satellite communication networks in provisioning of FSS (Fixed Satellite Services) including VSAT services and MSS (Mobile Satellite Services), TRAI may consider an authorisation for satellite communication network under Section 3(1)(b) of the Telecommunications Act, 2023 alongwith the following:*

- a. Terms and conditions relating to such authorisation*
- b. Provision of assignment of spectrum for both feeder link as well as user link under such authorisation*
- c. Service area of such authorisation."*

2.149 Subsequently, through its back-reference dated 03.07.2025 to the TRAI's recommendations dated 17.02.2025 on the Terms and Conditions of

Network Authorisations to be Granted Under the Telecommunications Act, 2023, DoT conveyed, *inter-alia*, as below to TRAI:

*" SCN authorisation under section 3(1) (b) will enable the relevant authorised entities under Section 3(1)(a), in mutual commercial agreement with the SCN authorised entities, to provide supplemental coverage from space using Mobile Satellite Service (MSS) spectrum bands to the users in areas with limited or no terrestrial coverage."*

2.150 Thereafter, through a letter dated 07.10.2025, DoT conveyed, *inter-alia*, as below:

*"It may also be possible that a SCN Authorised Entity without seeking spectrum may enter into sharing agreements with another authorised entity availing of its satellite network (the "partnering entity"), to utilise the spectrum assigned to such partnering entity for the limited purpose of providing the service of its satellite-based networks."*

2.151 At present, TRAI is preparing a consultation paper on the framework for Satellite Communication Network Authorisation and Assignment of Spectrum to Satellite Communication Network Providers. In the consultation paper, the issues related to the use of IMT spectrum in Non-Terrestrial Networks (NTNs) would also be deliberated upon.

### **Suggestion #2**

2.152 One of the stakeholders has mentioned that as major portions of these spectrum bands are already assigned, the remaining spectrum is available only in small fragments that too away from the existing assignments of the service providers and for this spectrum to be gainfully deployed there is a need to ensure the spectrum contiguity; while in past, in many cases, inter-operator arrangements have been successful in ensuring contiguous spectrum blocks for all users, however, this may not always be feasible

like in case of 3300 MHz band. Therefore, the Authority should address the issue of contiguity in this band.

### **Analysis of Suggestion #2**

2.153 Harmonization of the spectrum helps in increasing efficiency and mitigating interference related issues. It is worth noting that TRAI has been consistently of the view that, to the extent possible, the TSPs should be provided spectrum in a contiguous manner and DoT should carry out a harmonization exercise immediately after conducting the auction, and such exercise should be completed within a time frame of not more than six months from the date of conclusion of the auction.

2.154 In view of the above, **the Authority recommends that, to the extent possible, the TSPs should be assigned spectrum in a contiguous manner and DoT should carry out harmonization exercise immediately after conducting the auction, and such exercise should be completed within a time frame of not more than six months from the date of conclusion of the auction.**

### **Suggestion #3**

2.155 One of the stakeholders has mentioned that the India 800 MHz band (subset of 3GPP Band 5 range) operates in the uplink range of 824-844 MHz and downlink range of 869-889 MHz, while the adjacent India 900 MHz band (subset of 3GPP Band 8 range) operates in uplink frequencies from 890.1-915.1 MHz and downlink frequencies from 935-960 MHz; the close spectral adjacency of these frequency bands, coupled with the deployment by different TSPs, presents a significant risk of inter-system interference, particularly in uplink and downlink transmissions occurring in contiguous frequency blocks; currently, the Indian regulatory

framework lacks explicit, comprehensive guidelines to address interference mitigation in scenarios involving adjacent-band deployments; to date, only limited, case-specific field trials have been conducted, which are insufficient to standardize interference management nationwide; to safeguard network stability and ensure interference-free operation, it is imperative that the DoT and the WPC Wing should:

- (a) Develop and enforce clear technical guidelines and emission coordination protocols for operators deploying services in the 850 MHz and 900 MHz bands.
- (b) Mandate strict adherence to internationally accepted spurious emission limits as prescribed by 3GPP, tailored appropriately to Indian band specifications.
- (c) Implement a coordinated framework for interference mitigation that includes regular monitoring, reporting, and resolution mechanisms.

### **Analysis of Suggestion #3**

2.156 With regard to the issue raised by the stakeholder, it is noted that this issue was deliberated by the Authority in its recommendations on "Auction of Spectrum in frequency band identified for IMT/5G" dated 11.04.2022 and the Authority had recommended, *inter-alia*, as follows:

*"2.122 In view of the above, the Authority recommends that As regards assignment of the last block from 887.75-889 MHz, DoT should carry out limited field trial to ascertain the inter-band guard band requirement between 800 & 900 MHz bands. In case, the outcome of the field trial shows that the assignment can be made till 889 MHz without causing any interference to existing users in 900 MHz band, the last block in each LSA can also be put to auction, else the last block with reduced size (considering the guard band requirement) can be put to auction. In*

*case, it is not possible to conduct and conclude the study before forthcoming auction, the forthcoming auction should be conducted considering 15 blocks of 1.25 MHz each as total availability of spectrum in 800 MHz band and later on decision about the last block can be taken and included in the subsequent spectrum auction.*

*...”*

2.157 As mentioned by the stakeholder, limited case-specific field trials have been conducted. Thus, DoT conducted limited field trials as recommended by the Authority before deciding to use the last block of 800 MHz band i.e., 887.75-889 MHz. The stakeholder has claimed that the limited field trials are insufficient to standardize interference management nationwide. The stakeholder has not mentioned the specific interference-related issues being faced; however, they may have raised the specific issues with the WPC wing of DoT. Therefore, the Authority is of the view that DoT may appropriately examine the issue raised by the stakeholder.

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

2.158 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.

2.159 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.

2.160 After detailed examination, the Authority recommended that for the 600 MHz frequency range (612-703 MHz), the band plan APT 600 (Option B1) should be adopted in India.

2.161 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. However, no bid was received for the spectrum in the 600 MHz band in the auction of July/ August 2022.

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

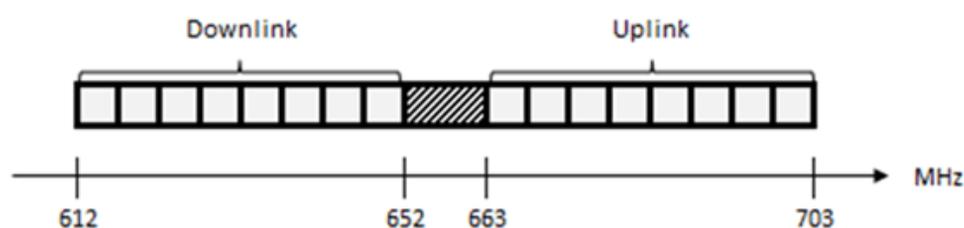
*“2.6 In the auction held in 2024, 600 MHz (612-652/663-703 MHz) band was not put to auction considering that this band was not sold in the Auction held during 2022, the equipment ecosystem has not yet fully developed for this band and only a few countries have deployed 600 MHz in their public networks. 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.”*

2.163 In the consultation Paper dated 30.09.2025, the Authority noted 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.

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:



**Figure 2.2: 3GPP Band Plan n105**

- (b) As per the World Radiocommunication Conference 2023 Final Acts<sup>13</sup>, 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

<sup>13</sup> <https://www.itu.int/pub/R-REG-RR-2024>

use by the administrations wishing to implement International 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<sup>14</sup>, STC won a total of 2x20 MHz in the 600 MHz band.
- (d) United Arab Emirates (UAE): In 2024<sup>15</sup>, 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<sup>16</sup>. 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 of the 600 MHz band. In Q1 2024, Mexico consulted on*

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<sup>14</sup> <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>

<sup>15</sup> <https://tdra.gov.ae/-/media/TDRA-Media/Newsletters/Ext-Newsletter2024/English-Out-Nov-24.ashx?c=NewsLetters&t=TDRA+in+Brief+November+2024>

<sup>16</sup> <https://www.acma.gov.au/sites/default/files/2024-04/Draft%20FYSO%202024-29.pdf>

*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<sup>17</sup> 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."*

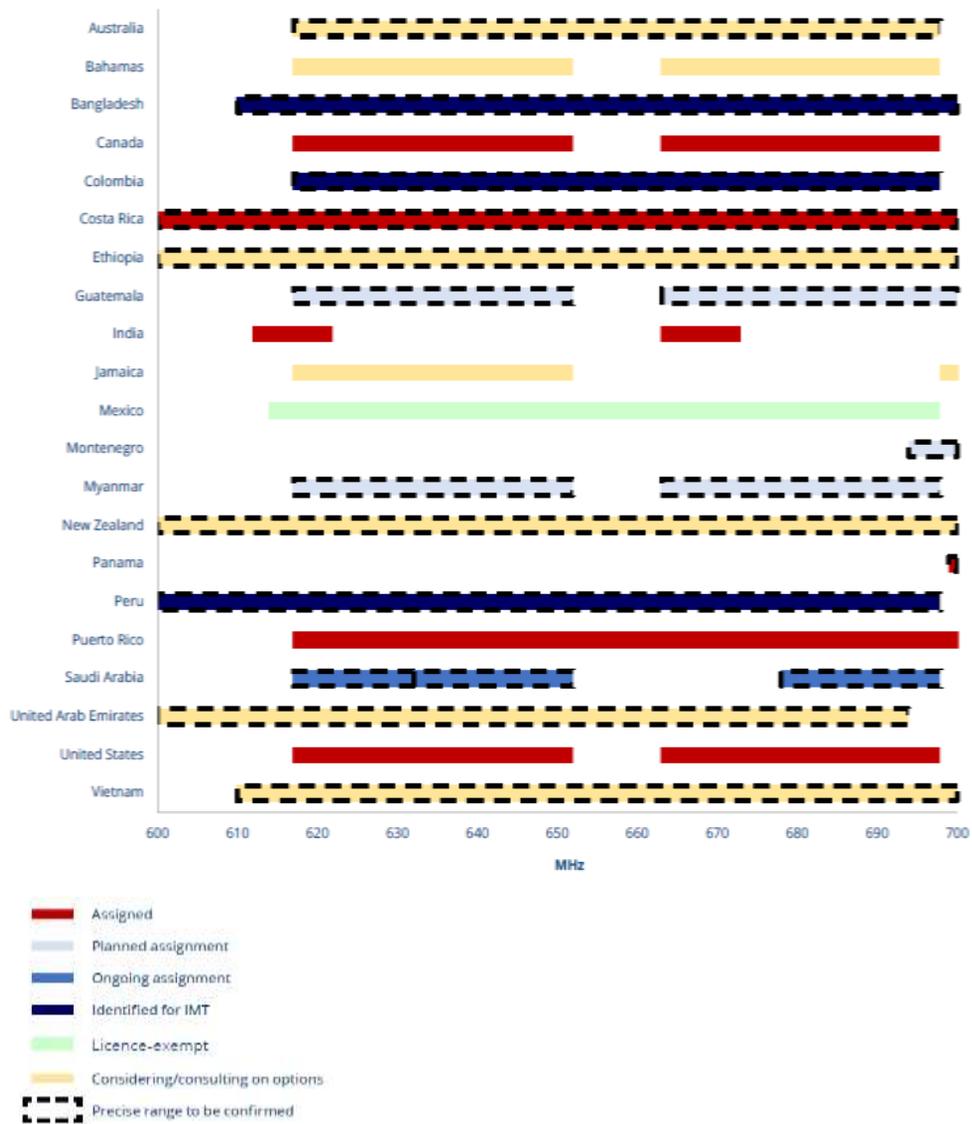
- (g) Qualcomm launched its chipset supporting the APT 600 MHz band (NR band n105) in October 2024 at the India Mobile Congress (IMC) 2024 at New Delhi.

2.164 According to the Global Mobile Suppliers Association (GSA) report on 'National Spectrum Positions' of August-2025<sup>18</sup>, 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:

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<sup>17</sup> <https://www.rsm.govt.nz/projects-and-auctions/current-projects/future-use-of-the-600-mhz-spectrum-paused-and-not-active>

<sup>18</sup> <https://gsacom.com/paper/national-spectrum-positions-august-2025/>



**Figure 2.3: Global status of spectrum licensing for mobile services in the 600 MHz band<sup>19</sup>**

2.165 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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*

<sup>19</sup> <https://gsacom.com/paper/national-spectrum-positions-august-2025/>

*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.*

### **Comments of stakeholders on Q10 and Q11**

2.166 A broad summary of the comments of stakeholders in response to Q10 and Q11 is given below:

(a) The stakeholders are of the view that for the 600 MHz band, band plan n105 (APT 600) should be adopted.

- (b) As regards whether the spectrum in the 600 MHz band should be put to auction in the forthcoming auction,
  - (i) Many stakeholders are of the view that the 600 MHz band should be put to auction in the forthcoming auction. One of these stakeholders further submitted that while the device ecosystem is currently limited, a successful auction by a major market like India would significantly accelerate global ecosystem development. The stakeholder also mentioned that regulatory clarity in India through the auction of this spectrum is bound to increase the already massive global interest in adopting the 3GPP n105 band post-3GPP standardization in October 2022.
  - (ii) A few stakeholders are of the view that 600 MHz band should be auctioned only after concrete evidence of ecosystem readiness, ideally post 2-3 years.

### **Comments of stakeholders on Q12 and Q13**

2.167 A broad summary of the comments of stakeholders is given below:

- (a) As regards the quantum of spectrum to be put to auction in the forthcoming auction, some stakeholders submitted that the entire available spectrum should be put to auction. The stakeholders have further submitted that this band has great potential for improving the coverage of wireless broadband and would play a very significant role in covering remote and rural areas.
- (b) As regards other terms and conditions such as 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, the

stakeholders are generally of the view that it should be same as that prescribed through NIA 2022.

### **Analysis of the issues raised through Q10 to Q13**

2.168 The comments of the stakeholders have been carefully examined. As regards the band plan, it is noted that the stakeholders are unanimously of the view that for the 600 MHz band, 3GPP band plan n105 (APT 600), as recommended by the Authority through its recommendation dated 11.04.2022, should be adopted. The Authority concurs with this view.

2.169 Further, it is noted that while many stakeholders have viewed that the entire available spectrum in the 600 MHz band should be put to auction in the forthcoming auction, a few stakeholders have suggested that the 600 MHz band should be auctioned only after concrete evidence of ecosystem readiness, ideally after 2-3 years. In this regard, the issue related to the lack of ecosystem was discussed with the leading OEMs. During the discussion, the leading OEMs were of the view that the network side devices can be made available by them within a period of 12 months from the clear signal from the TSPs regarding deployment of the 600 MHz band in their network(s). As regards the user devices, it is noted that GSA in its comments has submitted that –

*“...Qualcomm have already incorporated n105 support across their product lines, including smartphones, customer-premises equipment (CPE), and FWA platforms. This was showcased during IMC-2024, where commercial devices demonstrated seamless operation on n105. When telecom operators procure this band, original device manufacturers (ODMs) and original equipment manufacturers (OEMs) are expected to enable n105 support across their new devices, including budget-friendly models.”*

2.170 Thus, one of the leading chipset manufacturers has already designed chipset supporting band n105; however, other chipset manufacturers and device manufacturers will start deploying the same once they get a clear signal of its use. In this regard, Qualcomm, in its written comments, has submitted that -

*"Technically, Band n105 aligns with the Asia-Pacific Telecommunity (APT) harmonized band plan for IMT-also known as APT600 MHz Band -which has been endorsed by Qualcomm and finalized by the AWG as the preferred option for Asia-Pacific countries. The AWG's technical studies (APT/AWG/REP-79(Rev.2), Sept 2024) and updated recommendations (APT/AWG/REC-08) support this harmonization. ITU-R has also recognized this frequency arrangement as A13 in its M.1036-7 release (Dec 2023).*

...

*From a strategic standpoint, embracing Band n105 positions India as a leader in spectrum innovation across the Asia-Pacific region. As global markets increasingly align with APT600 MHz, early adoption ensures India's telecom ecosystem remains interoperable with international networks, fostering cross-border roaming, seamless device compatibility, and global investment appeal. This alignment also supports India's ambitions to become a manufacturing and export hub for telecom equipment and 5G-enabled devices, leveraging economies of scale and standardized components. By adopting n105, India sends a clear signal of regulatory foresight and technological readiness, attracting foreign direct investment and accelerating its digital economy.*

...

*The chipset ecosystem for 3GPP band n105 has been steadily maturing since the band was specified in 3GPP. The band is part of FR1 NR extensions, and the standards work explicitly added n105 support and coexistence rules, which lets chipset, RF-front end and module vendors*

*build multi-band parts that include 600 MHz. Hardware suppliers and semiconductor partners are supporting n105. Inclusion in 3GPP NR channel for this band makes it straightforward for handset, fixed wireless and IoT device makers to add support as they launch new multi-band SKUs — accelerating the availability of handsets and CPE that can operate with n105. Qualcomm has added hardware capability for n105 across our new generation of RFIC product portfolio. It's a default band on all of our new RFIC's with chipset attaches spanning our Mobile Handset and MBB, CPE/FWA platforms (Default Off). Following modem-RF solutions from Qualcomm support the n105 band (info also available at GAMBOD):*

- *Snapdragon X75 5G Modem-RF System*
- *Snapdragon X80 5G Modem-RF System*
- *Qualcomm X85 5G Modem-RF*

*Many countries (e.g. New Zealand, Vietnam, parts of Latin America and some emerging markets etc.) have taken a keen interest in adoption of n105. However, adoption remains uneven globally (some markets still follow other regional plans), but the policy momentum and regional coordination efforts make n105 a realistic path for many countries seeking low-band 5G capacity.”*

2.171 While the ecosystem for band plan n105 in 600 MHz band is yet to be developed, from the above submissions from GSA and Qualcomm, it may not be incorrect to conclude that if spectrum in the 600 MHz band is acquired by a TSP, the user device ecosystem may soon start supporting it. Having said that, it may also be worth mentioning that while the new devices may soon start supporting band plan n105, the customers presently holding older devices will have to change their handsets/devices to utilize services in 600 MHz band. Considering that the mobile handset replacement cycle is about three to four years, the TSP acquiring 600 MHz band in the auction may not be able to monetize the spectrum for the

initial three to four years.

2.172 Further, as mentioned earlier, while countries such as New Zealand and Australia have shown interest in adopting band plan n105, India is the first country to adopt band n105; therefore, the TSP may have to make some efforts to get the ecosystem developed. This is a typical chicken-and-egg situation - unless device ecosystem is available in band n105, a TSP may not be interested in buying the spectrum; on the other hand, device ecosystem is not getting developed as there is no clear signal from TSPs interested in deploying band n105. Further, while a few countries may have shown interest in band n105, no country other than India has adopted it so far. Therefore, there appears to be a need to create a framework such that the TSPs acquiring spectrum in 600 MHz band are suitably compensated for the risk being taken by them on account of the possibility of delayed monetization due to the lack of a readily available device ecosystem.

2.173 Since the issue is to deal with the chicken-and-egg situation, the TSPs acquiring spectrum in the 600 MHz band in the forthcoming auction should be offered with a suitable support. While one option could be to lower the price, other option could be to provide compensation for the reduced period of monetization by offering a longer validity period. The Authority is of the view that, considering that the TSP acquiring the spectrum in the 600 MHz band in the forthcoming auction may not be able to monetize the spectrum for the initial period of three to four years, it may be appropriate to increase the validity period by about four years, i.e., the usual 20 years *plus* 4 years, while the spectrum charge may be levied for the usual 20 years (monetization period). Further, the rollout obligations for the spectrum in 600 MHz band should also be delayed, i.e., it should begin after an initial period of four years.

2.174 The Authority, in the subsequent chapter, has deliberated and recommended the payment options for the successful bidder. Since for the 600 MHz band the validity period is being recommended as 24 years, instead of the usual 20 years, there is a need to create a separate plan for payment option, which would also encourage participation in the forthcoming auction for 600 MHz band. The Authority is of the view that, in addition to the upfront payment option, an additional payment option should be made available for the spectrum in the 600 MHz band, as given below:

5% upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. The buyer should be given a moratorium period of four years (i.e. no payment is required to be made from the 2<sup>nd</sup> year to the 5<sup>th</sup> year), and the balance amount should be payable in equal annual instalments over the remaining 19 years' period (starting from the beginning of the 6<sup>th</sup> year), payable in advance at the beginning of each year, after the period of moratorium, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.

2.175 As regards the spectrum cap, it is noted that in the NIA for the spectrum auction held in the year 2022, a spectrum cap was kept for the combined spectrum holding in the sub-1 GHz bands i.e. 600 MHz, 700 MHz, 800 MHz, 900 MHz bands, including existing spectrum holding of TSPs in these bands. While one option could be to continue with a combined spectrum cap for sub-1 GHz bands; however, since the terms and conditions being recommended for 600 MHz band are somewhat different from those applicable for other sub-1 GHz bands, the Authority is of the view that it would be appropriate that a band-specific spectrum cap for the frequency band n105 (600 MHz band) may be kept as 2 x 15 MHz (35% of the total spectrum, rounded off considering the block size).

2.176 As regards other terms and conditions, such as eligibility criteria, associated eligibility conditions, block size, minimum bid quantity of spectrum, and area of assignment on Telecom Circle/ Metro Area-basis for the spectrum in the 600 MHz band, the stakeholders are generally of the view that it should be same as that prescribed through NIA 2022. The Authority concurs with the views of the stakeholders. However, the changes in associated eligibility conditions as recommended in the previous section for existing frequency bands and spectrum cap shall also be made applicable to the 600 MHz band.

2.177 In view of the above, **the Authority recommends the following in respect of 600 MHz band -**

- (a) The entire available spectrum in the 600 MHz frequency band (3GPP band plan n105) should be put to auction in the forthcoming auction on LSA (Telecom Circle/ Metro) basis.**
- (b) While the spectrum charge may be levied for a period of 20 years, the validity period of the spectrum should be increased by four years, i.e., the usual 20 years *plus* 4 years.**
- (c) Frequency band n105 (600 MHz band) should be auctioned with a block size of 2 x 5 MHz, and the minimum number of blocks for bidding should be one. Further, DoT should ensure that in case a telecom service provider acquires more than one block, entire spectrum assigned to a telecom service provider is in a contiguous manner.**
- (d) Band-specific spectrum cap for the frequency band n105 (600 MHz band) should be kept as 2 x 15 MHz (35% of the total spectrum, rounded off considering the block size).**
- (e) The rollout obligations for the spectrum in 600 MHz band**

**should be the same as that applicable for other sub-1 GHz bands. However, it should be delayed by four years, i.e., no rollout obligations for the initial four years, and the applicable rollout obligations should begin after an initial period of four years.**

- (f) In addition to the upfront payment option, an additional payment option should be made available for the spectrum in the 600 MHz band, as given below:**

**5% upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. The buyer should be given a moratorium period of four years (i.e. no payment is required to be made from the 2<sup>nd</sup> year to the 5<sup>th</sup> year), and the balance amount should be payable in equal annual instalments over the remaining 19 years' period (starting from the beginning of the 6<sup>th</sup> year), payable in advance at the beginning of each year, after the period of moratorium, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.**

- (g) Eligibility conditions and associated eligibility conditions should be the same as those recommended for the existing frequency bands.**

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

2.178 Through its reference dated 15.05.2025, DoT requested TRAI to examine the feasibility and timing of auctioning the newly identified 6425-6725 MHz and 7025-7125 MHz bands and to provide recommendations on the auction timeline, reserve price, band plan, block size, quantum of

spectrum to be auctioned, and associated auction conditions. Additionally, 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:

<b>Frequency Range (MHz)</b>	<b>Timeline/ Status for vacation of spectrum by existing users for IMT based services</b>
6425-6725 <sup>#</sup>	Immediately
6725-7025 <sup>#</sup>	31-12-2030

*<sup>#</sup>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 ....*

2.179 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 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. ..."*

2.180 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."*

2.181 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)

2.182 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:

- (i) Standardization of the upper 6 GHz band for IMT by the 3GPP: The upper 6 GHz band (6425–7125 MHz) was standardized by 3GPP in June 2022 under Release 17 and designated as frequency band n104, operating in Time Division Duplex (TDD) mode. Earlier, in 2020, 3GPP Release 16 had standardized band n96, which covers the entire 6 GHz range from 5925–7125 MHz. The following figure depicts the band plans standardized by the 3GPP for the 6 GHz band:



**Figure 2.4: 3GPP Band Plans for the 6 GHz Band**

Thus, two band plans exist for the 6425–6725 MHz and 7025–7125 MHz ranges; however, band n96 is limited to shared-spectrum access under TS 37.213 [20] and applies only where such use is permitted by national regulations<sup>20</sup>.

- (ii) 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<sup>21</sup> considered identification of various mid-bands including 6425-

<sup>20</sup> 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](https://www.etsi.org/deliver/etsi_ts/138100_138199/138104/18.06.00_60/ts_138104v180600p.pdf)]

<sup>21</sup> 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-](https://www.itu.int/dms_pub/itu-)

7025 MHz, and 7025-7125 MHz for IMT. After considering the Agenda Item 1.2, ITU, in the Final Acts<sup>22</sup> 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]

*"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.*

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

<sup>22</sup> [https://www.itu.int/dms\\_pub/itu-r/opb/act/R-ACT-ARR.1-2022-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/act/R-ACT-ARR.1-2022-PDF-E.pdf)

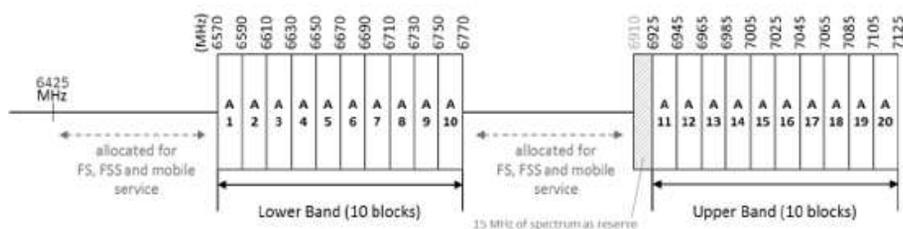
*9.21 with neighbouring countries. This identification does not preclude the use of this frequency band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations. Resolution 220 (WRC-23) applies. The frequency band is also used for the implementation 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.

- (iii) Spectrum Assignment in Hong Kong: In March 2024, Hong Kong’s Office of the Communications Authority (OFCA) amended the Hong Kong Table of Frequency Allocations to allocate the 6425–7075 MHz band to mobile services on a co-primary basis, in addition to existing allocations for fixed service (FS) and fixed satellite service (FSS) (Earth-to-space). OFCA clarified that new radio stations in this band must not cause harmful interference to existing co-primary services and cannot claim protection from interference caused by them, effectively applying a first-come-first-served protection principle. In November 2024<sup>23</sup>, 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:

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<sup>23</sup> [https://www.ofca.gov.hk/filemanager/ofca/en/content\\_1713/6\\_7\\_ghz\\_band\\_auction\\_IM.pdf](https://www.ofca.gov.hk/filemanager/ofca/en/content_1713/6_7_ghz_band_auction_IM.pdf)



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.

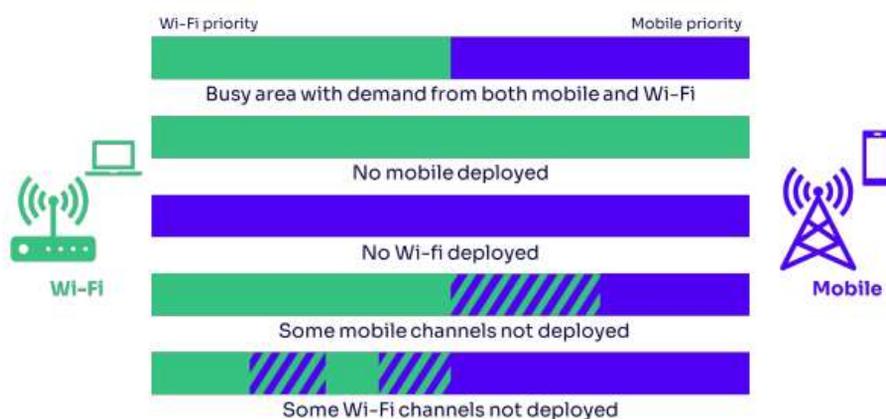
- (iv) Allocation of the upper 6 GHz band for IMT in China: China allocated the spectrum in the upper 6 GHz band for licensed mobile (5G and 6G services) in the year 2023<sup>24</sup>.
- (v) Allocation of the 6 GHz band for IMT in UAE: In November 2024<sup>25</sup>, the UAE's Telecommunications and Digital Government Regulatory Authority (TDRA) allocated the 6 GHz band for IMT.
- (vi) Consultation w.r.t. the upper 6 GHz band in Australia: As per the March 2025 draft consultation on the “Five-Year Spectrum Outlook 2025–30 and the 2025–26 Work Program,” the Australian Communications and Media Authority (ACMA) plans to introduce new radio local area network (RLAN) arrangements in the 6425–6585 MHz band through an update to the Low Interference Potential Device (LIPD) class licence. For the 6585–7100 MHz range, spectrum in defined population areas is proposed to be reserved for Wide Area

<sup>24</sup> 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](https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2024/09/GSMA_Mobile-Evolution-in-6-GHz.pdf)

<sup>25</sup><https://tdra.gov.ae/-/media/TDRA-Media/Newsletters/Ext-Newsletter2024/English-Out-Nov-24.ashx?c=NewsLetters&t=TDRA+in+Brief+November+2024>

Wireless Broadband (WA WBB) use, subject to the development of suitable international equipment markets. Outside defined population areas, ACMA proposes coordinated, apparatus-licensed WBB use supporting Wi-Fi and IMT technologies, with consultation planned for Q3 2025.

- (vii) Consultation w.r.t. the 6 GHz band in United Kingdom: In February 2025, Ofcom launched a consultation titled “Expanding Access to the 6 GHz Band for Mobile and Wi-Fi Services,” focusing on the upper 6 GHz band (6425–7125 MHz). Ofcom proposed a phased approach to enable shared use of the band by mobile and Wi-Fi services. In Phase 1, it plans to authorise low-power indoor Wi-Fi (up to 250 mW) across the entire band on a licence-exempt basis before the end of 2025. In Phase 2, subject to European harmonisation, Ofcom proposes to introduce sharing mechanisms between mobile services and Wi-Fi, including options such as a prioritised spectrum split or an indoor–outdoor split. Ofcom has indicated a preference for a prioritised spectrum split, reserving 160–400 MHz primarily for Wi-Fi and at least 300 MHz for mobile services, to support high-power mobile deployments in dense areas while allowing Wi-Fi use across the band where mobile deployment is limited.



**Figure 2.5: Prioritized spectrum split<sup>26</sup>**

<sup>26</sup> <sup>26</sup> <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->

(viii) Consultation w.r.t. the 6 GHz band in Brazil: In April 2024, Brazil's National Telecommunications Agency (ANATEL) initiated a public consultation to redefine Wi-Fi operations in the 6 GHz band, proposing to limit Wi-Fi use from 5925–7125 MHz to 5925–6425 MHz in order to reserve the 6425–7125 MHz range for future IMT systems and reduce interference. Subsequently, in January 2025, ANATEL updated Brazil's national frequency allocation plan to designate the 6425–7125 MHz band for IMT and has indicated plans to auction the 6 GHz band by 2026<sup>27</sup>.

2.183 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) In its February 2025 report "Spectrum Policy Trends 2025,"<sup>28</sup> GSMA noted that Hong Kong has completed the first IMT auction of the upper 6 GHz band and the UAE has assigned it to operators, while several countries across APAC, the Gulf, and Latin America—including India—are progressing towards IMT use of 6 GHz. The report also highlighted that many countries have moved away from fully unlicensed use and are expected to make the upper 6 GHz band available for IMT in 2025.

(b) As per a report from PolicyTracker<sup>29</sup>, 22 nations have [plans](#) to authorise [IMT](#) use of the upper 6 GHz range or portions thereof; this

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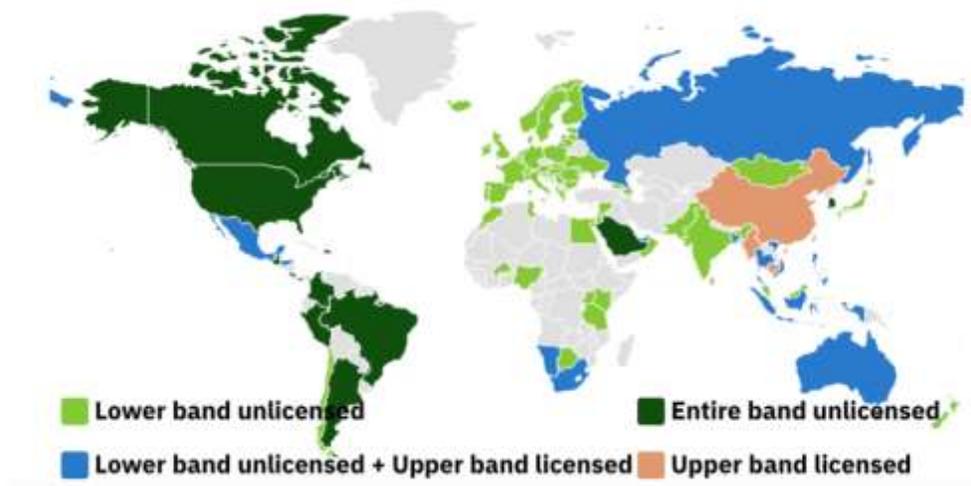
[the-6-ghz-band-for-mobile-and-wi-fi-services.pdf?v=391052](https://www.fcc.gov/record/2024-04-24-consultation-w-r-t-the-6-ghz-band-for-mobile-and-wi-fi-services.pdf?v=391052)

<sup>27</sup> <https://globalvalidity.com/brazil-anatel-approves-public-consultation-on-future-radio-frequency-planning/>

<sup>28</sup> 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>]

<sup>29</sup> <https://www.policytracker.com/blog/6-ghz-benchmark-updated-for-2025/>

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 2.6: Global Status on the 6 GHz band<sup>30</sup>**

2.184 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:

- (a) According to an Ericsson report, additional mid-band spectrum is essential for scaling 5G and advancing toward 5G Advanced, with the 6 GHz band offering the required capacity for wide-area innovation and socio-economic benefits. The report highlights successful Ericsson–MediaTek interoperability testing on the licensed 6 GHz band (3GPP n104, 6.425–7.125 GHz) and notes that Ericsson has commercial 3GPP radio solutions ready for deployment once the spectrum is licensed, subject to market demand<sup>31</sup>.

<sup>30</sup> <https://www.policytracker.com/blog/6-ghz-benchmark-updated-for-2025/>

<sup>31</sup> <https://www.ericsson.com/en/news/2023/11/ericsson-and-mediatek-demo-on-6-ghz-licensed-5g-band>

(b) According to Nokia's white paper on the subject "*The Potential of Upper 6 GHz for 6G: Field Insights and Comparison with 3.6 GHz,*" Nokia and Telia conducted indoor and outdoor field tests using existing macro network infrastructure to assess the feasibility of upper 6 GHz for mobile broadband. Using a 3.5 GHz massive MIMO cell with the same RF bandwidth to simulate real-world conditions, they completed a successful field pilot in June 2024, demonstrating uplink compatibility with current inter-site distances and concluding that the upper 6 GHz band is a practical and sustainable option for early 6G deployment<sup>32</sup>.

2.185 The international scenario indicates that the upper 6 GHz band is being considered for use by 5G, 5G-Advanced, and future 6G technologies. While 5G is already widely deployed and the 6 GHz band can address growing mid-band spectrum requirements, work on technical specifications for 5G-Advanced and 6G is still underway. As per 3GPP<sup>33</sup>, the ITU has set early 2029 as the target date for submitting technology proposals for IMT-2030, with full system specifications to be finalized by mid-2030. For 5G-Advanced (Release-20), 3GPP has adopted an 18-month roadmap focused on incremental enhancements, with Stage-1 (service requirements) frozen in June 2025, Stage-2 (system architecture) targeted for 80% completion by June 2026 and final freeze by September 2026, and Stage-3 (protocol specifications) planned for March 2027, followed by the final ASN.1/OpenAPI freeze in June 2027.

2.186 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*Q14. Whether the spectrum in 6425-6725 MHz and 7025-7125 MHz*

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<sup>32</sup> <https://www.nokia.com/asset/214700>

<sup>33</sup> <https://www.3gpp.org/specifications-technologies/releases/release-20>

*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.*

## Comments of stakeholders on Q14 and Q15

2.187 A broad summary of the comments of stakeholders in response to Q14, with respect to 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, is given below:

- (a) Some of the stakeholders are of the view that the spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should not be included in the forthcoming IMT auction. Justifications provided are given below:
- a. Only 400 MHz of spectrum—fragmented into the 6425–6725 MHz and 7025–7125 MHz blocks—is currently available for potential IMT deployment. The mid-block (6725–7025 MHz, 300 MHz) is expected to be vacated and become available only after December 2030. TRAI should plan to assign the band to mobile operators in large contiguous blocks to support urban capacity expansion and low-latency industrial applications.
  - b. The combined 6425-8400 MHz spectrum band is likely to provide up to four contiguous Blocks of 400 MHz. The 6 GHz band should be auctioned after WRC-27.
  - c. A premature auction could technologically isolate India, especially when the country already supports the “lower 7 GHz” band under WRC-27 Agenda Item 1.7, which may result in a more efficient and wider-channel band plan for mobile broadband.
  - d. While the upper 6 GHz band (6425-7125 MHz) has been standardized in 3GPP (as Band n104 under Release 17) for TDD operation, actual commercial deployments remain nascent. Premature auctioning may lead to under-utilization of spectrum, slow uptake, and inferior returns (in terms of service outcomes and spectrum value). A deferral will allow the ecosystem (chipsets, base-stations, terminals, passive

infrastructure) to mature, benefiting both service providers and consumers.

e. In India, the upper 6 GHz band carries incumbent satellite (Fixed Satellite Service — FSS) operations, thereby requiring India specific coexistence studies (keep-out distances, emission masks, interference coordination) prior to large-scale IMT deployment in this band. International best practices indicate that a phased approach with trials and coordination is prudent. For example, satellite operations in India may restrict immediate IMT access to parts of the band. Proceeding to auction without fully addressing these issues could expose both the mobile services and incumbents to the risk of interference, regulatory, or operational constraints.

(b) A few stakeholders opined that the entire available spectrum in the 6 GHz (upper) band should be put to auction in the forthcoming auction.

(c) Two stakeholders submitted that the entire 6 GHz spectrum band (5925-7125 MHz) should be auctioned in one go, including the parts that will be available only in 2030. One of the stakeholders further submitted that the spectrum should be assigned to the successful bidders so that they can start working on the other aspects of the network development on an initial payment of 5% of the successful bid amount. All other obligations, viz. deferred payment liabilities, rollout obligations, spectrum term, and rest should start from 2030, when the entire band will become available. The stakeholder provided the following justification:

a. The entire 1200 MHz of the 6 GHz band (5925-7125 MHz) should be allocated for IMT and other licensed uses. Delicensing the lower 500 MHz (5925–6425 MHz) would permanently constrain future use and increase interference risks, especially when the current mid-band availability of only about 370 MHz is already inadequate.

- b. The device and network equipment ecosystem for 6 GHz in India and globally is currently developing and availability of devices and supporting network equipment is expected only in 2030. Thus, this spectrum would not be deployable in next 5 years and effective deployment will start only in 2030. However, considering the importance of this spectrum in achieving national goals and network efficiencies, it is important that the investments in this band should start in right earnest at the earliest. Therefore, the entire spectrum in the band 5925-7125 MHz should be put to auction now in order to push device ecosystem development.
- c. Considering the high population density of India (481/sq km), lower penetration of fixed line broadband and resultant extensive use of mobile data, particularly driven by mobile wireless networks such as 4G/5G in India, the current spectrum availability of a mere 370 MHz in mid-band (i.e. 3300-3670 MHz) is inadequate. This scarcity of mid-band spectrum would significantly fall short in meeting the spectrum requirements of the TSPs.
- (d) Some of the stakeholders requested to delicense the upper 6 GHz band and permit Wi-Fi low-power indoors and VLPI to unlock consumer and enterprise benefit.

### **Comments of stakeholders on Q16**

2.188 A broad summary of the comments of stakeholders in response to Q16, with respect to whether the 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, considering that the satellite-based service (uplink) will coexist with IMT-based services in the upper 6 GHz band, is given below:

- (a) Most of the stakeholders are of the view that pilot trials under regulatory supervision should be conducted to assess interference, including determining appropriate keep-out distances between IMT base stations and satellite uplink stations.
- (b) A few stakeholders supported a coordinated national framework for IMT based upon evidence from international studies and decisions of WRC 23 in this regard.

### **Comments of stakeholders on Q17**

2.189 A broad summary of the comments received from stakeholders in response to Q17, concerning the possible auction of spectrum in the 6425–6725 MHz and 7025–7125 MHz ranges, is presented below. These comments address, inter alia, the adoption of the 3GPP band plan n104 for the upper 6 GHz band, the area and validity period of spectrum assignment, block size, minimum bid quantity, roll-out obligations, and the eligibility criteria and associated conditions for participation in the auction:

- (a) A few stakeholders recommended that the entire 6 GHz band, totaling 1200 MHz, be put to auction and 3GPP band plan n96 should be adopted. They suggested a 10 MHz block size, aligned with the 3300 MHz band, and a minimum bid quantity of 50 MHz given that this is a new spectrum band. Roll-out obligations should only apply once the entire band or at least 300 MHz of contiguous spectrum is assigned. Eligibility conditions should remain consistent with other access bands, permitting only Access Service Providers (ASPs) to participate in the auction.
- (b) Some of the stakeholders supported 3GPP band plan n104 for the

upper 6 GHz band in India.

- (c) One of the stakeholders recommended block size of 100 MHz.
- (d) Some of the stakeholders suggested earmarking the entire Upper 6 GHz band for IMT and revisit its allocation post-WRC-27 to ensure long-term national and global benefits.

### **Comments of stakeholders on Q18**

2.190 A broad summary of the comments received from stakeholders in response to Q18, with respect to whether 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, whether a combined spectrum cap for the 3300 MHz band and the upper 6 GHz band should be prescribed, is given below:

- (a) One stakeholder suggested Spectrum cap for the 3300 MHz band and the upper 6 GHz band should not be combined. There should be a specific and separate spectrum cap for the upper 6 GHz spectrum. Since only 400 MHz is available at present, a maximum spectrum cap of 100 MHz per TSP should be recommended.
- (b) Some of the stakeholders are not in favor of auctioning spectrum in 6 GHz band in the forthcoming auction. One of such stakeholders further recommended a band specific cap of 25% for the upper 6 GHz band.
- (c) A few stakeholders opined that the apprehensions of monopolization of spectrum bands are misplaced in the Indian context, when a large amount of spectrum has remained unsold in recent auctions. Therefore, the spectrum caps should be completely abolished. However, without prejudice to the above, if spectrum caps are retained, for Mid-Band TDD bands (2300 MHz, 2500 MHz, 3300 MHz and 6 GHz), there should be a combined cap of 50%.

## **Comments of stakeholders on Q19**

2.191 In response to Q19, with respect to 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, to mitigate inter-operator interference due to TDD-based configuration, the stakeholders were generally in favour of adopting a similar approach as adopted for the 3300 MHz and 26 GHz bands. However, some additional suggestions received from the stakeholders are given below:

(a) One of the stakeholders suggested that:

- a. Assign identical frequency ranges across all circles to national winners where possible.
- b. Rank 1 holder in majority of LSAs should be allocated the preferred frequency spot in all LSAs.

(b) A few stakeholders suggested that:

- a. Common GPS based synchronization across all TSP networks,
- b. Uniform UL/ DL frame configuration for all outdoor sites,
- c. Coordination mechanism facilitated by WPC to harmonize operator deployments.

## **Analysis of the issues raised through Q14 to Q20**

2.192 The Authority carefully examined the comments of the stakeholders. While a few stakeholders who favoured to put the spectrum in 6 GHz band to auction, were of the view that entire 1200 MHz spectrum (5925-7125 MHz) i.e. including the spectrum that will be available in 2030, should be put to auction in the forthcoming auction and one of these stakeholders further submitted that the spectrum should be assigned to the successful bidders on an initial payment of 5% of the successful bid amount and all other obligations, viz. deferred payment liabilities, rollout obligations, spectrum term, and rest should start from 2030, when the entire band

will become available. On the other hand, some stakeholders are of the view that the spectrum in the 6425-6725 MHz and 7025-7125 MHz ranges should not be included in the forthcoming auction and should be reexamined after WRC-2027.

2.193 As regards the suggestion to include the spectrum that is likely to be available in 2030 in the forthcoming auction, the Authority notes that while the spectrum is likely to become available in 2030, there is still some level of uncertainty on the exact date of release of the spectrum for IMT. Therefore, the Authority is of the view that it would not be proper to include spectrum that is likely to become available after five years in the forthcoming auction.

2.194 According to GSMA<sup>34</sup> *"the upper 6 GHz band (6.425-7.125 GHz) is seen by mobile operators as the foundation for the next phase of mobile evolution. Its use has been the focus of industrial development and regulatory activity, including the decisions at the World Radiocommunication Conference 2023 (WRC-23). It offers wide channel bandwidths for MNOs to deliver city-wide capacity, including the 200-400 MHz channels that will be required for 6G."* GSMA has also provided information on the progress in the 6 GHz band, as reproduced below:

*"Progress for the 6 GHz band*

*6 GHz momentum has been growing. Hong Kong's regulator OFCA made history by becoming the first to auction the band, while the UAE became the first country in the world to assign the full upper part of the band to its operators through an administrative process.*

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<sup>34</sup> <https://www.gsma.com/connectivity-for-good/spectrum/one-year-since-wrc-23-where-are-we-now-with-6-ghz/#:~:text=The%20licensed%20mobile%20upper%206,drive%20the%20evolution%20of%205G.>

*In Australia, regulator ACMA has decided to reserve the 6585–7100 MHz range for wide-area mobile broadband use to help drive the evolution of 5G. Elsewhere in APAC, Bangladesh, Cambodia, China, India, Indonesia, Thailand, and Vietnam added the full upper part of the band to their spectrum roadmap plans. Bangladesh’s new roadmap includes more than 2 GHz of mid-band spectrum, supported by 6 GHz capacity. With large Chinese population already falling under the upper 6 GHz mobile footprint, India made its own decision to support the band in 2025 and make it available for mobile.*

*Europe has recommended making a minimum of 665 MHz available in the wider band 6.425–7.250 GHz, with a decision pending outcomes of the next WRC.*

*In the Americas, Brazil and Mexico both supported the band at WRC-23 and subsequently identified the upper part of the band to IMT in their table of frequency allocations. Brazil is now considering the conditions and timeline for assigning the band to its mobile operators.*

*The first commercial connections are expected to be made using CPEs in 2026, with broad ecosystem deployment the following year where the capacity is needed. After years of planning, 6 GHz is beginning to become part of the fabric of mobile connectivity.”*

2.195 From the above, it can be inferred that wider channel bandwidths of the order of 200-400 MHz will be required for 6G. In India, presently, 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. The Authority notes that after WRC-27, there will be clarity on 7 GHz (and exact quantum/ range)

becoming globally harmonized for IMT; thus, it may be appropriate to wait for the outcome of WRC-27. It is also noted that while developments are happening in 6 GHz band, the device ecosystem in 6 GHz band is not readily available.

2.196 As regards the contention that additional spectrum is required to meet the growing data usage, the Authority notes that the TSPs are already holding sufficient mmWave spectrum in 26 GHz band, which should be put to use by the TSPs to cater to the growing data usage, particularly for the use cases such as Fixed Wireless Access (FWA). Additionally, vacant spectrum is available in mid bands, including the 3300 MHz band, which will be put to auction in the forthcoming auction.

2.197 In view of the foregoing discussion, after WRC-2027, there will be more clarity on the bands getting globally harmonized for IMT, particularly 6/7 GHz bands, this will also be closer to 2030 timeline when the 300 MHz (6725-7025 MHz) is likely to become available for auction. Therefore, it will be prudent to decide the terms and conditions after getting such clarity. Accordingly, the Authority is of the view that while 6 GHz (upper) band is important for IMT services, it will be appropriate that the 6 GHz (upper) band may not be put to auction in the forthcoming Auction, and the same may be reexamined after the outcome of WRC-27. With this view, other issues such as block size, rollout obligations, spectrum cap, etc., have not been examined.

2.198 Further, as mentioned earlier, 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 at 34 locations in India. In this regard, DoS conveyed to DoT the required EIRP density of Hub/ Feeder/ TTC Earth Stations for the said satellite-based services.

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. ..."*

2.199 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."*

2.200 Many stakeholders are of the view that trials should be conducted under the supervision of competent Authorities. As mentioned above, DoS had also requested WPC Wing of DoT to share the analysis of IMT/ terrestrial service providers with DoS for further discussions. The Authority is also of the view that it will be prudent to conduct field trials around all 34 locations where satellite uplink stations are located in the relevant

frequencies (in-band and adjacent frequencies) to determine the requirement of the keep-out distance of IMT base stations from satellite uplink stations. The outcome of the trials will not only enable the prospective bidders to take informed decisions and accordingly plan their network layout, but also the outcome of the trials will be used by the Authority while making recommendations after WRC-2027.

2.201 In view of the above, **the Authority recommends the following in respect of the spectrum in the 6 GHz (upper) band -**

- (a) Considering the importance of 6 GHz (upper) band, it should be kept reserved for IMT.**
- (b) The available frequency ranges in the 6 GHz (upper) band, viz. 6425-6725 MHz and 7025-7125 MHz should not be put to auction in the forthcoming auction. The issue of auctioning the spectrum in 6 GHz (upper) band should be re-examined after considering the outcome of WRC-27.**
- (c) DoT may carry out a plan (involving all TSPs) to conduct trials around all 34 locations where satellite uplink stations are located in the relevant frequencies (in-band and adjacent frequencies) to determine the requirement of the keep-out distance of IMT base stations from satellite uplink stations. The outcome of the trials may also be shared with TRAI.**

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

2.202 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."*

2.203 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.

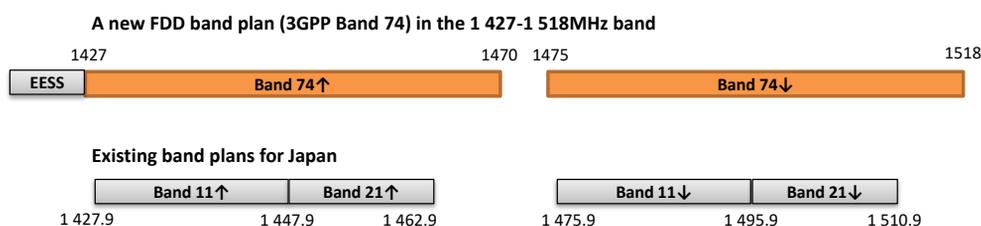
2.204 The 3GPP has designated the following band plans for LTE and 5G-NR in the 1427-1518 MHz range:

**Table 2.13: 3GPP Band Plans for the 1427-1518 MHz Range**

<b>Band Plan for LTE</b>	<b>Band Plan For 5G NR</b>	<b>Uplink (MHz)</b>	<b>Downlink (MHz)</b>	<b>Mode</b>	<b>Duplex spacing (MHz)</b>
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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	-

2.205 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 3GPP band plan 74.



**Figure 2.7: 3GPP Band plan 74**

2.206 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.<sup>35</sup> It is noteworthy that the CEPT (European Conference of Postal and Telecommunications Administrations) Electronic Communications

<sup>35</sup> Source: <https://tec.gov.in/pdf/Studypaper/Supplementary%20Downlink.pdf>

Committee (ECC) Decision (17)<sup>36</sup> 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.

2.207 GSA in its report<sup>37</sup> 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”.

2.208 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:

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<sup>36</sup> <https://docdb.cept.org/download/1471#:~:text=1.,ECC%20Decision%20is%20nationally%20implemented.>

<sup>37</sup> <https://gsacom.com/paper/national-spectrum-positions-august-2025/>



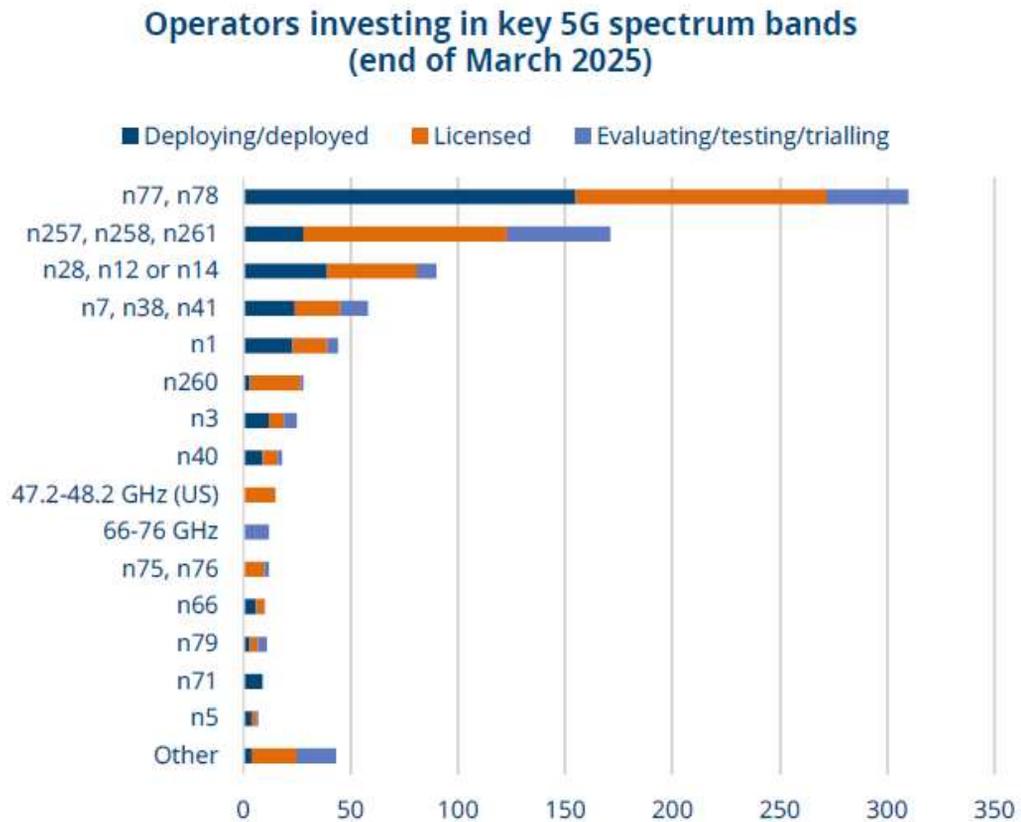
**Figure 2.8: Global Status for national spectrum licensing for mobile services in the 1400 MHz to 1500 MHz range**

2.209 In the consultation paper dated 30.09.2025, it was mentioned that as per the frequency check website<sup>38</sup>, 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<sup>39</sup> on 5G-Market Snapshot April

<sup>38</sup> [FrequencyCheck - Mobile Network Compatibility Search for Unlocked Phones and Devices](https://frequencycheck.com/)

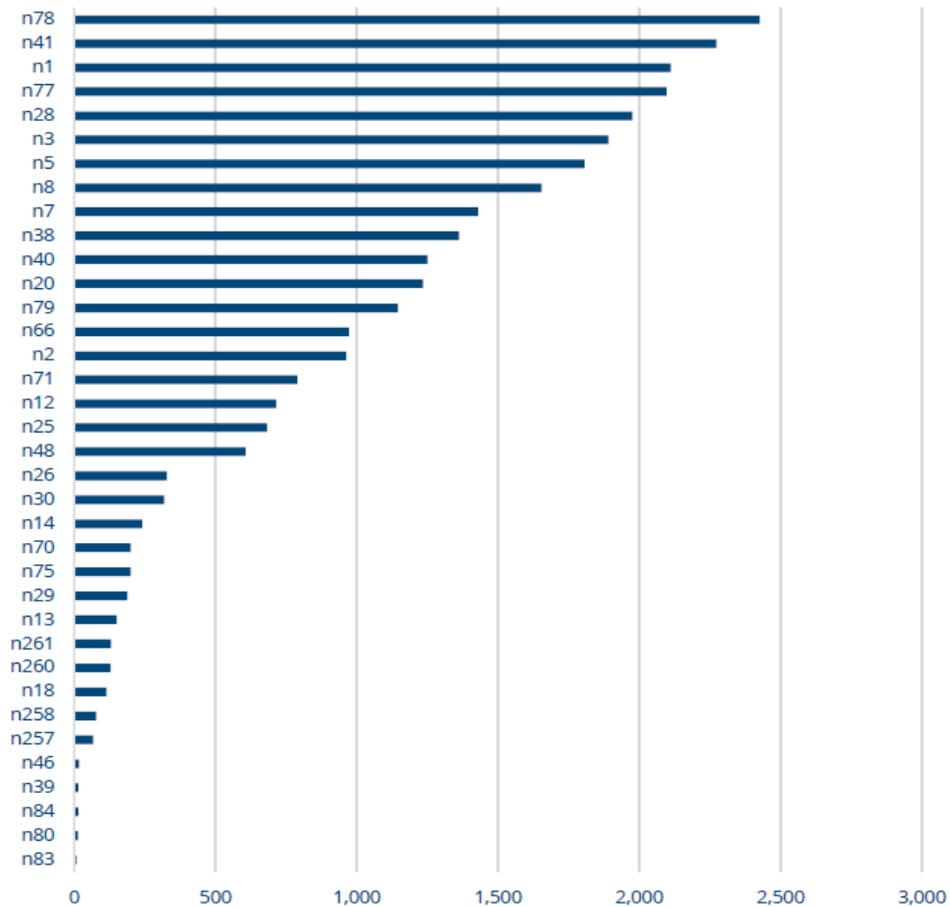
<sup>39</sup> <https://gsacom.com/paper/5g-market-snapshot-april-2025/>

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:



**Figure 2.9: Operators investing in Key Spectrum bands**

**Announced 5G device models supporting key 5G spectrum bands (end of March 2025)**



**Figure 2.10: 5G devices supporting key 5G spectrum bands**

2.210 In May-2022<sup>40</sup>, 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.

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

<sup>40</sup> <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.>

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).<sup>41</sup>
- (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.<sup>42</sup>
- (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:<sup>43</sup>

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<sup>41</sup> [comcom.admin.ch/en/nsb?id=73916](https://comcom.admin.ch/en/nsb?id=73916)

<sup>42</sup> <https://www.rcrwireless.com/20200723/5g/dutch-operators-secure-5g-spectrum#:~:text=The%20carrier%20paid%20a%20total,80%25%20of%20the%20country's%20population>

<sup>43</sup> [https://www.bipt.be/file/cc73d96153bbd5448a56f19d925d05b1379c7f21/75cde6b9aa34a554c89eef48699f03c2cc8b2bd1/pr\\_radio\\_spectrum\\_auction\\_ultimately\\_yields\\_more\\_than\\_1.4-billion\\_euro\\_2022-07-20.pdf](https://www.bipt.be/file/cc73d96153bbd5448a56f19d925d05b1379c7f21/75cde6b9aa34a554c89eef48699f03c2cc8b2bd1/pr_radio_spectrum_auction_ultimately_yields_more_than_1.4-billion_euro_2022-07-20.pdf)

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

2.212 The Ofcom, UK released a consultation paper<sup>44</sup> 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.

2.213 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

<sup>44</sup> <https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/call-for-input-1.4-ghz-band-available-for-mobile>

## **Comments of stakeholders on Q21 and Q22**

2.214 A broad summary of the comments received from stakeholders in response to Q21 and Q22, with respect to considering the need to assign a contiguous 24 MHz block in the 1427-1518 MHz range to the Government user, band plan and duplexing scheme to be adopted and range of spectrum, is given below:

(a) As regards the band plan, the stakeholders are generally of the view that

- a. Many stakeholders highlighted that the L-band (1427–1518 MHz) is critical for long-term capacity expansion and should be brought under IMT services. Owing to its superior propagation characteristics, the band is well suited for Supplemental Uplink (SUL) in 5G networks, enabling improved cell-edge performance, enhanced spectral efficiency, and reduced interference by offloading uplink traffic. One of such stakeholders further requested to hold back on designating 1427-1518 MHz as supplementary downlink for Government user now & instead re-evaluate the suitability of this band once the 5G networks are mature & 6G networks on the rise.
- b. A few stakeholders are of the view that a decision on band-plan should be deferred at this stage and reconsidered in future consultations, when the 3GPP specifications are further evolved & developed based on the capacity/coverage demands in UL/DL beyond 2026.
- c. One of the stakeholders mentioned that the L-band spectrum could be utilized under three possible 3GPP band plans- n74 (FDD) and n50/n75 (SDL).

(b) As regards a contiguous 24 MHz block for the Government user, the stakeholders are of the view that a contiguous 24 MHz block may be allocated to the Government user at either end. A few stakeholders

suggested that a contiguous 24 MHz block, preferably in the 1427–1451 MHz range, be reserved for government use. On the other hand, one of the stakeholders suggested that IMT-based services can benefit more from the lower edge, i.e., 1427-1494, due to a more favourable ecosystem.

(c) Other suggestions received from the stakeholders are:

- a. One of the stakeholders submitted that the entire IMT-identified 1427–1518 MHz band should be made available for mobile services.
- b. Another stakeholder submitted that there is a need to define a roadmap for release of 24 MHz from Government user for IMT services.
- c. One of the stakeholders suggested that efforts should be initiated through DoT, WPC, and TRAI to engage with 3GPP and global OEMs for defining and standardizing an SUL option in this spectrum band. The stakeholder further suggested that DoT and TRAI should initiate early consultations with chipset, device, and network vendors to ensure ecosystem readiness for SUL deployment in the 1427-1518 MHz band.

### **Analysis of the issues raised through Q21 and Q22**

2.215 Comments of the stakeholders have been carefully examined by the Authority, and it is noted that the stakeholders are generally of the view that this band should be adopted for Supplementary Uplink (SUL). The rationale provided by some of the stakeholders is reproduced below:

*“The spectrum in the 1427-1518 MHz range, total- 91 MHz, of which 67 MHz is identified for commercial IMT and a continuous 24 MHz block is required for the Government user. This Band offers superior propagation characteristics compared to higher frequency bands like 3.5 GHz and 6*

*GHz, making it ideal for Supplemental Uplink (SUL) in 5G networks. Lower frequencies experience less free-space path loss, allowing signals from low-power user devices to travel farther and penetrate obstacles like buildings and foliage more effectively. This ensures reliable connectivity, especially in urban and suburban environments. Unlike downlink transmissions, which benefit from high-power base stations and massive MIMO, uplink transmissions are constrained by device limitations such as battery life and hardware. These constraints make higher frequencies less effective for uplink, leading to signal degradation and reduced range. By shifting uplink traffic to the L Band, operators can maintain robust connectivity even at cell edges, improving overall network performance and user experience.*

*...*

*Telecom networks are undergoing a paradigm shift due to rising uplink traffic. Historically focused on downlink for streaming and browsing, networks now face surging demand for uploads driven by video calls, live streaming, cloud gaming, IoT, and remote work. Modern devices continuously transmit data to the cloud, necessitating low-latency and high-efficiency uplink channels. Technologies like 5G, edge computing, and massive MIMO are being deployed to support symmetrical data flows. This shift is critical for emerging applications such as virtual reality, telemedicine, autonomous vehicles, and industrial IoT, which rely on real-time, two-way communication. As users increasingly generate and share content, the traditional download-centric model is obsolete. Strengthening uplink capacity is essential to meet the demands of a hyperconnected world and ensure seamless digital experiences."*

2.216 From the above submission of the stakeholders, the following can be inferred:

- (a) Uplink traffic is increasing due to upload-driven applications.
- (b) While downlink transmissions can benefit from high-power base

stations and massive MIMO, uplink transmissions are constrained by device limitations such as user safety, battery life and hardware. Thus, higher frequencies are less effective for uplink, particularly at cell edges. By shifting uplink traffic to SUL band in lower frequencies such as the 1427-1518 MHz frequency range, operators can maintain robust connectivity even at cell edges, improving overall network performance and user experience.

2.217 The Authority notes that the stakeholders are of the view that the frequency range 1427-1518 MHz should be utilized for Supplementary Uplink (SUL). It is also noted that with increased use of AI on user devices, uplink traffic is likely to increase further. However, it is also noted that for the frequency range 1427-1518 MHz, 3GPP has not defined any band plan for SUL. In this regard, it is noted that one of the stakeholders has mentioned that currently, there is no 3GPP-defined SUL band plan for the L Band, though discussions are underway. Another stakeholder has requested that efforts should be initiated through DoT, WPC, and TRAI to engage with 3GPP and global OEMs for defining and standardizing an SUL option in this spectrum band.

2.218 In view of the foregoing discussion and the fact that this band is not planned to be put to auction in the forthcoming auction, the Authority is not recommending band plan for 1427-1518 MHz frequency range and the same will be re-examined later. Further, considering the demand of the stakeholders, the Authority is of the view that DoT may explore the possibility of taking up the matter with the regional and global standards bodies for the creation of a suitable band plan for utilizing the frequency range for 1427-1518 MHz for SUL. The action taken and the outcome of the same may be shared with the Authority.

2.219 As regards 24 MHz to be earmarked for the Government user, it is noted

that DoT, through its letter dated 14.08.2025, requested TRAI 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. With such a requirement, it is noted that the adoption of FDD-based band plan, viz. band plan n74 (Uplink: 1427-1470 MHz and Downlink: 1475-1518 MHz) becomes unfeasible as a 24 MHz block for the Government user cannot be carved out within the duplexing gap of 5 MHz [1470-1475 MHz]. With any other band plan i.e., TDD-based, SDL or SUL, the Authority concurs with the views of the stakeholders that a 24 MHz block can be allocated to the Government user at either end to have contiguous spectrum availability for IMT services. Having said that, (i) since band plan to be adopted for this band is yet to be decided and (ii) use case of the government user is not known, it may be premature to recommend the frequency range to be allocated to the Government user.

2.220 In view of the above, **the Authority recommends that –**

- (a) The matter relating to the adoption of an appropriate band plan for 1427-1518 MHz frequency range should be re-examined after the Government decides to put this band to auction.**
- (b) DoT may explore the possibility of taking up the matter with the regional and global standardization bodies for the creation of a suitable band plan for utilizing the frequency range for 1427-1518 MHz for Supplementary Uplink (SUL). The action taken and the outcome of the same may be shared with the Authority.**
- (c) While allocating a 24 MHz block to the Government user, DoT should ensure that a contiguous 67 MHz block is available for IMT services.**

## **E. The aspects related to the methodology of auction of spectrum**

2.221 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 may 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 may also depend 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.

2.222 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.<sup>45</sup>
- (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 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. The first practical implementations were the Trinidad and Tobago

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<sup>45</sup> Bichler M, Goeree JK, eds. *Handbook of Spectrum Auction Design*. Cambridge University Press; 2017.

Spectrum Auction, in 2005, and the UK's 10-40 GHz and L-Band Auctions, in 2008.<sup>46</sup>

2.223 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:

*"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."*

2.224 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.

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<sup>46</sup> 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>

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<sup>47</sup> for spectrum auctions held in June 2024.

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

2.226 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of stakeholders on Q23**

2.227 A broad summary of the comments received from stakeholders in response to Q23, with respect to whether there is a need to review the spectrum auction method and design followed in India, is given below:

- (a) Most of the stakeholders are of the opinion that existing auction method of SMRA should be continued in forthcoming auctions as well.
- (b) One of the stakeholders suggested to move from the current SMRA to a Combinatorial Clock Auction, which better fits India's

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<sup>47</sup> <https://www.dot.gov.in/ministry/our-division/details/wpc-and-spectrum-management-QTMzMTMtQWa>

consolidated market and complex spectrum valuations. The stakeholder stated that in SMRA, bidders bid on single, generic blocks in each of the 22 Licensed Service Areas (LSAs); the core flaw of SMRA is that it forces bidders to risk winning some but not all of the components needed for an efficient network (e.g., winning in Mumbai but losing in Delhi); in the proposed CCA method, bidders bid on packages of spectrum blocks across multiple bands and/or LSAs simultaneously; CCA eliminates this "aggregation risk" by allowing bids for complementary packages (say 10 MHz in 2300 MHz across all four Metro LSAs). This ensures that spectrum goes to the operator who values it most for an integrated network.

- (c) Another stakeholder submitted that there could be merit in updating the auction design to address the evolving requirements of 5G-Advanced and 6G, while safeguarding efficiency, competition, and investor confidence in the telecom sector.

### **Analysis of the issues raised through Q23**

2.228 On examination of the comments received from the stakeholders it is noted that most of the stakeholders are of the view that SMRA based spectrum auction is working well and it should be continued. On the other hand, one of the stakeholders has suggested to move from the current SMRA to a Combinatorial Clock Auction. It is observed that the stakeholder suggesting moving to CCA, has also mentioned that CCA eliminates this "aggregation risk" by allowing bids for complementary packages. In this regard, it may be noted that in the knowledge of Authority, there has been no such instance where a TSP has faced such an aggregation issue due to auction design. Moreover, no TSP has raised such concerns or suggested to move from SMRA to CCA.

2.229 International experience favours SMRA over CCA for its simplicity and

efficiency. For instance, Ofcom in its award of the 2.3 and 3.4 GHz spectrum bands adopted SMRA auction format. Ofcom had considered alternative auction formats, particularly the Combinatorial Clock Auction (CCA) which they had used previously, but the regulator concluded that the SMRA format had important advantages – particularly simplicity – which meant it was well suited to the particular circumstances of the 2.3 and 3.4 GHz award. Ofcom also concluded that the residual risks were not likely to have a significant impact on the efficiency of the award<sup>48</sup>.

2.230 The Australian Communications and Media Authority (ACMA) adopted the CCA format for its 2013 Digital Dividend (700 MHz) and 2.5 GHz spectrum auction. However, for subsequent auctions—including the 3.6 GHz band (2018), 26 GHz band (2021), 850/900 MHz band (2021), and 3.4/3.7 GHz bands (2023)—ACMA shifted to the Enhanced Simultaneous Multi-Round Ascending (ESMRA) format<sup>49</sup>. The ESMRA approach promotes allocative efficiency by enabling bidding on generic lots during the allocation stage, followed by a separate assignment stage to determine specific frequencies.<sup>50</sup>

2.231 Further, in CCA or package bidding, a package could be (i) a combination of two or more frequency bands and/ or (ii) distinct blocks (having different characteristics or externalities such as coexistence with an incumbent user) within a frequency band. CCA's performance may be impeded by several limitations. First, with a large number of product categories (e.g., in spectrum auctions in countries with regional licenses), it may be difficult or impossible for bidders to express their values for all relevant combinations of items in the supplementary round. Second, the

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<sup>48</sup><https://www.ofcom.org.uk/siteassets/resources/documents/consultations/uncategorised/93522-award-of-the-spectrum-bands/associated-documents/statement-award-of-the-2.3-and-3.4-ghz-spectrum-bands-competition-issues-and-auction-regulations.pdf>

<sup>49</sup> [About spectrum auctions | ACMA](#)

<sup>50</sup><https://www.anao.gov.au/work/performance-audit/management-spectrum-reallocation-to-support-the-deployment-5g-services>

activity rules imposed on bidders may at once be too stringent, preventing straightforward bidding, and too weak, permitting manipulative and exploitative pricing of opponents. Third, unlike most other auction formats, the current CCA is "iterative second-price" rather than "iterative first-price": bidders generally pay less than the amounts of their winning bids. This creates a fundamental tension between the clock rounds and the supplementary round<sup>51</sup>. To implement CCA, the regulator needs to gather information from bidders on how they value different packages of spectrum and create bundles accordingly, which could be quite a complex exercise, and the possibility of going wrong cannot be ruled out in such a situation.

2.232 In India, considering the global developments, various frequency bands have been earmarked and opened up for IMT at different times. Further, within a frequency band, different blocks are generally substitutable in nature. Moreover, no TSP has either raised the concerns relating to 'aggregation risk' or suggested to move from SMRA to CCA.

2.233 In view of the above, **the Authority recommends that the Simultaneous Multiple Round Auction (SMRA)-based spectrum auction should be continued.**

2.234 The following chapter analyzes the issues related to the valuation and reserve price of spectrum.

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<sup>51</sup> Ausubel, L. M., & Baranov, O. V. (2014). Market design and the evolution of the combinatorial clock auction. *American Economic Review*, 104(5), 446-451

## **Chapter III: Valuation and Reserve Price of Spectrum**

### **A. Introduction**

- 3.1 This chapter deals with various aspects of the valuation and reserve price of the different spectrum bands that have been discussed in previous two chapters, i.e. 600 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz and 6425-6725 MHz & 7025-7125 MHz spectrum bands.
- 3.2 Although the spectrum itself is not a depletable resource, technology and network requirements determine how efficiently different spectrum bands can be utilized at any given time. The use of spectrum is typically regulated and licensed across the world to ensure fair access, prevent harmful interference, and maximize broader socio-economic benefits. With wireless demand continuing to rise, sharply driven by increasing mobile data usage, new use cases such as Fixed Wireless Access (FWA), Internet of Things (IoT), and enterprise connectivity, spectrum has emerged as a highly valuable commodity in many countries, including India.
- 3.3 Efficient spectrum valuation is fundamental to ensuring optimal allocation and utilisation of this finite public resource. A well-designed valuation framework must reflect the intrinsic economic value of spectrum, its utility in delivering next-generation services, and prevailing market conditions. It should be forward-looking, largely technology-neutral, and sensitive to ecosystem maturity and demand dynamics. A balanced and evidence-based approach seeks to ensure that spectrum is valued in a manner that promotes efficient use, incentivises network investment, and supports public good and innovation, while preventing artificial scarcity or under-utilisation.

3.4 In this context, the objectives articulated by the Government for recent spectrum auctions, as set out in the section 1.2 of NIA for the 2022 and 2024<sup>52</sup> auctions, signify a calibrated and progressive shift in auction objectives, focusing on maximizing efficiency, competition, sustainability, and consumer welfare, rather than merely maximizing auction revenue. The same are reproduced below:

*1.2 Objectives of the Auction*

*The Government has set itself 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.*

3.5 In fact, while other broad objectives have remained the same, the last bullet point, highlighting sustainable and affordable access to Digital communications as an objective of auctions, has come to replace the objective of “maximizing revenue proceeds from the auctions within the set parameters” which was mentioned in the NIAs of auctions prior to 2022. The changing objectives underscore the recognition that spectrum pricing should not only reflect economic value but also facilitate robust participation in auctions, timely rollout of services across frequency bands and overall consumer welfare. A rational and balanced spectrum valuation and consequent reserve price, therefore, serves as an instrument to advance digital inclusion, strengthen competition, and ensure that the benefits of advanced wireless technologies reach citizens and enterprises

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<sup>52</sup> <https://www.dot.gov.in/static/uploads/2025/07/2d3a956120dccd49e7ef1078163811cf.pdf>

in an affordable and equitable manner.

- 3.6 Further, National Digital Communications Policy (NDCP) 2018 emphasizes the need for transparent, efficient, and forward-looking spectrum management. The policy articulates key objectives, including adequate spectrum availability for broadband services, optimization of spectrum utilization, and promotion of next-generation access technologies, to enable equitable access and socio-economic development.
- 3.7 In India, the shift to market-based allocation of spectrum through auctions began in 2010-11, moving away from administrative assignment to transparent competitive bidding to promote efficient use, prevent hoarding, stimulate competition, and catalyse rollout of advanced services such as 3G, BWA, 4G and, more recently, 5G services. The adoption of auction as the preferred and legally robust method for allocation of spectrum in India emanates from the judgments of the Hon'ble Supreme Court, particularly its decision dated 02.02.2012 in Centre for Public Interest Litigation and Others v. Union of India and Others [(2012) 3 SCC], commonly referred to as the 2G case. In the said judgment, the Hon'ble Court, *inter alia*, emphasized that natural resources such as spectrum are held by the State in trust for the people, and that their allocation must adhere to constitutional principles, including the doctrine of equality, transparency, and maximization of public good. The Court further observed that wherever the State transfers or alienates natural resources to private entities, it is duty-bound to adopt a transparent and non-discriminatory process that affords all eligible persons a fair opportunity to participate, and that auction constitutes the preferred method for such allocation. Further, Section 4(4) of Chapter II of the Telecommunications Act, 2023<sup>53</sup>

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<sup>53</sup> [https://www.trai.gov.in/sites/default/files/2024-09/Telecommunications\\_01012024.pdf](https://www.trai.gov.in/sites/default/files/2024-09/Telecommunications_01012024.pdf)

provides that 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.

- 3.8 The Authority has consistently recognised that rational valuation and appropriate pricing of spectrum are essential for the orderly growth and sustainability of the telecommunications sector, given its critical role in enabling digital economy. The valuation of spectrum is inherently complex, involving a blend of techno-economic analysis, market dynamics, and regulatory considerations. Past recommendations related to spectrum auction by the Authority have underscored the importance of objective and transparent valuation methodologies grounded in both technical and economic principles, acknowledging that valuation is not an exact science but relies on robust analytical frameworks alongside informed judgement.
- 3.9 International experience indicates notable variations in auction results and pricing, influenced by factors such as spectrum supply, licensing terms, market structure and economic conditions. Recent global analyses by industry bodies, including GSMA, highlight the importance of aligning spectrum policy with broader digital objectives, noting that high spectrum costs can affect investment and network expansion, and stressing the need for sustainable, investment-friendly spectrum pricing strategies <sup>54</sup>.
- 3.10 Spectrum valuation and reserve price determination form the core of this Chapter, which addresses the methodologies, analytical models, key assumptions and rationale adopted by the Authority in recommending valuation and reserve prices for the spectrum bands identified for the proposed IMT auction. These valuation exercises are conducted on a

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<sup>54</sup> <https://www.gsma.com/newsroom/press-release/smarter-spectrum-policies-could-ease-europes-mobile-investment-needs-new-gsma-report-finds/>

license service area-wise basis for each band under consideration, and the underlying processes have been discussed in the consultation process to facilitate informed stakeholder participation. The subsequent sections also explain how reserve prices are derived from valuation estimates, along with the justification for associated recommendations and conditions.

**B. DoT's Reference Dated 15.05.2025**

3.11 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:

*(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.*

3.12 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."*

3.13 The present chapter addresses the interrelated aspects of spectrum valuation and the determination of reserve prices for the spectrum bands proposed to be auctioned for IMT services. In line with established regulatory practice, the Authority has carried out detailed valuation exercises to arrive at LSA-wise estimates for each spectrum band under consideration. The methodologies employed, along with the modelling frameworks and key assumptions underpinning the valuation, have been placed in the public domain through the consultation process to enable informed and meaningful participation by stakeholders. The process by which reserve prices are derived from the valuation estimates, along with the rationale for the associated recommendations and conditions, has been elaborated in the subsequent sections of this Chapter.

### **C. Factors Affecting Valuation of Spectrum**

3.14 Radio spectrum constitutes the backbone of telecommunication networks and is an indispensable input for the provision of wireless voice and data services. As a finite national resource held in public trust, the manner in which spectrum is valued and priced has significant implications for service affordability, quality of service, network expansion, competition, and the pace of digital inclusion. Spectrum valuation, therefore, extends beyond a sectoral financial exercise; it has a direct bearing on consumer tariffs, investment incentives, and the broader trajectory of the digital economy.

3.15 In this context, spectrum pricing must be anchored in a transparent, well-reasoned, and forward-looking framework. Appropriate valuation ensures that spectrum is assigned for its most efficient and productive use, while simultaneously supporting effective competition and the long-term financial sustainability of service providers. The Authority has consistently adopted a balanced and evidence-based approach, drawing upon technical, financial, economic, and market-based considerations to safeguard public interest and promote optimal utilisation of this finite resource.

3.16 Although the reserve price derived from spectrum valuation serves only as the floor price in an ascending auction, and the final auction outcome and prices are a result of complex interplay of multiple techno-economic, commercial and wider policy and regulatory factors, the robustness of the valuation exercise can definitely be continually enhanced by periodically reassessing the economic, technical, and market-related factors that influence spectrum demand and supply. Such reassessment is necessary in view of evolving market conditions, technological advancements, and sectoral developments.

3.17 In this regard, the Authority solicited comments from stakeholders on the following set of question(s):

*Q.24. 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?*

#### **Comments of Stakeholders on Q24**

3.18 In response, stakeholders have outlined a comprehensive array of

economic, technical, and market-related factors essential for determining spectrum valuation and reserve prices to foster effective competition, optimal utilization, and broader auction participation. Some stakeholders have highlighted the importance of economic sustainability of the telecom sector, affordability of services, and the long-term socio-economic benefits arising from widespread digital connectivity. Key economic considerations include the overall macroeconomic environment, consumer affordability, ARPU levels, GDP growth, inflation, availability of financing, and the cost of network rollout. Stakeholders have also pointed out that excessively high reserve prices have historically resulted in limited participation and unsold spectrum, thereby leading to sub-optimal utilization of a scarce public resource. Many stakeholders have stressed the need to align spectrum valuation with national digital objectives, sectoral health, investor confidence, and the opportunity cost associated with spectrum remaining idle. International benchmarking using globally accepted metrics, adjusted for Indian market realities, has also been suggested as an important reference.

- 3.19 From a technical and market perspective, some stakeholders have underlined that the intrinsic characteristics of different frequency bands such as propagation, coverage, capacity, replaceability, and efficiency should be explicitly factored into valuation. Considerations such as higher CAPEX and OPEX requirements for mid- and high-band spectrum, interference issues, technology evolution, spectrum refarming costs, and spectrum sharing mechanisms were identified as relevant technical inputs. On the market side, factors such as demand-supply balance, auction design, spectrum caps, rollout obligations, market concentration, and the maturity of device and use-case ecosystems were highlighted as influencing effective competition and auction participation. Some stakeholders have also proposed differentiated approaches for bands already auctioned earlier versus new bands, including maintaining price

stability to protect investor confidence, reducing reserve prices where spectrum has repeatedly gone unsold, and ensuring availability of contiguous spectrum blocks.

- 3.20 While a range of stakeholders have provided an extensive list of economic, technical, and market-related factors that should form the basis of spectrum valuation, no stakeholder has proposed a precise alternative methodology or pricing formula for quantitatively incorporating these into spectrum valuation beyond continuing existing approaches.

### **Analysis of the issues raised through Q24**

- 3.21 The views and submissions made by the stakeholders on the relevant factors for determination of spectrum valuation and reserve prices have been carefully examined. As highlighted by several stakeholders, the revenue potential of spectrum remains a critical input in the valuation process. Revenue potential is influenced by multiple dynamic variables such as the size and growth of the subscriber base, consumer affordability, uptake of new services, pricing strategies adopted by service providers, and the pace of technological adoption. These factors evolve over time and vary across operators and service areas. The ability of spectrum to generate sustainable revenues, while enabling affordable services and supporting long-term investments, remains a central consideration in valuation.
- 3.22 The importance of broader economic and financial indicators, including GDP growth, inflation, ARPU levels, cost of capital, availability of financing, and overall macroeconomic conditions in valuation of spectrum brought out by stakeholders has also been noted. These parameters have a direct bearing on the financial health of the telecom sector and the capacity of operators to invest in spectrum and network deployment. While

international benchmarking of spectrum prices can provide useful reference points, particularly for new bands or in situations where domestic data is limited, such benchmarks must be applied with due caution. Significant differences exist across countries in terms of geography, population density, income levels, market structure, regulatory frameworks, spectrum usage rights, and auction designs. Accordingly, international comparisons need to be suitably adjusted to reflect Indian market conditions and cannot be relied upon in isolation.

3.23 Further, the stakeholder views on the relevance of past auction outcomes, demand-supply dynamics, and instances of unsold spectrum as indicators of market response has been duly noted. Prices discovered in previous auctions reflect market assessments at a given point in time and can serve as important inputs for future valuation, subject to appropriate adjustments for inflation, time value of money, and changes in market and technological conditions. At the same time, it is recognised that technical characteristics of spectrum bands such as propagation, coverage, capacity, efficiency, interference environment, and associated CAPEX and OPEX requirements significantly influence their economic value and must be duly incorporated in the valuation framework.

3.24 It is noted that the reserve price, derived from valuation, operates only as a floor price in an ascending auction, while the final auction price is determined through competitive bidding based on the interaction of demand and supply. It is often perceived that if the full quantum of spectrum offered in an auction remains unsold, or if it is acquired only at the reserve price, this necessarily reflects weak demand arising from an excessively high or prohibitive reserve price. Here, it is important to understand that although the reserve price may influence participation and bidding intensity to some extent, it is only one among several interrelated determinants of auction outcomes. The reserve price, in itself,

does not singularly determine bidder participation, the quantity of spectrum acquired, or the extent to which auction prices move beyond the reserve level. Rather, auction outcomes and demand patterns emerge from a combination of several interdependent factors operating simultaneously. Demand for spectrum is a derived demand contingent upon the demand for telecom services and is shaped by multiple economic, financial, technical, and market-related factors, including projected subscriber growth, traffic demand, related projections on revenue and expenditure, coverage requirements within an LSA, and the number of participating bidders along with their financial health and investment capacity. It is further influenced by existing spectrum holdings, timing of recent auctions and monetisation of previously acquired spectrum, individual business plans and technology roadmaps, impending licence expiries, introduction of new technologies and spectrum bands, maturity of the device ecosystem, and the prevailing reserve price. These factors also demonstrate that auction outcomes, including instances of unsold spectrum or spectrum being acquired at reserve price, cannot be attributed solely or very significantly to the level of the reserve price, but rather emerge from the combined effect of technical feasibility, commercial viability, financial capacity, competitive dynamics, and the broader policy environment.

- 3.25 The Government and the economy are witnessing rapid digitisation of services across sectors. Further, the increasing adoption of data-intensive technologies, including Artificial Intelligence, M2M, IoT etc. is expected to significantly accelerate data consumption. Given that broadband adoption in India is predominantly wireless, enhancement of network capacity requires access to additional spectrum, along with densification of network infrastructure. Accordingly, medium to long term demand and supply of spectrum cannot be assessed solely from the extent of bidder participation in a particular auction.

- 3.26 Participation of bidders in spectrum auctions is also influenced by a range of policy-related factors, including Government policies affecting the overall attractiveness of the sector for private investment, the financial sustainability of existing service providers, and the potential entry of new service providers. In addition, spectrum planning by the Department of Telecommunications, including the National Frequency Allocation Plan (NFAP) and its implementation, plays a critical role in determining the availability and supply of spectrum for service providers and prospective bidders.
- 3.27 Amongst other important indications, these considerations in the above two paras collectively underscore that while past auction outcomes provide useful market signals, careful contextual assessment is required before applying auction-determined prices (ADP) as benchmarks for future valuation. More importantly, the complex factors influencing demand of spectrum and level and intensity of participation in spectrum auctions brought out above make it all the more imperative to marshal all possible knowledge and resources to attempt to incorporate these factors into valuation and pricing of spectrum as accurately as possible.
- 3.28 The reserve price is determined on the basis of a comprehensive valuation exercise undertaken by the Authority, which takes into account a range of financial, economic, technical, and other relevant considerations. In carrying out this exercise, the Authority adopts established valuation methodologies to appropriately reflect these factors and arrive at an optimal valuation that provides a reasonable and objective basis for fixation of the reserve price.
- 3.29 In view of the above, the Authority reiterates that spectrum valuation cannot be based on any single parameter or method. Parameters such as revenue potential, subscriber growth, traffic demand, projected

investments and return on investment, macro and micro-economic indicators, technical efficiency, past auction prices, and relevant international benchmarks, which have also been considered in earlier exercises, remain pertinent for the present valuation as well. The Authority is of the view that adopting a multi-dimensional and methodologically diverse approach to spectrum valuation is the most appropriate way to capture the complex interplay of economic, technical, and market factors, and to arrive at reserve prices that promotes competition, optimal spectrum utilization, and sustainable growth of the telecom sector.

#### **D. Periodicity for Conduct of Fresh Valuation Exercise**

3.30 The Authority in its Recommendations on the Auction of Spectrum in frequency bands identified for IMT/5G dated 11.04.2022<sup>55</sup>, had set out a structured framework for the periodicity of spectrum valuation. Specifically, the Authority recommended that, for existing spectrum bands, including those being offered for auction for the first time, a comprehensive spectrum valuation exercise should be undertaken once every three years, with the Government making appropriate reference to the Authority for this purpose.

3.31 The Authority further held at Para 3.40 of the Recommendations dated 11.04.2022 that, for auctions conducted during the intervening period between two such three-year valuation exercises, reserve prices should be derived using auction outcomes from previous auctions. In this regard, it was stipulated that, for LSAs where spectrum offered in a previous auction was sold, the auction-determined prices should be used for arriving at reserve prices for subsequent auctions, with suitable indexation

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<sup>55</sup> [http://www.trai.gov.in/sites/default/files/2024-09/Recommendations\\_11042022.pdf](http://www.trai.gov.in/sites/default/files/2024-09/Recommendations_11042022.pdf)

using the applicable MCLR if more than one year had elapsed since the earlier auction. However, for LSAs where the spectrum remained unsold in previous auctions, the last recommended reserve price (RP) without any indexation should be adopted, thereby indirectly providing for a discount equal to the interest rate.

3.32 As discussed above, the Authority's recommendations of 11.04.2022 envisaged a three-year valuation cycle, with interim auctions drawing upon auction-determined prices, suitably indexed where applicable. It is pertinent to note that more than three years have elapsed since the spectrum valuation exercise carried out for the 2022 recommendations.

3.33 In this regard, the Authority solicited comments from stakeholders on the following set of question(s):

*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.*

### **Comments of Stakeholders on Q27**

3.34 In response to the question on the periodicity of conducting spectrum valuation exercises, stakeholders have expressed divergent views on the periodicity of spectrum valuation exercises for IMT services. Some stakeholders have supported the Authority's earlier recommendation of undertaking a comprehensive spectrum valuation exercise once every three years, particularly for existing spectrum bands. They have suggested that this approach provides regulatory certainty and stability, while allowing interim auctions to rely on indexed prices from previous auctions or the last recommended reserve price in cases where spectrum

remained unsold. They are of the view that a three-year cycle, supplemented by suitable indexation mechanisms, is adequate to keep reserve prices reasonably aligned with market conditions without imposing unnecessary regulatory or administrative burden.

- 3.35 On the other hand, several other stakeholders have argued that a fixed three-year periodicity may not be sufficient in the current environment characterized by rapid technological advancements, evolving market structures, and frequent spectrum auctions. These stakeholders have emphasized that annual or more frequent valuation reviews would better capture changes arising from developments such as 5G-Advanced, emerging 6G technologies, new IMT bands, shifts in demand-supply conditions, sectoral consolidation, and changes in the financial health of operators. Some have proposed an annual valuation exercise, or at least an annual re-look at reserve prices, to ensure that valuations remain contemporary, data-driven, and responsive to market realities, while suggesting that the depth and extent of such exercises could be calibrated based on circumstances such as unsold spectrum, new band identification, or significant market events. Overall, stakeholders have broadly agreed on the need for flexibility in valuation periodicity, with most supporting either a three-year comprehensive valuation complemented by interim adjustments, or a more frequent review framework to maintain relevance and promote efficient spectrum utilization.

### **Analysis of the Issues raised through Q27**

- 3.36 With regard to the issues raised by stakeholders on the periodicity of spectrum valuation, the diverse views expressed have been examined. Spectrum valuation exercises are undertaken using a combination of established models and approaches that draw upon technical parameters, market conditions, and economic indicators, all of which are periodically

updated. It is felt that these financial models and underlying parameters and assumptions do not typically undergo substantial changes over short period of time. At the same time, it is recognized that the telecom sector is subject to steady technological evolution and market developments, which warrant a structured and periodic reassessment of spectrum value rather than ad-hoc or overly frequent revisions.

- 3.37 It is further observed that while auctions may be conducted annually and may yield auction-determined prices for certain bands and LSAs, such price discoveries are often partial. Experience from past auctions indicates that spectrum in several bands or LSAs remains unsold, and auction outcomes do not always provide comprehensive market-based price signals across all bands and LSAs.

Accordingly, the Authority is of the considered view that a comprehensive spectrum valuation exercise once every three years, as recommended in its recommendations dated 11.04.2022, remains appropriate. This periodicity strikes a balance between ensuring regulatory stability and allowing sufficient scope to capture meaningful changes in techno-economic conditions. Thus, while the Authority does not find it necessary to undertake full-scale valuation exercises on an annual basis, it reiterates the need for periodic comprehensive valuation at three-year intervals, complemented by pragmatic interim adjustments, to ensure efficient spectrum utilization and a predictable, stable auction framework.

- 3.38 At the same time, the Authority considers it appropriate that interim auction outcomes should be suitably leveraged within this framework. As has been mentioned above, it was held at para 3.40 (2) in recommendation dated 11.04.2022, that for auctions conducted within a period of 3 years of a comprehensive valuation exercise, the Auction determined prices can be used for arriving at Reserve prices, after appropriate indexation to account for the time value of money and

inflation, as these prices directly reflect market preferences. Further, within this 3-year period, for spectrum band-LSA combinations that remain unsold in previous auction, the Authority had taken the view that the Reserve price without indexation can be used, thereby indirectly providing for a discount equal to the interest rate.

3.39 For the present exercise, the Authority agrees with these recommendations of 2022, as they balance a stable and predictable regulatory stance with need for contemporary and multi-pronged spectrum valuation. These recommendations have also been suitably adapted while using past ADPs/ RPs of 2022/ 2024 as one of the valuation methodologies in this present comprehensive valuation exercise and is detailed at Section E (1) below.

3.40 Accordingly, 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 should 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,**
  - i. 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.**

- ii. 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.**

3.41 Before concluding this section, the Authority would also like to reiterate an important aspect relating to the auction process, which has a bearing on the robustness of future valuation exercises. The Authority, at Para 3.38 of its Recommendations dated 11.04.2022, had emphasized that the availability of comprehensive and analytically examined auction data is critical for informed spectrum valuation. The Authority had observed that spectrum auctions are conducted by DoT in accordance with the Notice Inviting Applications (NIA) prepared and issued by DoT, and therefore DoT is best placed to critically analyse the auction outcomes. Accordingly, the Authority at Para 3.38 of its Recommendations dated 11.04.2022 had recommended that:

*"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."*

3.42 Consequently, DoT prepared Auction outcomes reports after the spectrum auctions held in July 2022 and June 2024, which were communicated to the Authority on 14.12.2022 and 08.01.2025 respectively. Though the said reports contain factual position of the respective auction outcomes,

analysis of the auction outcomes is lacking. A detailed causal analysis on the facts observed, such as quantity of sold & unsold spectrum, level of ADPs vs RPs, number of participants, intensity of participation etc. should be contained in such reports on auction outcomes.

- 3.43 In view of the above, and consistent with its earlier Recommendation dated 11.04.2022, **the Authority recommends that DoT should prepare a comprehensive report analysing the outcomes of each forthcoming auction to be shared with the Authority within 90 days of conclusion of the auction.** Such structured post-auction analysis will further strengthen the evidentiary basis for future spectrum valuation exercises, enhance transparency, and contribute to a more informed and stable auction framework.

**E. Valuation and Reserve Price of Spectrum in Existing Bands: 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz Bands**

- 3.44 Vide reference dated 15.05.2025, the DoT has, inter alia, requested TRAI to furnish its recommendations on the applicable reserve prices for the auction of spectrum in the existing bands, namely 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz.

- 3.45 This section addresses the valuation of spectrum in existing bands, i.e., those bands that have been auctioned in the past and have attracted bids, including the related issues of soundness of various valuation methodologies and methods to arrive at reserve prices.

- 3.46 For the existing spectrum bands as mentioned above in the preceding section, past auction-determined prices are available. Further, since service providers have acquired spectrum in these bands through

auctions, relevant financial, technical and other associated data are also available. Accordingly, the use of past auction-determined prices for the respective bands may constitute one of the approaches for their valuation.

- 3.47 The valuation of spectrum in existing bands as mentioned above may also be undertaken using comparative approaches based on relative spectral efficiency, wherein the technical characteristics such as coverage of a particular spectrum band are compared with those of another band, and an appropriate spectral efficiency factor is derived as a ratio.
- 3.48 In addition to the use of past auction-determined prices and spectral or technical efficiency factors discussed in subsequent sections, other valuation models and approaches may also be applied for determining the value of spectrum in the existing bands of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz, given the availability of financial, technical and other relevant data. These models/ approaches, which are discussed in the subsequent sections, include:
- (i) Multiple Regression Approach
  - (ii) Trend Line Approach
  - (iii) Production Function Model
  - (iv) Producer Surplus Model
  - (v) Revenue Surplus Model and
  - (vi) Economic Premium Model

#### **E (1) Applicability of 2022/2024 Past ADPs (Auction Determined Prices) for Existing Bands**

- 3.49 In several spectrum valuation exercises undertaken in the past, including the IMT/5G valuation exercise of 2022, the Authority has considered past auction-determined prices as one of the approaches for valuing spectrum

bands. The Authority has consistently held the view that auction-determined prices represent an important indicator of the value ascribed to spectrum by the market.

Accordingly, details relating to the reserve price, auction-determined price, quantity of spectrum put to auction, and quantity sold in the IMT/5G auctions conducted in 2022 and 2024 have been presented in Table 3.1 and Table 3.2 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)
<b>600MHz</b>	6600 (22 LSAs)	3927 (22 LSAs)	-	22	Received no bid	
<b>700MHz</b>	550 (22 LSAs)	3927 (22 LSAs)	220 (22 LSAs)	0	3927 (22 LSAs)	3927 (22 LSAs)
<b>800MHz</b>	136.25 (22 LSAs)	3620 (22 LSAs)	20 (4 LSAs)	18	210 (4 LSAs)	210 (4 LSAs)
<b>900MHz</b>	74.40 (21 LSAs)	3658 (21 LSAs)	12.8 (3 LSAs)	18	86 (3 LSAs)	86 (3 LSAs)
<b>1800MHz</b>	267.20 (22 LSAs)	2116 (22 LSAs)	88.40 (10 LSAs)	12	1148.76 (10 LSAs)	1221.76 (10 LSAs)
<b>2100MHz</b>	160 (19 LSAs)	1486 (19 LSAs)	35 (7 LSAs)	12	636 (7 LSAs)	636 (7 LSAs)

<b>2300MHz</b>	60 (6 LSAs)	362 (6 LSAs)	-	6	Received no bid	
<b>2500MHz</b>	230 (12 LSAs)	482 (12 LSAs)	20 (2 LSAs)	10	65 (2 LSAs)	65 (2 LSAs)
<b>3300MHz</b>	7260 (22 LSAs)	317 (22 LSAs)	5490 (22 LSAs)	0	317 (22 LSAs)	317 (22 LSAs)
<b>26GHz (mmWave)</b>	62700 (22 LSAs)	6.99 (22 LSAs)	45350 (22 LSAs)	0	6.99 (22 LSAs)	6.99 (22 LSAs)

3.50 The salient features of the 2022 IMT/5G spectrum auction are summarized below:

- A total of 72,098 MHz of spectrum was offered for auction, out of which 51,236 MHz (approximately 71% of the total) was sold, with aggregate bids amounting to ₹1,50,173 crore.
- No bids were received for the 600 MHz and 2300 MHz bands.
- With respect to the 600 MHz band, the Ministry of Communications, vide Press Release dated 02.08.2022, stated that *"the device ecosystem of the 600 MHz band is still not developed for mobile telephony. In a few years, this band may become important."*
- Four bidders participated in the auction and acquired spectrum across various bands.
- Auction-determined prices for the 700 MHz band, 3300 MHz (mid-band), and 26 GHz (mmWave band) were discovered across all 22 Licensed Service Areas.

**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)
<b>800 MHz</b>	118.75 (19 LSAs)	3426 (19 LSAs)	-	19	Received no bid	
<b>900 MHz</b>	117.20 (22 LSAs)	3855 (22 LSAs)	60.80 (14 LSAs)	8	1851 (14 LSAs)	1851 (14 LSAs)
<b>1800 MHz</b>	221.40 (22 LSAs)	2337 (22 LSAs)	50.60 (10 LSAs)	12	789 (10 LSAs)	791.92 (10 LSAs)
<b>2100 MHz</b>	125 (15 LSAs)	1353 (15 LSAs)	20 (4 LSAs)	11	109 (4 LSAs)	109 (4 LSAs)
<b>2300 MHz</b>	60 (6 LSAs)	443 (6 LSAs)	-	6	Received no bid	
<b>2500 MHz</b>	70 (6 LSAs)	77 (6 LSAs)	10 (1 LSA)	5	15 (1 LSA)	15 (1 LSA)
<b>3300 MHz</b>	1110 (19 LSA)	355.04 (19 LSA)	-	19	Received no bid	
<b>26 GHz</b>	8700 (21LSA)	7.61 (21 LSA)	-	21	Received no bid	

3.51 The salient features of the 2024 IMT/5G spectrum auction are as follows:

- The auction included spectrum expiring in 2024 as well as unsold spectrum from the 2022 auction, with the objective of meeting the spectrum requirements of Telecom Service Providers to ensure continuity and growth of services.

- Spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands was offered. Bids were received in the 900 MHz, 1800 MHz, 2100 MHz, and 2500 MHz bands.
- Three service providers participated in the auction and acquired spectrum in different bands.
- The Ministry of Communications, vide Press Release dated 22.07.2024, noted that *"as the auction for 5G spectrum was held recently and 5G monetization is still in progress, no bidding took place in the 800 MHz, 2300 MHz, 3300 MHz, and 26 GHz bands. A total quantum of 141.4 MHz (26.5%) was sold from the balance 533.6 MHz spectrum, despite the fact that a very large amount of spectrum, i.e. 51.2 GHz, was sold in August 2022."*

3.52 In both the 2022 and 2024 auctions, it is observed that a substantial portion of the spectrum was sold at the reserve price. However, in the case of the 1800 MHz band, in two LSAs each during the 2022 and 2024 auctions, the entire spectrum offered was sold at prices above the reserve price. The relevant details are provided in Table 3.3 below.

**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

3.53 With regard to LSA-wise availability of spectrum in existing bands, the discussion and the Authority's recommendations at paragraphs 2.3 to 2.22

of Chapter II may please be referred. Further, with regard to whether the entire spectrum in the existing bands should be put to auction, the discussion and the Authority's recommendations at paragraphs 2.23 to 2.49 of Chapter II may please be referred.

3.54 Based on the foregoing discussion on demand and supply, it may be observed that where the entire quantum of spectrum offered for auction in certain frequency bands has not been sold in specific Licensed Service Areas (LSAs), the auction-determined price may not represent a market-clearing price. Nevertheless, since such prices are discovered through the interaction of demand and supply in the auction process, they continue to constitute market-determined prices.

3.55 In this context, it is relevant to note that in its earlier recommendations, the Authority has, inter alia, observed the following:

- Economic theory suggests that the pricing of a public resource should, as far as possible, reflect its prevailing economic value so as to promote efficient, optimal and equitable use.
- The economic value of a good is reflected in the maximum amount a user is willing to pay to acquire it, commonly referred to as "willingness to pay". In a market economy, the price paid by consumers is an accepted measure of such economic value, and accordingly, market-determined prices serve as an important indicator of value.
- In view of the above, prices discovered through the auction process have been regarded as reliable indicators of the market's valuation of spectrum and have been adopted as one of the approaches for spectrum valuation in the past.

3.56 Since 2018, the Authority has consistently taken the view that the Marginal Cost of Funds based Lending Rate (MCLR) system, which

replaced the base rate system with effect from 1 April 2016, represents the most realistic benchmark for indexation. The Authority, in its recommendation dated 11.04.2022, had recommended that MCLR be used in place of the SBI base rate for indexation purposes. The past auction-determined prices for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz and 2300 MHz bands were available from the 2021 auction. These prices, duly indexed using MCLR, were therefore considered in 2022 as one of the valuation methodologies for these bands.

3.57 It is pertinent to note that in the 2022 valuation exercise, only auction prices from the most recent auction, namely the 2021 auction, were taken into consideration. The Authority at Para 3.98 of its Recommendation dated 11.04.2022 held the view, that auction determined prices revealed in the auction(s) held in the *previous two years*, duly indexed with MCLR, should be used as one of the methods for spectrum valuation. If a similar approach were to be adopted in the present exercise, only the ADPs from the 2024 IMT/5G auction would be considered.

3.58 However, in the 2024 auction, spectrum was sold only in a limited number of bands and LSAs. As stated by Ministry of Communications, vide Press Release dated 22.07.2024, this was largely attributable to the fact that the auction for 5G spectrum had been held recently (in 2022) and a very large quantity of spectrum, approximately 51.2 GHz had already been sold in the said auction. Consequently, in 2024, only the spectrum expiring in that year along with the unsold spectrum from the 2022 auction was offered, primarily to meet the continuity and growth requirements of telecom service providers.

3.59 In this regard, another important guideline for usage of past ADPs is available at Para 3.39 & 3.40 of Recommendations dated 11.04.2022, which covered the periodicity of fresh comprehensive valuation exercise as well as usage of RP/ ADPs in case of interim auctions:

*"3.39 Further, as has been the experience in past auctions, spectrum,*

*even in the same band, is often sold only in some (and not all) LSAs, and there is every likelihood that auctions may yield auction determined prices only for some LSAs and for some spectrum bands. DoT has also expressed the view that "spectrum lying idle is a waste for the economy". As such, the Authority is of the view that while annual valuation exercises may not be necessary, there is an imperative need to revisit spectrum valuation at regular intervals. While the auction determined prices can be utilized for setting reserve prices (after indexation) since they explicitly reveal market preferences, spectrum in bands/ LSAs that remained unsold could be put to auction in subsequent auctions without the need for indexation, thereby indirectly providing for a discount equal to the interest rate.*

*3.40 Accordingly, 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"*

As noted above, the Authority in its Recommendations dated 11.04.2022 at Para 3.40 had recommended a three-year periodicity for comprehensive spectrum valuation, while also providing guidance on usage of RP/ADPs for auctions in the interim period.

3.60 In this regard, for the present exercise, it is necessary to examine whether past auction-determined prices (ADPs) can be adopted as the sole or as one of the valuation approaches as part of fresh comprehensive valuation exercise, and whether indexation should be done and should continue to be based on MCLR or whether alternative indicators such as the Wholesale Price Index (WPI), Cost Inflation Index (CII), or any other suitable metric may be considered.

3.61 In this context, the Authority solicited comments from stakeholders on the following question:

*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.*

## **Comments of Stakeholders on Q25 & Q26**

- 3.62 Many stakeholders are of the view that the valuation of spectrum across bands such as 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz should not be based exclusively on past auction-determined prices from the 2022 and/or 2024 auctions, even if such prices are indexed. These stakeholders have highlighted that auction outcomes are heavily influenced by contemporaneous market conditions, bidder participation, financial health of operators, and technology cycles. In particular, the experience of the June 2024 auction where a large proportion of spectrum remained unsold and several bands received no bids was cited as evidence that auction prices, especially when they reflect reserve prices, may not represent true economic value of spectrum. Reliance on such backward-looking prices risks perpetuating unviable reserve prices and inefficient spectrum allocation. Therefore, a fresh comprehensive valuations exercise is required.
- 3.63 Several stakeholders emphasized that the telecom sector has undergone structural and technological changes since the valuation methodologies originally evolved, including industry consolidation, technology-neutral licensing, spectrum fungibility across generations, and evolving roles of different frequency bands in 5G and beyond. In this context, they argued for a fresh or revised valuation framework that better reflects current and future market realities rather than mechanically extrapolating past auction prices. Factors such as replaceability of bands, intrinsic propagation and capacity characteristics, availability of spectrum, device ecosystem maturity, and future technology pathways (including 6G) were highlighted as critical determinants of value.
- 3.64 Some stakeholders suggested that past auction-determined prices may still be considered, but only as one reference input among multiple

valuation approaches. These stakeholders supported a more holistic methodology combining auction outcomes with alternative approaches such as income-based (discounted cash flow), cost or opportunity-cost methods, benchmarking with comparable markets, and assessment of incremental or marginal revenues generated from additional spectrum.

3.65 On the issue of indexation of past auction determined prices, many stakeholders expressed reservations about using the Marginal Cost of Funds Based Lending Rate (MCLR). They argued that MCLR reflects banks' internal lending costs and is not an appropriate proxy for preserving the time value of money or for adjusting asset values like spectrum. Instead, alternatives such as the RBI Repo rate, Reverse Repo rate, External Benchmark Lending Rate (EBLR), or inflation-based indices like CPI or WPI were suggested as more transparent and economically sound bases for indexation. Some stakeholders further opined that indexation should not be applied mechanically, particularly in cases of low demand or unsold spectrum, as it could render spectrum unaffordable and undeployable.

3.66 One stakeholder supported basing valuation primarily on auction-determined prices from recent auctions, while proposing a structured set of principles to adjust reserve prices depending on auction outcomes. These included reductions where spectrum remained unsold across consecutive auctions, maintenance of reserve prices without indexation where demand was weak or absent, and limited indexation only in cases where excess demand was observed.

### **Analysis of the issues raised through Q25 & Q26**

3.67 The comments and suggestions received from various stakeholders have been carefully examined. A number of stakeholders have expressed reservations regarding the exclusive reliance on auction-determined

prices discovered in 2022 and/or 2024 auctions for valuation of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. These stakeholders have highlighted factors such as unsold spectrum in recent auctions, evolving technology, industry consolidation and demand uncertainty.

3.68 After examining the comments of stakeholders, the Authority in its recommendation dated 11.04.2022 and 04.02.2025<sup>56</sup> stated that the auction-determined price remains the most transparent, objective and market-validated indicator of the value of spectrum. Auction outcomes reflect the collective assessment of licensed service providers, who are best placed to evaluate the commercial potential of spectrum based on prevailing market conditions, technology options, and business strategies. The Authority has consistently held the view that prices discovered through an auction process provide a robust and credible benchmark for spectrum valuation, irrespective of whether the auction results in excess demand or spectrum being sold at reserve price.

3.69 With regard to the concerns raised by certain stakeholders about unsold spectrum and subdued demand in specific bands or LSAs, it is noted that auction outcomes, including instances where spectrum remains unsold, constitute meaningful indicators of prevailing market conditions. However, such outcomes do not diminish the significance of auction-determined prices for spectrum that has been successfully sold, nor do they justify departure from the ADP-based valuation framework. It is considered that maintaining continuity and regulatory certainty in valuation methodology is essential to avoid distortions and to protect the integrity of past investments made by service providers. Accordingly, the Authority holds that past Auction Determined Prices (ADPs) from previous auction(s)

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<sup>56</sup> [http://www.trai.gov.in/sites/default/files/2025-02/Recommendations\\_04022025.pdf](http://www.trai.gov.in/sites/default/files/2025-02/Recommendations_04022025.pdf)

continue to provide a robust and credible benchmark for spectrum valuation and should be used for the present exercise.

3.70 On the issue of indexation of past ADPs, the stakeholders' suggestions have been examined. The purpose of indexation of past ADPs is to preserve the time value of money between successive auction cycles. An appropriate indexation factor therefore must reflect the opportunity cost of capital faced by market participants in acquiring the spectrum. Spectrum is a capital asset acquired by telecom service providers through long-term financing arrangements, and its economic valuation is intrinsically linked to their cost of borrowing and weighted average cost of capital (WACC). The MCLR rate directly reflects the marginal cost at which banks raise funds and lend to borrowers and therefore closely approximates the economy-wide cost of debt capital. In contrast, inflation indices such as CPI or WPI measure changes in general price levels and are designed to preserve purchasing power, not capital costs. Indexing ADPs to CPI/WPI would therefore adjust for consumer price inflation rather than the financing cost relevant to investment decisions in spectrum. Similarly, the RBI Repo/ Reverse Repo Rate is a short-term policy rate used for liquidity management and does not incorporate banks' operating costs, credit risk premium, or term spreads.

3.71 In view of the above, there seems to be lack of merit in considering CPI/WPI and RBI Repo rate & Reverse-Repo Rate as an effective proxy for indexing the cost of capital incurred by telecom service providers. The Authority holds that the use of MCLR is thus aligned with established financial principles that asset valuation over time should reflect changes in the cost of capital rather than changes in general price levels or short-term policy signals.

3.72 Further, **consistent with the Authority's past Recommendations**

**dated 11.04.2022 adopting MCLR-based indexation, the Authority reiterates use of MCLR for indexation of past ADPs** to ensure that the indexation reflects approximate cost of capital in line with medium-term lending conditions, maintains inter-temporal comparability of auction prices, and aligns with the principle that public resource pricing should estimate its prevailing economic value while maintaining regulatory certainty.

3.73 With clarity on indexation of past ADP as discussed above, it is necessary to examine the other aspects regarding duration of indexation and usage of ADP as sole or one of the valuation tools in the current exercise, considering all LSA-band combinations across the last two auctions.

3.74 In this regard, the Para 3.96 - 3.98 of Recommendations of 2022, offers guidance for usage of past ADP as one of the valuation methods in a comprehensive exercise, where it was held that auction determined fresh prices revealed in the auction(s) held in the previous two years, duly indexed with MCLR, be taken as one of the possible valuations. **Accordingly, in line with the same, the Authority reiterates that for the existing spectrum bands which were sold in a particular LSA in the 2024 auction, the auction determined prices (ADPs) of 2024, indexed using the applicable MCLR, should be considered as one of the valuation benchmarks in the present spectrum valuation exercise.**

3.75 Further, where spectrum in a particular band-LSA combination was put to auction but remained unsold in the 2024 auction, the Paras 3.39 & 3.40 of the Authority's recommendations dated 11.04.2022 provide guidance regarding usage of past ADP as a valuation tool. As noted earlier in Section D, the recommendations at Para 3.40 (II) of 2022 do not directly hold true in case of a fresh comprehensive valuation exercise but can be

suitably adapted to the present case.

It was then held that, for auctions conducted within 3 years of a fresh valuation exercise, in LSAs where spectrum remained unsold in previous auctions, the past recommended reserve price, without indexation, should be used for arriving at reserve prices for the next auction. The same principle can be adopted, in case of spectrum band-LSA combinations unsold in 2024 but sold in 2022 Auctions, for the present valuation exercise. The principle is particularly applicable here considering that, as stated in the Ministry of Communications Press Release dated 22.07.2024, the 2024 Auctions had limited sale and was primarily offering the spectrum expiring in that year along with the unsold spectrum from the 2022 auction. **Accordingly, for the spectrum in a particular band-LSA combination, which was put to auction and remained unsold in the 2024 auction, but was sold in 2022 auctions, the Reserve Price (RP) of 2024 without indexation should be considered as one of the possible valuation benchmarks for the present spectrum valuation exercise.**

Further, on examination of 2022 & 2024 auction details, 10 LSA-band combinations have been noticed in 800 MHz/2100 MHz/2500 MHz/ 26 GHz bands, where spectrum was sold in 2022 but not put up for auction in 2024. Since these band-LSA combinations were sold in 2022, past market prices are available, and hence this data should not be disregarded and can serve as one of the valuation inputs for the particular LSA-band combinations. Accordingly, **keeping valuation approach consistent, it is considered that these cases warrant the same approach as is being taken for band-LSA combinations which were put to auction and not sold in 2024 but were sold in 2022. Hence the RPs of 2024 auctions should be used as one of the valuation approaches for such cases.** Since these band-LSA combinations were not put to auction in 2024, the RPs for 2024 are not available. Hence, the RPs of 2024 have been approximated in the present exercise using MCLR

based indexation for ADPs of 2022 and used as one of the valuation approaches.

- 3.76 In addition to the above scenarios, there exist certain LSAs where existing spectrum bands were put to auction but remained unsold in both the 2022 and 2024 auctions. In such cases, no past auction determined prices (ADPs) are available from either auction cycle. The absence of market discovery across two successive auctions indicates that the prevailing valuation benchmarks may not have aligned with market expectations or demand conditions in those LSAs at the time of auction. In view of the foregoing, the Authority is of the considered view that for LSAs where specific spectrum bands were put to auction but remained unsold in both the 2022 and 2024 auctions, any past auction-determined prices or reserve prices should not be relied upon as one of the basis for valuation in the forthcoming auction.
- 3.77 Regarding the need for conducting a fresh comprehensive valuation exercise in the present Recommendation, the Authority is of the view that the periodicity of a comprehensive valuation exercise prescribed at Para 3.40 (I) of the Recommendations dated 11.04.2022 holds good in the current context. As discussed in detail in Section D above, a period of three years constitutes a substantial duration for meaningful changes to occur in the technical, economic and commercial factors that influence spectrum valuation. Since more than three years have elapsed since the comprehensive valuation exercise was conducted in 2022, the Authority believes that presently it is necessary to conduct a fresh comprehensive valuation exercise for the upcoming auctions.
- 3.78 Therefore, while continuing to treat past auction-determined prices and/or reserve prices, with or without suitable indexation, as a one of key and reliable references, the Authority has decided that a fresh comprehensive

valuation exercise for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz spectrum bands, based on multiple valuation models & approaches, should be undertaken.

## **E (2) Applicability of Valuation Models/ Approaches for Existing Bands**

- 3.79 For the purpose of spectrum valuation, it is noted that the economic value of spectrum is influenced by a large number of interrelated variables. Conceptually, the valuation of spectrum can be expressed as a function of available market information, technological factors, and macro- as well as micro-economic variables, as follows:

$$\mathbf{V = f(I, T, E)}$$

Where, I represents available market information, T denotes technological factors, and E captures macro and micro economic variables.

- 3.80 Based on this functional relationship, the Authority has, in its past recommendations, adopted multiple valuation models and methodologies to estimate spectrum value. The Authority has consistently held the view that it is neither feasible nor appropriate to identify any single valuation model or methodology as the “correct” one. Each model has its own strengths and limitations, and no single model is capable of comprehensively capturing all technical, economic, sectoral, geographic, and regulatory factors that influence spectrum valuation.
- 3.81 While certain models are better suited to reflect intrinsic technical characteristics of spectrum, others are grounded more firmly in economic and market dynamics. Accordingly, in past valuation exercises, a basket of valuation models have been employed, each reflecting specific

financial, technical, or market-related aspects, in order to arrive at a reasonable and balanced estimate of spectrum valuation.

3.82 These valuation 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 base transceiver stations (BTS), Gross State Domestic Product (GSDP) per capita, capital expenditure, operating costs and so on, the models incorporate assumptions regarding growth rates of various parameters and other structural assumptions specific to each model. Some models also employ forecasting techniques and statistical analysis, using both historical and the most recent available data. Based on rational assumptions and an assessment of the robustness and statistical significance of results, these models are used to derive spectrum valuations. The valuation methodologies employed by the Authority include:

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

3.83 It is pertinent to note that all the above models/ approaches are not applicable to every frequency band considered for auction. Approaches such as the Multiple Regression and Trend Line, which are primarily statistical tools not requiring spectrum band-specific disaggregated technical data and relying largely on economic, demographic, or time-based variables, can be applied across multiple bands, contingent on sufficiency of data points available and statistical significance of the results.

3.84 In contrast, models such as the Production Function Model, Producer Surplus Model, Revenue Surplus Model, and Economic Premium Model are applicable only to specific bands. This distinction arises primarily due to limitations in the availability of spectrum band-wise segregated data. For a model to be applied directly to any band, band-specific data such as revenue, subscriber base, BTS deployment, and radio network expenditure must be available. However, such data is generally reported in an aggregated manner by service providers. In such cases, spectrum holdings across different bands are converted into a representative band, generally the 1800 MHz band as in the past valuation exercises using a technical efficiency factor. The model is then applied to this representative band, and the valuation thus derived is subsequently used to estimate the valuation of other bands through back-calculation, applying the relevant technical efficiency factors. Further, there may be instances where certain models, though theoretically applicable, are not finally used if the results obtained lack statistical significance or robustness.

3.85 A brief description of each of the valuation approach/model employed by the Authority is given below.

### **1. Multiple Regression Approach**

a) Under this approach, spectrum values are estimated by examining the relationship between prices discovered in earlier auctions and a set of economic and demographic variables that influence demand for wireless services. Past auction-determined prices are statistically linked with factors such as regional income levels, subscriber base and data usage to estimate spectrum valuation for the Licensed Service Areas in which auctions were conducted.

b) A multiple regression framework can be represented by the following general form:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \dots + \beta_n * X_n + \epsilon$$

where

Y is the dependent variable

X<sub>1</sub>, X<sub>2</sub>, ..., X<sub>n</sub> are the explanatory variables

β<sub>0</sub> is the intercept

β<sub>1</sub>, β<sub>2</sub>, ..., β<sub>n</sub> are the coefficients of explanatory variables

ε is the error term

c) The robustness of the regression results is assessed using standard statistical diagnostics, including the p-values of coefficient estimates and the adjusted R-squared of the model. The direction and magnitude of the estimated coefficients are also examined to understand the influence of each explanatory variable on spectrum prices.

d) In this model, the ADP from past auctions serves as the dependent variable. For each LSA, it is regressed against key explanatory variables, namely: i) Number of mobile subscribers (ii) GSDP per capita, and (iii) Wireless Data usage. These variables are considered representative of economic activity and service demand that may affect the valuation of spectrum.

e) This approach has been used in the valuation recommendations for 1800 MHz in 2013, 2018 and 2022, 800MHz in 2016 & 2022 and 900 MHz in 2016.

f) The detailed methodology of the Multiple Regression approach is provided in Annexure 3.2.

## 2. Trend Line Approach

a) The Trend Line Approach estimates future spectrum prices by analysing historical trends in auction-determined prices across multiple auction cycles. It employs a time-series regression framework in which the ADP per MHz is expressed as a function of time. By fitting a linear trend to observed auction prices over a specified period, the model derives coefficients that are then used to project expected values.

b) The trend estimation can be expressed as:

$$ADP = a + b * T$$

where T represents the year in which the auction was conducted, and a and b are the estimated intercept and slope parameters, respectively. The time series regression is run using LSA wise fixed effects to reflect differences in economic development and market conditions across these categories.

c) In the 2022 valuation exercise, the Trend Line Approach yielded statistically reliable estimates for the 1800 MHz and 2300 MHz bands and was applied accordingly.

d) The detailed methodology of the Trend-line approach is provided in Annexures 3.3.

## 3. Production Function Model

a) The Production Function model estimates the value of spectrum by using the Cobb-Douglas production function, where spectrum and base stations are treated as key inputs required to generate mobile traffic. This functional form is widely used to analyse how different inputs contribute to the level of output.

- b) Under this approach, the relationship between inputs and output is represented as:

$$X = A \cdot y^{\alpha} \cdot z^{\beta}$$

where

X denotes Total mobile traffic

A represents the efficiency factor

y indicates spectrum holding

z denotes the number of BTS deployed

Parameters  $\alpha$  and  $\beta$  represent the responsiveness of output to a unit change in each input.

- c) The model assumes that spectrum and BTS are substitutable inputs in producing mobile traffic. Service providers are expected to choose an optimal combination of these inputs based on their relative costs. An increase in spectrum prices may induce substitution towards additional BTS deployment, whereas relatively lower spectrum costs may reduce the need to deploy additional BTS.
- a) In view of the fact that the Production Function model provides a reasonable approximation of the value per MHz of spectrum to a TSP, the Authority has used the Production Function model to obtain one possible valuation of the spectrum in the 1800 MHz band.
- d) This approach was used for valuation of the 1800 MHz band in Recommendations of 2013, 2014, 2016, 2018 and 2022 spectrum valuation exercises.
- e) The detailed methodology of the Production Function model is provided in Annexure 3.5.

#### **4. Producer Surplus Model**

- b) The Producer Surplus Model values spectrum by estimating the net economic benefit accruing to a telecom service provider from acquiring additional spectrum. This benefit arises from the reduction in Radio Access Network (RAN) expenditure required to meet a given level of traffic demand, particularly in high-density and capacity-constrained areas.
  
- c) The model is based on the inverse relationship between quantum of spectrum and RAN expenditure and assumes substitutability between spectrum and BTS, similar to the Production Function Model. The allocation of additional spectrum to an existing TSP creates a producer surplus, on account of savings in its expenditure on RAN. This producer surplus, estimated using this model, is a possible valuation of spectrum, as it represents the price that a rational service provider would be willing to pay for incremental spectrum.
  
- d) The model compares two scenarios: one with the existing spectrum holding ( $x$  MHz) and another with enhanced holding ( $x + a$  MHz). It estimates traffic demand, network infrastructure requirements, and associated costs (including CAPEX, OPEX, and SUC) for both scenarios over a 20-year period. The difference in the present value of total costs between the two scenarios yields the producer surplus per MHz, which serves as the estimated spectrum valuation for an average service provider in each LSA.
  
- e) This approach was used for valuation of the 1800 MHz band in Recommendations of 2013, 2014, 2016, 2018 and 2022 spectrum valuation exercises.

- f) The detailed methodology of the Producer Surplus model is provided in Annexure 3.4.

## **5. Revenue Surplus Model**

- a) The Revenue Surplus Model is founded on the premise that the net present value of projected surplus revenue over the license period reflects the upper limit of what a service provider may be willing to pay for spectrum. The model estimates the surplus generated by wireless access services after accounting for all operating and capital expenditures, excluding spectrum acquisition costs.
- b) The net present value of revenue surplus for an LSA is calculated over a 20-year horizon as the difference between projected revenues and total non-spectrum-related costs. The valuation per MHz is derived by dividing this surplus by the aggregate spectrum holdings of all service providers in the LSA. The Authority has relied on a 20-year projection horizon in such models, consistent with the prevailing validity period of spectrum and drawing upon experience from earlier valuation exercises.
- c) This approach was used for valuation of the 1800 MHz band in 2014, 2016, 2018 and 2022 spectrum valuation exercises.
- g) The detailed methodology of the Revenue Surplus model is provided in Annexure 3.6.

## **6. Economic Premium Approach**

- a) Economic Premium Model derives relative valuations for different spectrum bands based on cost trade-offs when operations are switched from a technically more efficient band to a technically less efficient band.

For instance, spectrum in the 900 MHz band exhibits superior propagation characteristics compared to the 1800 MHz band, resulting in lower infrastructure and operating costs.

- b) Under this approach, the valuation of the 900 MHz band is obtained by adding the cost savings in radio network expenditure arising from its superior efficiency to the valuation of the 1800 MHz band. The incremental cost incurred by a service provider operating in the 1800 MHz band represents the saving that would accrue if operations were shifted to the 900 MHz band.
- c) This saving may be interpreted as the premium a service provider would be willing to pay for spectrum in the 900 MHz band relative to the 1800 MHz band. Accordingly, the maximum price payable for 900 MHz spectrum is equal to the value of 1800 MHz spectrum plus the associated savings in capital and operating expenditure.
- d) This approach was used for valuation of the 900 MHz band in 2013, 2014, 2016, 2018 and 2022 spectrum valuation exercises.
- e) The detailed methodology of the Economic Premium Approach is provided in Annexure 3.8.

3.86 Details of the spectrum bands for which the above models have been applied in various valuation exercises are provided in Annexure 3.1.

3.87 As discussed above, the valuation models adopted by the Authority rely on several assumptions relating to growth rates, forecasting methodologies, and technology characteristics. There is a need to examine whether modifications or refinements are required in the existing valuation methodologies or consideration of additional technology-specific

factors.

- 3.88 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of Stakeholders on Q28 & Q29**

- 3.89 Several stakeholders have emphasized that the spectrum valuation framework needs to be viewed in the context of current market realities, particularly subdued demand, significant unsold spectrum in recent auctions, and structural changes in the telecom sector. Several stakeholders have pointed out that the existing valuation approaches, which rely heavily on past auction outcomes and models developed over a decade ago, may no longer fully capture the true economic value of spectrum in a consolidated and technology-neutral market.

- 3.90 Some stakeholders are of the view that auction-determined prices from the 2022 and/or 2024 auctions provide a reasonable and objective basis for valuing spectrum in existing bands. According to them, these prices already reflect market discovery and should continue to be used, especially where spectrum has been sold, with limited need for

methodological changes.

- 3.91 On the other hand, some stakeholders have argued for a comprehensive review and updating of valuation methodologies. They have highlighted that current models were designed in an earlier era of higher competition and technology-specific spectrum use, whereas spectrum today is increasingly fungible across technologies. These stakeholders have stressed that reliance on legacy assumptions may lead to reserve prices that are misaligned with operators' ability to monetize spectrum, thereby contributing to repeated instances of unsold spectrum.
- 3.92 Several stakeholders have also linked valuation concerns with auction design and reserve prices. It was submitted by them that high and static reserve prices have effectively acted as price ceilings, resulting in negligible or zero bids in multiple bands in recent auctions. In this context, there is a view that valuation should shift from a revenue-maximization approach towards one that promotes efficient allocation and actual spectrum utilization.
- 3.93 One stakeholder stated that the Authority's current mix of approaches using auction-determined prices, technical efficiency analyses, and benchmarking appears broadly adequate, provided the Authority remains open to incorporating new valuation techniques as they emerge.

### **Analysis of the issues raised through Q28 & Q29**

- 3.94 The Authority has carefully examined and taken note of the views and suggestions submitted by the stakeholders. The Authority acknowledges that the structure and functioning of the telecom sector have undergone significant changes in recent years, marked by evolving business models, and rapid technological advancements. The Authority also notes that

spectrum is increasingly being used in a technology-neutral manner, enabling telecom service providers to deploy multiple generations of technologies and diverse services using the same spectrum band, in line with the prevailing licensing framework.

3.95 In this context, the Authority recognizes that valuation methodologies and reserve prices need to remain closely aligned with market realities, operators' capacity to deploy and monetize spectrum, and the overarching objective of optimum spectrum utilization rather than mere revenue maximization. The progressive shift in this view of spectrum has been well encapsulated in the overall objectives of the Spectrum auctions held in 2022 and 2024, as has been brought out in Para 3.4 above.

3.96 The Authority has also examined the concerns expressed by stakeholders that the continued use of past ADPs and valuation methods developed over the last decade may not adequately reflect present market conditions. In this regard, it is reiterated that past ADPs (indexed or non-indexed, as applicable) constitute only one of the valuation approaches adopted by the Authority and not the sole basis for spectrum valuation. The overall valuation framework is founded on the use of multiple well-established economic and financial models. These valuation methods are grounded in widely accepted principles of economic theory and have been applied, tested, and refined over multiple spectrum valuation cycles. Importantly, while stakeholders have expressed concerns regarding continuation of past methods, no specific alternative valuation methodology supported by empirical robustness or theoretical grounding, has been proposed for consideration.

3.97 With regard to the stakeholder's concern that the valuation methods were designed in an era of higher competition or technology-specific spectrum use, it is noted that competition in the telecom sector continues, and that

the spectrum valuation approaches adopted by the Authority are based on universal financial modelling and projection, based on updated assumptions deriving from the current context of telecom sector. As such it is clear that these models and approaches are not trends tied to any particular context or era. The underlying economic relationships captured by the valuation methods are not contingent upon a specific generation of technology but are adaptable to evolving technologies and usage patterns.

In each comprehensive spectrum valuation exercise, the Authority undertakes a detailed review of all relevant assumptions, including data traffic projections, revenue and subscriber growth rate projections, capital and operating expenditure parameters, technology deployment patterns, subscriber distribution, and overall market structure, within a larger techno-economic milieu. Contextual factors such as introduction of new technologies, changes in spectrum efficiency, evolving business models, and updated macroeconomic indicators are incorporated into the valuation methods. In view of the aforesaid, the concerns that reliance on existing valuation methods perpetuates outdated or legacy assumptions are misplaced and do not appear well informed whereas the spectrum valuation framework followed by the Authority is well founded, dynamic and updated periodically to reflect prevailing market and technological realities. **The Authority, therefore, is of the view that continuation of the existing multi-model approach, with suitable refinements based on latest data and developments, appropriately balances methodological continuity with responsiveness to sectoral evolution.**

- 3.98 For the present exercise, it is noted that 5G in India has been deployed since 2022 and has achieved rapid adoption with over 400 million users (approx. 35% of mobile users), while 4G remains dominant, covering 99% of the country and a majority of active subscriptions. Accordingly, as a

broad level update for operationalizing the models, the Authority has taken the view that the techno-economic models are likely to yield more reliable and valid estimations by adapting them for both 4G & 5G mobile networks. Thus, the valuation models for the present comprehensive valuation exercise have been modified to suitably incorporate the adoption of 5G & 4G network as far as possible, at the level of data points and assumptions, such as data traffic, Capex/ Opex, number of BTS, throughput per BTS, number of subscribers, average spectrum holding and so on.

This also serves as a case in the point being made regarding universality, adaptability and strong foundations of the techno-economic models and approaches being used by the Authority for spectrum valuation, which have a high probability of yielding context specific and valid results with use of updated assumptions and projections.

**E (3) Applicability of Spectral Efficiency Factor for Existing Bands: 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz.**

3.99 One of the approaches adopted for valuing spectrum in existing bands is based on relative or comparative valuation, wherein the technical characteristics of one spectrum band such as coverage potential are compared with those of another band. Based on such comparisons, a spectral or technical efficiency factor is derived as a ratio, which is then used to estimate relative spectrum values. In its Recommendations dated 11.04.2022, the Authority applied this approach for valuation of spectrum in sub-GHz bands, 2100 MHz, 2300 MHz, 2500 MHz and mid-band spectrum.

3.100 In its Recommendations on Auction of Spectrum in Frequency Bands Identified for IMT/5G dated 11.04.2022, the Authority relied on the

Technical Note (2018) by M/s Nokia titled “5G Spectrum and Coverage Consideration Aspects” along with other international and domestic resources, to assess and compare the coverage characteristics of different spectrum bands and to derive corresponding technical efficiency factors. The technical efficiency factors used in recommendation dated 11.04.2022 are discussed below:

- The coverage provided by the 2300 MHz and 2500 MHz TDD spectrum bands was estimated to be around 50% of the coverage of the 1800 MHz FDD band. Accordingly, a technical efficiency factor of 0.5 was adopted for the 2300 MHz and 2500 MHz bands with reference to the 1800 MHz band.
- The mid-band spectrum (3300-3600 MHz) in TDD mode was estimated to offer approximately 30% of the coverage of the 1800 MHz FDD band, leading to the adoption of a technical efficiency factor of 0.3 for the mid-band spectrum relative to the 1800 MHz band.
- The 600 MHz band, being a sub-1 GHz band with propagation characteristics comparable to the 700 MHz band, was estimated to provide coverage similar to that of the 700 MHz band. Accordingly, it has been treated at par with the 700 MHz band for valuation purposes. The technical efficiency approach was used to link the 600 MHz band with other sub-1 GHz bands, considering its superior coverage and indoor penetration relative to higher frequency bands. Thus, the valuation of the 600 MHz band was treated equal to 700 MHz band.
- The coverage potential of the 800 MHz band was assessed to be significantly higher than that of the 1800 MHz band owing to its superior propagation characteristics. In its Recommendations dated 11.04.2022, the Authority relied upon two separate technical studies for estimating the relative technical efficiency of the 800 MHz band. In order to accord equal weightage to both technical assessments, the efficiency factors derived from each study were considered. Accordingly, technical efficiency factors of 2 and 1.5 were adopted for

the 800 MHz band vis-à-vis the 1800 MHz band. These factors were applied to appropriately capture the superior coverage footprint and spectral efficiency advantage of the 800 MHz band relative to higher frequency bands.

- The coverage provided by the 900 MHz band was also estimated to be significantly higher than that of the 1800 MHz band. Hence, a technical efficiency factor of 2 and 1.5 was considered for the 900 MHz band with reference to the 1800 MHz band. Further, for inter-band comparison across sub-GHz bands, a technical efficiency factor of 1 was considered for the 900 MHz band with respect to the 800 MHz band respectively.

3.101 In the 2022 valuation exercise, the Authority adopted an alternative approach for valuation of 26 GHz band by examining the ratio of auction prices for the 26 GHz and 3.5 GHz bands in countries where auctions for both bands had been conducted. Based on this analysis, an average international auction price ratio between the two bands was derived and subsequently applied to the calculated valuation of the 3.5 GHz band to arrive at the valuation of the 26 GHz band.

3.102 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of Stakeholders on Q30 & Q31**

3.103 A majority of stakeholders have expressed the view that auction-determined prices of other spectrum bands, adjusted solely through the application of a spectral efficiency factor, should not serve as the primary or standalone basis for valuation of the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. These stakeholders have emphasized that spectrum valuation is a multi-dimensional exercise and that reliance on a single technical parameter risks oversimplification and distortion of true economic value.

3.104 Several stakeholders acknowledged that spectral efficiency is an important technical consideration, as it reflects differences in propagation characteristics, coverage potential, and deployment economics across frequency bands. However, they proposed that spectral efficiency factors should only be applied in a limited and calibrated manner, particularly where spectrum bands are technically comparable and substitutable, such as among harmonized mid-bands. Applying such factors across dissimilar bands with varying propagation behaviour, ecosystem maturity, regulatory constraints, and use cases was commented as inappropriate and potentially misleading.

3.105 Some stakeholders highlighted that all the bands under consideration have already been auctioned multiple times and, therefore, have their own auction-determined prices, which themselves act as benchmarks. According to these stakeholders, where reliable auction-determined prices are available, there is no necessity to derive valuations indirectly by linking them to other bands through spectral efficiency ratios. Instead, existing auction prices, suitably indexed where required, should be used as the

primary reference.

### **Analysis of the issues raised through Q30 & Q31**

3.106 The comments received from stakeholders regarding the use of spectral efficiency factors in conjunction with past ADPs have been carefully examined.

3.107 A predominant view among stakeholders is that spectrum valuation is inherently multi-dimensional and cannot be appropriately determined through the application of a single parameter such as spectral efficiency. It is a considered view that exclusive reliance on a single technical parameter may not adequately capture the true economic value of a spectrum band. However, spectral efficiency is an important technical consideration as it reflects the ability of a given frequency band to deliver capacity per unit of spectrum, where spectrum bands are technically comparable and capable of supporting similar services under similar deployment configurations. Application of a calibrated spectral efficiency factor may provide useful analytical reference and can be used as one of the valuation approaches wherever available.

3.108 The Authority notes that auction-determined prices represent revealed market valuations under specific demand-supply conditions prevailing at the time of auction. While such prices are important reference indicators, they can be time specific in the sense that they reflect factors such as reserve price levels, spectrum caps, financial health of bidders, competitive intensity, and overall sectoral conditions at the relevant time. Therefore, past auction prices cannot be applied mechanically without careful consideration of contextual factors. Nonetheless, where sufficient auction data exists, such data constitutes one of the important valuation approaches

3.109 The existing spectrum bands under ambit of this question have already been auctioned in the past and therefore have established auction-determined prices that serve as market benchmarks. Accordingly, it is reiterated that while reliable and recent auction data can serve as one of the valuation approaches, valuations can also be linked to other bands through spectral efficiency ratios, particularly in cases where the spectrum bands under comparison are technologically and functionally comparable. The two approaches of using past ADPs as well as linking to other bands through Spectral Efficiency factors are proposed to be used in conjunction with multiple other models/ approaches. Such a methodology would ensure that reserve prices are balanced and well founded, anchored in market evidence, technically sound comparisons, and economic prudence, thereby promoting efficient allocation of spectrum while safeguarding the long-term sustainability of the sector.

#### **E (4) Valuation of Spectrum Using Single vs Multiple Approaches**

3.110 The Authority has consistently held the view that no single valuation methodology can, by itself, fully capture the complex and multi-dimensional factors that determine the economic value of different spectrum bands. Each valuation approach whether based on technical parameters, financial modelling, market outcomes, or international benchmarks offers certain strengths, while also being subject to inherent limitations. These approaches differ in the way they account for demand patterns, technological characteristics, market structure, regulatory conditions, and economic assumptions. As a result, reliance on any one method in isolation may lead to outcomes that do not adequately reflect the true or comprehensive value of spectrum.

3.111 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

### **Comments of Stakeholders on Q40 & Q41**

3.112 In response to the above questions, all stakeholders unanimously opposed using a single valuation approach for the diverse spectrum bands put forth for proposed auction. Several stakeholders have emphasized that spectrum bands differ significantly in terms of propagation characteristics, coverage versus capacity attributes, maturity of the device and network ecosystem, commercial use cases, and market demand. Accordingly, they have submitted that adopting a single valuation approach across all bands would not accurately reflect their relative economic and technical value and could result in inefficient pricing outcomes, including the risk of unsold spectrum.

3.113 Several stakeholders have broadly supported the Authority's position that each spectrum band should be evaluated independently and that multiple valuation approaches may be applied, depending on the characteristics of the band. These stakeholders have noted that no single valuation method can deterministically be considered the correct approach, as each model

has inherent strengths and limitations. Bands with an established auction history and mature ecosystems, such as sub-1 GHz and mid-bands, were generally considered suitable for approaches based on auction-determined prices, while new or emerging bands were suggested to be valued using a mix of international benchmarking, technical efficiency analysis, and relative band comparisons.

3.114 With respect to averaging of valuations obtained through different approaches, several stakeholders have expressed reservations about adopting a simple arithmetic mean, particularly where valuation outcomes are widely divergent or where one methodology is clearly more appropriate for a given band. Few stakeholders have suggested that valuation approaches should be selectively applied rather than simple arithmetic mean.

#### **Analysis of the issues raised through Q40 & Q41**

3.115 The views expressed by the stakeholders on the choice of valuation approaches and the manner of arriving at a final valuation have been carefully examined. It is felt that there are no grounds to question the long-standing position that it is not feasible to deterministically establish any single methodology or model as the definitive approach for valuing spectrum across bands. Each valuation approach is founded on a distinct set of assumptions and analytical constructs and, therefore, has its own inherent strengths and limitations. While certain approaches are better suited to capturing the intrinsic technical attributes of spectrum, such as propagation and efficiency, others reflect prevailing economic conditions, market behaviour, and auction outcomes. No individual model is capable of comprehensively incorporating the full range of technical, economic, sectoral, geographic, and regulatory factors that influence value of spectrum.

3.116 It is an indisputable truth that spectrum valuation is inherently subject to uncertainty, based on numerous assumptions and projections, and is influenced by a wide range of interrelated technical, economic, and market factors whose future trajectories cannot be predicted with accuracy. It is, therefore, practically impossible to compute the entire spectrum of potential valuation outcomes or to identify a single definitive value. In this context, the Authority has consistently maintained that a probabilistic approach, which considers the range of values generated by different methodologies, provides a more balanced and robust basis for decision-making. By adopting a simple average of valuations derived from multiple approaches, a representative value is sought to be arrived at, which reasonably reflects the central tendency of possible outcomes while mitigating the extremes.

3.117 Accordingly, the Authority has consistently considered both prudent and methodologically sound to adopt a multi-approach framework for spectrum valuation. Such an approach allows the Authority to draw insights from multiple perspectives, thereby reducing the risk of bias or distortion arising from the assumptions embedded in any single model. Given the dynamic nature of the telecom sector and the multitude of variables influencing spectrum value, many of which are uncertain, evolving, or operator-specific, it is neither feasible nor realistic to assert that any one model can deterministically arrive at a precise or universally correct valuation.

3.118 It is also noted that spectrum valuation is constrained by limitations in the availability, granularity, and reliability of data, particularly for new or emerging bands and evolving technologies. These constraints make it impracticable to model the complete universe of possible valuation outcomes with precision. In such a context, selective reliance on a single approach or methodology risks over-emphasising certain determinants of

spectrum value while understating others. The Authority is therefore of the view that a multi-method approach remains the most balanced and analytically robust framework for spectrum valuation, as it enables consideration of diverse perspectives and mitigates the biases inherent in any one model.

3.119 Consistent with its practice since September 2013, the Authority has been conducting spectrum valuation by taking the simple arithmetic mean of the valuations obtained from various applicable approaches, predicated on the assumption of equal probability across feasible methods for a given band. This probabilistic aggregation yields the 'Expected Value' of spectrum as a robust measure of central tendency, mitigating biases from any single method while incorporating balanced insights from various approaches.

3.120 Accordingly, the Authority has decided to continue with the established framework of applying multiple valuation approaches, wherever feasible and relevant, for each spectrum band and to arrive at the final valuation by taking the simple average of the values derived from these approaches. The Authority considers that this methodology best balances analytical rigor, transparency, and consistency, while adequately capturing the complex and multi-dimensional factors that determine the economic value of spectrum.

**E (5) Valuation of Spectrum in Existing Bands: 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands.**

**i Valuation of 1800 MHz Spectrum**

3.121 Spectrum in the 1800 MHz band was put up for auction in 2022 and 2024 across 22 LSAs in both the auctions. A total of 267.200 MHz of spectrum

was put to auction in 2022 across 22 LSAs and 221.40 MHz of spectrum in 2024. 88.40 MHz of spectrum was sold in 10 LSAs in 2022 and 50.60 MHz of spectrum was sold in 10 LSAs in auction held in 2024.

3.122 Spectrum in the 1800 MHz band remained unsold in 7 LSAs in both the auctions held in 2022 and 2024; therefore, no auction determined price is available for 1800 MHz band in those 7 LSAs from the last two auctions.

3.123 For the purposes of the present exercise, the Authority has used the following approaches/ models for the valuation of the 1800 MHz spectrum:

- i. Multiple Regression approach;
- ii. Trend Line approach;
- iii. Producer Surplus model;
- iv. Production Function model;
- v. Revenue Surplus model;
- vi. Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not put to auction/ not sold in particular LSA in June 2024 but sold in 2022 auctions

The details of the models/ approaches are provided at Annexures 3.2, 3.3, 3.4, 3.5 and 3.6, respectively. The valuation of 1800 MHz arrived at using the above models are given at Annexure 3.7.

## **ii Valuation of the 800 MHz Spectrum**

3.124 Spectrum in the 800 MHz band was auctioned in 2022 and 2024 across 22 LSAs and 19 LSAs respectively. Of the total 136.25 MHz of spectrum made available across 22 LSAs in 2022 and 118.75 MHz of spectrum across 19 LSAs, 20.00 MHz was sold in 4 LSAs in 2022, however, no bid was received in any of the 19 LSAs in auction held in 2024. For the present

exercise, the Authority has employed multiple methodologies to determine the valuation of spectrum in the 800 MHz band.

3.125 Spectrum in the 800 MHz band remained unsold in 18 LSAs in both the auctions held in 2022 and 2024; therefore, no auction determined price is available for 800 MHz band in those 18 LSAs from the last two auctions.

3.126 A detailed discussion on the relative efficiency between 800 MHz and 1800 MHz spectrum bands is provided in paras 3.17 to 3.27 of the February 2014<sup>57</sup> recommendations. In the said recommendation, the Authority recommended that technical efficiency factor of 800 MHz spectrum could be taken as 1.5 times and 2 times of the value of 1800 MHz spectrum, as had been adopted for 900 MHz in the Recommendations of September 2013<sup>58</sup>. The same methodology was subsequently adopted in the Authority's Recommendations in January 2016<sup>59</sup>, August 2018<sup>60</sup>, and April 2022.

3.127 In view of the established and time-tested technical superiority of the 800 MHz band over the 1800 MHz band, as recognised in the Authority's earlier recommendations since 2014, the Authority considers it appropriate that, in the present comprehensive valuation exercise, technical efficiency of both 1.5 times and 2 times vis-à-vis 1800MHz can be taken as valuation approaches for 800MHz.

3.128 In addition to the above, it is also noted that 800MHz and 900 MHz have

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<sup>57</sup> <https://www.trai.gov.in/sites/default/files/2024-09/Final%20Recommendations.pdf>

<sup>58</sup> <https://www.trai.gov.in/sites/default/files/2024-09/Recommendations%2009.09.2013.pdf>

<sup>59</sup> [https://www.trai.gov.in/sites/default/files/2024-11/Recc\\_27\\_1\\_2016.pdf](https://www.trai.gov.in/sites/default/files/2024-11/Recc_27_1_2016.pdf)

<sup>60</sup> <https://www.trai.gov.in/sites/default/files/2024-09/RecommendationsAuctionofSpectrum01082018.pdf>

rightly been treated as having equivalent technical efficiency factors (of 2 and 1.5) vis-à-vis 1800MHz, and hence, having an equivalent technical efficiency factor vis-à-vis each other. Keeping this technical efficiency over 1800MHz in mind, it is logical that 800MHz should also yield an economic premium in usage over 1800MHz, in the same manner as has been considered and used as a valuation tool for 900MHz. Accordingly, the **Authority is of the view that the incremental economic efficiency or the economic premium of 800 MHz band over 1800 MHz band should also be treated as one of the approaches for valuation of 800MHz band, as has been done for 900 MHz band.**

3.129 Overall, the valuation models/approaches adopted for valuation of 800 MHz include the following:

- (i) Factor of technical efficiency of 2 for the spectrum in the 800 MHz band with respect to the spectrum in the 1800 MHz band;
- (ii) Factor of technical efficiency of 1.5 for the spectrum in the 800 MHz band with respect to the spectrum in the 1800 MHz band;
- (iii) Economic premium of spectrum in the 800 MHz band over spectrum in the 1800 MHz band;
- (iv) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions.

The spectrum valuation derived from the above approaches is presented in Annexure 3.10.

### **iii Valuation of the 900 MHz Spectrum**

3.130 Spectrum in the 900 MHz band was put to auction in 2022 and 2024 across 21 LSAs and 22 LSAs respectively. A total of 74.39 MHz of spectrum was offered in 2022 across 21 LSAs and 117.20 MHz of spectrum was

offered in 22 LSAs in 2024. 12.8 MHz was sold in 3 LSAs in 2022 and 60.80 MHz was sold in 14 LSAs in auction held in 2024. For the purposes of the present exercise, the Authority has considered multiple approaches to determine the valuation of spectrum in the 900 MHz band.

3.131 Spectrum in the 900 MHz band remained unsold in 9 LSAs in both the auctions held in 2022 and 2024; therefore, no auction determined price is available for 900 MHz band in those 9 LSAs from the last two auctions.

3.132 With respect to use of technical efficiency approach, a detailed discussion on the relative efficiency of the 900 MHz and 1800 MHz spectrum bands is provided in paragraphs 4.45-4.47 of the September 2013 Recommendations. The same methodology was adopted in the Authority's past Recommendations of September 2013, October 2014<sup>61</sup>, January 2016, August 2018, and April 2022.

3.133 In view of the established and time-tested technical superiority of the 900 MHz band over the 1800 MHz band, as recognised in the Authority's earlier recommendations, the Authority considers it appropriate that, for the present comprehensive valuation exercise, technical efficiency of both 1.5 times and 2 times vis-à-vis 1800MHz can be taken as valuation approaches for 900MHz.

3.134 Overall, the valuation of 900 MHz model is determined using following models/approaches:

- (i) Factor of technical efficiency of 1.5 for the spectrum in the 900 MHz band with respect to the spectrum in the 1800 MHz band;
- (ii) Factor of technical efficiency of 2 for the spectrum in the 900

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<sup>61</sup> [https://www.trai.gov.in/sites/default/files/2024-09/Recommendations-Final15102014\\_0.pdf](https://www.trai.gov.in/sites/default/files/2024-09/Recommendations-Final15102014_0.pdf)

- MHz band with respect to the spectrum in the 1800 MHz band;
- (iii) Estimation of the economic premium of spectrum in the 900 MHz band over spectrum in the 1800 MHz band.
- (iv) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions

The methodology followed for estimating the economic premium is detailed in Annexure 3.8. The valuation of spectrum in the 900 MHz band derived on the basis of the above approaches is provided in Annexure 3.9.

#### **iv Valuation of the 2100 MHz Spectrum**

3.135 Spectrum in the 2100 MHz band was auctioned in 2022 and 2024 across 19 LSAs and 15 LSAs respectively. A total of 160 MHz of spectrum was offered in 19 LSAs in 2022 and 125.00 MHz of spectrum was put to auction across 15 LSAs in 2024. 35 MHz was sold in 2022 in 7 LSAs and 20 MHz spectrum in this band was sold in 5 LSAs in 2024.

3.136 Spectrum in the 2100 MHz band remained unsold in 8 LSAs in both the auctions held in 2022 and 2024; therefore, no auction determined price is available for 2100 MHz band in those 8 LSAs from the last two auctions.

3.137 For the purposes of the present exercise, the Authority has considered the following approaches to determine the valuation of spectrum in the 2100 MHz band:

- (i) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions

(ii) Application of a technical efficiency factor of 0.83 to reflect the relative efficiency of spectrum in the 2100 MHz band compared to spectrum in the 1800 MHz band, as taken in 2022.

The valuation of spectrum in the 2100 MHz band derived using these approaches is provided in Annexure 3.11.

#### **v Valuation of the 2300 MHz Spectrum**

3.138 Spectrum in the 2300 MHz band was auctioned in 2022 and 2024 across 6 LSAs in both the auctions. A total of 60 MHz of spectrum was put to auction in these 6 LSAs in both the auctions held in 2022 and 2024, however, no bids were received in any of the 6 LSAs in 2022 as well as 2024. Consequently, the entire spectrum offered in the 2300 MHz band remained unsold.

3.139 Spectrum in the 2300 MHz band remained unsold across 6 LSAs in both the auctions held in 2022 and 2024, while not being put to auction in the other 16 LSAs in both the auctions of 2022 and 2024; therefore, no auction-discovered price is available for this band in any of the 22 LSAs from the last two auctions.

3.140 For the purposes of the present exercise, multiple approaches have been considered to determine the valuation of spectrum in the 2300 MHz band. These approaches include:

- (i) Application of a technical efficiency factor of 0.5 for spectrum in the 2300 MHz band relative to spectrum in the 1800 MHz band, as taken in Recommendations dated 11.04.2022;
- (ii) Application of Trend-line approach.
- (iii) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024

but sold in 2022 auctions.

(Since the 2300 MHz band remained unsold across all LSAs in both the 2022 and 2024 auctions, no past ADPs or Reserve Prices for this band shall be considered as an input for valuation of 2300 MHz)

The methodology followed for the trend-line approach is provided in Annexure 3.3. The valuation of spectrum in the 2300 MHz band derived using these approaches is presented in Annexure 3.12.

#### **vi Valuation of the 2500 MHz Spectrum**

3.141 Spectrum in the 2500 MHz band was auctioned in 2022 and 2024 across 12 LSAs and 5 LSAs respectively. A total of 230 MHz of spectrum was put to auction in 2022 and 70 MHz of spectrum in 2024. 20 MHz of spectrum was sold in 2 LSAs in 2022 and 10 MHz of spectrum was sold in 1 LSAs in auction held in 2024.

3.142 Spectrum in the 2500 MHz band was not put to auction in both the years in 10 LSAs, while remaining unsold in 4 LSAs in both the auctions held in 2022 and 2024; therefore, no auction determined price is available for this band in those 14 LSAs from the last two auctions.

3.143 It is noted that, due to their adjacency in frequency and similar propagation characteristics, the 2500 MHz band exhibits coverage properties comparable to the 2300 MHz band when assessed relative to the 1800 MHz band. Therefore, the valuation of spectrum in the 2300 MHz band may be used as one of the approaches for estimating the value of spectrum in the 2500 MHz band. Additionally, as learnt from the Technical Note of 2018 by Nokia on "5G Spectrum and Coverage Consideration Aspects", in addition to the coverage consideration aspects of the 2300 MHz vis-a-vis the 2500 MHz, the technical efficiency of the 2500 MHz band (TDD) in relation to the 1800 MHz band (FDD) may also be applied to

arrive at a potential valuation for the 2500 MHz band across different LSAs.

3.144 For the purposes of the present exercise, the following approaches have been considered to determine the valuation of spectrum in the 2500 MHz band:

- (i) Adopting the valuation of spectrum in the 2300 MHz band by assuming equivalence between the 2500 MHz and 2300 MHz bands, and
- (ii) Applying the technical efficiency factor of 0.5 for the 2500 MHz band relative to the 1800 MHz (FDD) band.
- (iii) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions

The valuation of spectrum in the 2500 MHz band derived using these approaches is presented in Annexure 3.13.

## **vii Valuation of the 3300 MHz Spectrum**

3.145 Spectrum in the 3300 MHz band was put up for auction in 2022 and 2024 across 22 LSAs in both the auctions. A total of 7260.00 MHz of spectrum was put to auction in 2022 across 22 LSAs and 1110.00 MHz of spectrum in 2024. 5490 MHz of spectrum was sold in 22 LSAs in 2022 however no bid was received in any of the 22 LSAs in auction held in 2024.

3.146 Spectrum in the 3300 MHz band was sold in all 22 LSAs in 2022, and remained unsold in all 22 LSAs in 2024; thus it was not unsold in both auctions in none of the LSAs.

3.147 The Authority in its Recommendation dated 11.04.2022 had recommended valuation for the 3300 MHz TDD band equivalent to 30% of the average valuation of the 1800 MHz FDD band. This decision was based on the coverage analysis presented in the Nokia Technical Note. According to Nokia's coverage analysis, the 3.5 GHz TDD band provides coverage that is around 70% lower than the 1800 MHz FDD band, which indicated that the 3300 MHz TDD spectrum would provide coverage equivalent to approximately 30% of that of the 1800 MHz FDD band. The Nokia Technical Note also highlighted that the 3.5 GHz band is expected to operate in TDD mode, and mentioned that the coverage using this band is limited due to higher propagation losses and the inherent TDD mode penalty.

3.148 For the purposes of the present exercise, the Authority has decided to determine the valuation of the 3300MHz TDD band on basis of two approaches:

- a. 30% of the average valuation of the 1800 MHz FDD band, with the calculation adjusted to account for the unpaired nature of the spectrum.
- b. Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions

Using the above approaches, the valuations for the 3300MHz band are provided in Annexure 3.15.

## **viii Valuation of the 26 GHz Spectrum**

3.149 Spectrum in the 26 GHz band was put up for auction in 2022 and 2024 across 22 LSAs and 21 LSAs respectively. A total of 62700.00 MHz of spectrum was put to auction in 2022 across 22 LSAs and 8700.00 MHz of

spectrum in 2024. 45350 MHz of spectrum was sold in 22 LSAs in 2022 however no bid was received in any of the 21 LSAs in auction held in 2024.

- 3.150 Spectrum in the 26 GHz band was sold in all 22 LSAs in 2022 auction however, remained unsold in all 22 LSAs in the auction held in 2024; therefore, non-indexed Reserve price from June 2024 for all 22 LSAs shall be taken as an input for valuation of this band.
- 3.151 The 26 GHz spectrum band was auctioned for the first time in India in July 2022. In its Recommendations dated 11.04.2022 (refer para 3.191), the Authority adopted an international relative price benchmarking approach, wherein countries having auctions of both mid-band (3300 MHz) and mmWave (26GHz) spectrum were used to determine the value of mmWave (26Ghz) spectrum as a proportion of mid-band spectrum.
- 3.152 The Authority had observed in its recommendation dated 11.04.2022 that intra-country comparison using relative band pricing factors avoids purchasing power, market maturity, and ARPU distortions, and therefore eliminates the requirement of cross-country normalization. Accordingly, the valuation of the 26 GHz band was determined as 2.20% of the valuation of the 3300MHz band.
- 3.153 For the present comprehensive valuation exercise, the Authority has considered the international pricing dataset for 26 GHz and midband (~3.6-3.8 GHz) spectrum, as was included in the Recommendations of 2022, with the purpose of arriving at a relative band pricing factor between the two bands. The international benchmarking dataset of 2022, which was quite comprehensive including 08 countries, has been updated in the present exercise by including any other major jurisdiction(s), where auctions of both mid-band spectrum (~3.6-3.8 GHz) band and 26 GHz

band have been conducted, since the purpose is to update the relative band pricing factor between the two bands.

- 3.154 It has been observed that multiple countries have carried out the auction of 26GHz in the last decade, since 26GHz has emerged as a ultra-high capacity band having priority for 5G. In addition to the countries already documented in Recommendations of 2022, several other nations such as U.K, Russia, Austria, Denmark, Belgium, Germany, Brazil, Croatia, Estonia, Hungary, Hong Kong, Canada etc have allocated this band.

Among the mentioned international jurisdictions, the data related to pricing of both 3300 MHz and 26 GHz was readily available for the major jurisdictions of U.K., Brazil and Austria and are discussed below:

**a. Austria:**

The auctions for 3.5 GHz were conducted in 2019 with a cleanup/ residual auction conducted in 2024. The total proceeds from both auctions for approximately 400MHz of the spectrum was found to be EUR 196 million. Further, 26 GHz was auctioned in 2024, with 1400MHZ having sold for EUR 16.2 million. The auctions of both bands were of pan country nature, and the region/ circle wise status of sale and the region wise prices are not available readily. Further, the auctions have been conducted relatively close together. Accordingly, based on above information and limitations, an approximation of relative band pricing factor for the bands (Price/ MHz/ pop) has been calculated as 0.0235.

**b. Brazil:**

The auctions for both 3.5 GHz & 26 GHz bands were conducted together in the 5G auctions of 2021. 3200 MHz of 26GHz and 400 MHz of 3.5 GHz were put to auction, with a system of national lots plus varying regional lots. The total proceeds from 3.5GHz was found to be USD 5.39 billion,

while the same from 26 GHz was USD 605 million was auctioned in 2024. Both bands were auctioned across the country, and the region/ circle wise status of sale and the region wise prices are not available readily. Accordingly, based on above information and limitations, an approximation of relative band pricing factor for the bands (Price/ MHz/ pop) has been calculated as 0.014.

**c. UK:**

The auctions for 3.5 GHz and 26 GHz bands were conducted in 2021 and 2024 respectively. The total proceeds from the auction of 120 MHz of the spectrum in 3.5 GHz band was £512.4 million, while total proceeds from 2400 MHz of 26 GHz band was £24 million. The auctions of both bands were countrywide, and the region/circle wise status of sale along with the region wise prices are not readily available in the public domain. Accordingly, based on above information and limitations, an approximation of relative band pricing factor for the 26 GHz band with respect to 3.5 GHz band (Price/MHz/pop) has been calculated at 0.0023.

**d. International study<sup>62</sup>:**

A study conducted by a thinktank, Plum Consulting, on behalf of Nokia & Qualcomm, named "Stimulating demand for 26 GHz in Europe", in July 2021, has studied auction results for many nations, in and outside of Europe, including Denmark, Finland, Germany, Greece, Italy, UK, Russia, Japan, Korea, Australia etc. Plum's research finds that in recent awards the average value of 26 GHz spectrum (\$/MHz/pop) is \$0.0033 whereas for 3.5 GHz auctions the value is \$0.1087, with normalised values for 26 GHz at \$0.0034 and 3.5 GHz at \$0.1059, yielding a relative band pricing factor of 0.033.

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<sup>62</sup> "Stimulating demand for 26 GHz in Europe" (July, 2021) for Qualcomm / Nokia by Plum Consulting (<https://www.qualcomm.com/media/documents/files/stimulating-demand-for-26-ghz-in-europe.pdf>)

3.155 The Auction Prices captured in Recommendations of 2022 are reproduced below for easy reference:

**TABLE 3.4: INTERNATIONAL AUCTION PRICES IN THE MMWAVE BAND**

Country	Mid Band	Auction Price per MHz per pop (in US \$)	mmwave Band	Auction Price per MHz per pop (in US \$)
USA	3.45 GHz	0.67	24GHz	0.009
USA	3.7 GHz	0.88	28GHz	0.003
Greece	3.4-3.8GHz	0.03	26 GHz	0.002
Taiwan	3.3-3.5 GHz	0.74	28 GHz	0.001
Australia	3.6GHz	0.21	26 GHz	0.009
Italy	3.4-3.8GHz	0.43	26 GHz	0.003
Republic of Korea	3.5GHz	0.20	28 GHz	0.005
Finland	3.4-3.8GHz	0.04	26GHz	0.002
Singapore	3.5 GHz	0.07	26 GHz	0.0001

Source : Global Mobile Suppliers Association, Regulators websites, S&P Global

3.156 With inclusion of international auction prices and pricing factors studied for new countries (U.K, Austria, Brazil) as well as captured in the international study by Plum Consulting, the relative band pricing factors from various sources are tabulated below:

**TABLE 3.5: RATIO OF INTERNATIONAL AUCTION PRICES**

S.no.	Band Pricing factors between 26 GHz and 3.5 GHz	
	Country	Mm-wave band/ Mid band
1	USA (24/3.4)	0.020
2	USA(28/3.4)	0.006

<b>3</b>	<b>USA (24/3.7)</b>	0.015
<b>4</b>	<b>USA(28/3.7)</b>	0.004
<b>5</b>	<b>South Korea</b>	0.048
<b>6</b>	<b>Italy</b>	0.008
<b>7</b>	<b>Australia</b>	0.031
<b>8</b>	<b>Taiwan</b>	0.002
<b>9</b>	<b>Greece</b>	0.064
<b>10</b>	<b>Finland</b>	0.042
<b>11</b>	<b>Singapore</b>	0.001
<b>12</b>	<b>U.K</b>	0.002
<b>13</b>	<b>Austria</b>	0.024
<b>14</b>	<b>Brazil</b>	0.014
<b>15</b>	<b>Study by Plum Consulting</b>	0.033
	<b>Mean</b>	<b>0.021</b>

3.157 As per the international auction price ratio analysis conducted, the average auction price ratio between the two bands viz. mmWave band and mid-band is about 2.10%. Since the ratio is between auction prices of the two bands in same jurisdictions, it avoids the problem of cross-country divergences, and thereby no further normalization would be required.

3.158 Thus, for the purposes of the present exercise, the Authority has decided to determine the valuation of the 26 GHz band on basis of two approaches:

- a) 2.10% of the average valuation of the 3300MHz band; and,
- b) Duly indexed past Auction determined price discovered in the June 2024 auctions for spectrum sold in particular LSA in June 2024 OR non-indexed Reserve price of June 2024 auctions for spectrum not auctioned/ not sold in particular LSA in June 2024 but sold in 2022 auctions.

Using the above approaches, the valuations for the 26 GHz band are provided at Annexure 3.16.

**E (6) Arriving at the Average Valuation of the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz Spectrum Bands**

- 3.159 Considering the various valuation approaches applied to different spectrum bands, as discussed in the preceding paragraphs, the Authority has arrived at an expected average valuation for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz spectrum bands. The expected average valuation for each band has been calculated as the simple mean of the valuations obtained using the different approaches adopted for that band, as detailed in Annexures 3.7, 3.9, 3.10, 3.11, 3.12, 3.13, 3.15, and 3.16 of this Chapter.
- 3.160 In line with the methodology followed in earlier recommendations, it is held that the expected value of spectrum is best estimated by taking into account multiple valuation approaches. Based on the results from these approaches, the average valuation for each band may be computed as the simple mean of the available estimates. Accordingly, the Authority has decided that the LSA-wise average expected valuation of spectrum for each of the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands shall be derived as the simple mean of the various valuation approaches applicable to that band.
- 3.161 The LSA-wise average expected valuation of spectrum for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands is presented in the table below.

**TABLE 3.6: AVERAGE VALUE PER MHz (20 years)****(Rs. in crore)**

LSA	Average Value per MHz of 800 MHz Band	Average Value per MHz of 900 MHz Band	Average Value per MHz of 1800 MHz Band	Average Value per MHz of 2100 MHz Band	Average Value per MHz of 2300 MHz Band	Average Value per MHz of 2500 MHz Band	Average Value per MHz of 3300 MHz Band	Average Value per MHz of 26 GHz Band
	PAIRED				UNPAIRED			
Andhra Pradesh	302.77	309.89	180.85	150.11	62.64	54.99	28.12	0.62
Assam	67.81	71.93	40.71	30.70	12.85	11.51	5.85	0.12
Bihar	179.92	177.21	99.61	79.42	22.29	21.48	14.19	0.30
Delhi	544.84	544.84	357.45	273.84	121.34	105.35	49.21	1.02
Gujarat	252.14	252.14	154.48	134.11	53.11	45.86	24.47	0.54
Haryana	85.23	85.23	51.18	40.28	16.94	14.87	7.20	0.15
Himachal Pradesh	32.69	32.69	18.69	15.51	9.66	7.17	2.52	0.06
Jammu & Kashmir	35.10	36.28	23.87	14.51	10.54	8.26	2.35	0.04
Karnataka	237.11	236.49	145.15	116.24	72.82	54.55	20.97	0.45
Kerala	136.46	136.46	81.59	60.74	25.43	22.92	11.16	0.22
Kolkata	135.38	145.53	88.57	73.52	34.08	28.11	15.04	0.34
Madhya Pradesh	185.14	185.14	106.83	88.67	24.08	25.39	15.29	0.32
Maharashtra	335.59	335.59	201.88	167.56	62.19	56.33	31.38	0.68
Mumbai	358.99	358.99	237.09	196.79	107.73	83.50	37.38	0.83
North East	34.55	35.51	23.69	12.71	10.29	8.11	2.34	0.04
Orissa	87.80	84.25	48.52	40.27	14.91	13.52	6.44	0.13
Punjab	113.35	114.92	69.33	57.54	25.11	19.38	10.24	0.22
Rajasthan	165.69	163.09	96.23	79.87	21.79	22.92	13.38	0.28
Tamil Nadu	273.40	268.89	166.24	137.98	92.01	66.78	24.23	0.51
U. P. (East)	322.70	295.51	170.46	141.48	32.38	37.50	20.62	0.39

U.P. (West)	229.63	236.10	133.40	96.77	29.02	31.18	17.29	0.34
West Bengal	151.71	142.25	84.69	55.86	19.83	20.50	11.39	0.22

**E (7) Estimation of Reserve Price of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300MHz, 2500 MHz, 3300 MHz and 26 GHz Spectrum Bands**

3.162 The reserve price in a spectrum auction represents the minimum price at which the Government is willing to offer spectrum and serves as the entry point for the bidding process in an ascending auction framework. It play an important role in facilitating effective price discovery while safeguarding the public interest by ensuring a minimum realization for a finite national resource. In the context of spectrum auctions, the reserve price is not intended to reflect the final market value of spectrum, but rather to provide an appropriate starting benchmark that encourages participation, promotes competition, and enables the discovery of market-clearing prices through competitive bidding. It is however, well accepted that demand for spectrum, level of participation in auctions and other auction outcomes are dependent on a complex interplay of wide variety of techno-commercial and market factors which have been documented in the succeeding paragraphs. Nonetheless, Reserve price is an important regulatory tool which has to be calibrated on basis of current and future technological and market realities, which are to be studied and predicted with utmost care and caution, within the overall context of promoting efficient use of spectrum and preventing idling of this valuable resource.

3.163 In formulating its recommendations dated 11.04.2022 on the auction of spectrum in frequency bands identified for IMT/5G services, the Authority has consistently emphasized that the determination of reserve prices must be guided by valuation exercises, past auction outcomes, prevailing market conditions, and broader policy objectives. These objectives include

ensuring optimum spectrum utilization, supporting sustainable growth of the telecommunications sector, facilitating timely deployment of advanced technologies such as 5G, and balancing revenue considerations with long-term sectoral health. Accordingly, reserve price estimation is undertaken as a distinct and carefully calibrated exercise, informed by both economic principles and the specific context of the forthcoming spectrum auctions.

- 3.164 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

#### **Comments of stakeholders on Q42**

- 3.165 A majority of stakeholders have emphasized the need to substantially recalibrate the ratio between the reserve price and the assessed valuation of spectrum, particularly in light of muted demand, reduced competition, and significant unsold spectrum observed in recent auctions, including the June 2024 auction. These stakeholders are of the view that high reserve prices have acted as a key impediment to effective participation and market-driven price discovery.
- 3.166 Several stakeholders have advocated that the reserve price for all spectrum bands should be limited to around 50% of the estimated valuation. They have argued that a lower reserve price would better facilitate competitive bidding, reduce the risk of spectrum remaining unsold, and enable the market to discover the true economic value of spectrum. According to these stakeholders, the primary objective of

spectrum auctions should be efficient allocation and utilization of spectrum for public benefit, rather than short-term revenue maximization. It has also been highlighted that lower reserve prices would free up financial resources for telecom service providers to invest in network deployment, expansion, and adoption of new technologies such as 5G and beyond.

- 3.167 Some stakeholders have drawn attention to international regulatory practices and policy guidance, noting that regulators in jurisdictions such as the UK and the European Union consciously set reserve prices below estimated market value to encourage participation, avoid unsold inventory, and support long-term investment in digital infrastructure. Reference has also been made to the declining number of effective bidders, absence of new entrants, and increasing capital intensity of the sector as factors necessitating a departure from the earlier reserve price benchmarks.
- 3.168 Further, certain stakeholders have suggested that for spectrum bands which were entirely or largely unsold in recent auctions, the reserve price should be reduced even further, with the explicit objective of clearing inventory and ensuring productive use of spectrum. For new or less mature bands, such as the 600 MHz band, it has been suggested that additional discounts may be warranted to account for ecosystem uncertainty and higher deployment risks.
- 3.169 One stakeholder has supported the continuation of the 70% reserve price-to-valuation ratio, as recommended by the Authority in its earlier recommendations, arguing for consistency and predictability in the auction framework.

## **Analysis of the issues raised through Q42**

- 3.170 After examination of comments received from stakeholders, it is noted that the reserve price serves as the starting point in an ascending auction, with competitive bidding facilitating price discovery through the interaction of demand and supply. A reserve price ensures a minimum assured return to the seller and prevents excessive bargaining during the auction process.
- 3.171 As elaborated earlier, demand for spectrum is a derived demand arising from the telecommunication needs of economy and the growing data consumption requirements of the economy. It is influenced by multiple inter-related factors including subscriber growth, traffic demand, coverage requirements across LSAs, financial health and investment capacity of bidders, adequacy of existing spectrum holdings, timing of recent auctions, monetization of previously acquired spectrum, impending spectrum allocation expiries, technology evolution, maturity of device ecosystems, individual business strategies and overall policy and regulatory environment. For the auction to be efficient, the reserve price must therefore be set at an appropriate level, keeping these dynamics in view, however with the knowledge that it is an exercise in judgement rather than arithmetic. An excessively high reserve price could likely deter participation and weaken competition, while an unduly low reserve price could impede realization of the true economic value of the spectrum. A balanced reserve price therefore could aid effective price discovery while discouraging strategic bidding tendencies and anti-competitive behaviour. Thus, the level of reserve prices could have a bearing on key objectives of spectrum auctions, including efficiency, competition, transparency, market development, and government revenue.
- 3.172 It is often perceived that if the full quantum of spectrum offered in an

auction remains unsold, or if it is acquired only at the reserve price, this necessarily reflects weak demand arising from an excessively high or prohibitive reserve price. However, participation levels and instances of unsold spectrum cannot be attributed solely or even very significantly to the levels of reserve price. Spectrum demand and auction outcomes emerge from the combined effect of spectrum availability, demand-supply conditions, macroeconomic factors, sectoral financial sustainability, availability of financing, policy stability, and expectations regarding future technology adoption and service revenues, with the reserve price constituting only one such factor. The reserve price, in itself, does not determine bidder participation, the quantity of spectrum acquired, or the extent to which auction prices move beyond the reserve level. Rather, auction outcomes and demand patterns emerge from a combination of several interdependent factors operating simultaneously. Nonetheless, reserve price remains the major regulatory tool the Authority has to guide the efficient allocation of spectrum. Accordingly, reserve price determination must be undertaken within a broader assessment of sectoral and market conditions, rather than being viewed in isolation.

3.173 It is further noted that reserve price determination is a distinct stage following the valuation exercise. In principle, an optimal reserve price would require information on the full range of possible valuations and their associated probabilities. Given the uncertainty associated with obtaining such information, a pragmatic approach for valuation by using the simple arithmetic mean of all available valuation estimates for each spectrum band has been adopted. However, fixing the reserve price at the level of the average valuation entails the risk of setting it too high, particularly in the absence of knowledge of the true theoretical value.

3.174 The Authority remains cognizant of the limitations of theoretical auction models. As recognized in the literature, auction design is inherently

context-specific and requires the exercise of informed judgment, guided by theory, empirical evidence, and prevailing market conditions. In the present context, these prevailing conditions include sustained growth in mobile data consumption, rapid digitisation of services across sectors, increasing adoption of data-intensive technologies such as Artificial Intelligence, M2M and IoT, and the predominantly wireless nature of broadband access in India. Enhancement of network capacity therefore requires both additional spectrum and infrastructure densification. At the same time, operators continue to optimise capital expenditure and prioritise investments based on techno-commercial viability and rollout obligations. These considerations reinforce the need for a calibrated and forward-looking approach to reserve price fixation.

3.175 With respect to the relationship between RP & ADP as discussed above in Section E(1), the Authority is of the considered view that past ADPs should continue to be used as one of the valuation methodologies within the overall valuation framework. In its previous recommendations, the Authority has consistently treated past ADPs as one of the important valuation inputs within a broader framework comprising multiple valuation approaches to arrive at the reserve prices from the average valuation, thereby mitigating exclusive reliance of past ADPs on level of Reserve price. While auction-determined prices (ADPs) provide useful market-based signals, excessive dependence on past ADPs may constrain future price discovery to outcomes shaped by contextual factors prevailing at the time of earlier auctions. Accordingly, past ADPs have been incorporated alongside other established valuation approaches/methods to ensure balanced and robust determination of reserve price from average valuation.

3.176 Accordingly, it is clear that wherever a fresh comprehensive valuation is being undertaken, past ADPs should not be used as the sole approach for

determining current Reserve prices, but only as one of the valuation methods. Reserve Prices should be based on the valuation which has been arrived at through the multiple approaches and models.

Going forward, the differing views on the appropriate level of reserve prices relative to average valuations have been examined. Historically, prior to 2022, the Authority had set reserve prices at 80% of the average valuation. This approach was informed by international experiences, the understanding that reserve prices are not final transaction prices, and empirical evidence indicating that reserve prices in the range of 70-80% of asset value may enhance revenue outcomes<sup>63</sup>. The Authority in its recommendation dated 11.04.2022 and 04.02.2025 recommended setting the reserve price at 70% of the average valuation.

3.177 Studies further indicate that the ratio of reserve price to final auction price varies widely across auctions, and that regulators in several jurisdictions have adopted reserve prices in the range of 70-80% of estimated spectrum valuation<sup>64</sup>.

3.178 To assess prevailing market conditions relevant to the forthcoming auction, the Authority reviewed bidding outcomes, including relationship between RP & ADP, from previous auctions, as summarized in Table 3.7.

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<sup>63</sup> 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

<sup>64</sup> 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)

**Table 3.7. Spectrum Prices and Bidding Activity in Previous Auctions**

Year of Auction	Spectrum Band	Quantum of spectrum put to auction (MHz)	Quantum of spectrum sold (MHz)	% of Quantum of spectrum unsold	No. of LSAs that remained unsold	Number of bidders who acquired spectrum	No. of LSAs where ADP>RP
<b>2015</b>	800MHz	108.75 (20 LSAs)	86.25 (18 LSAs)	20.69%	2	3	14
	900MHz	177.8 (17 LSAs)	168 (17 LSAs)	5.51%	-	4	17
	1800 MHz	99.2 (15 LSAs)	93.8 (14 LSAs)	5.44%	1	7	9
	2100 MHz	85 (17 LSAs)	70 (14 LSAs)	17.65%	3	3	10
<b>2016</b>	700 MHz	770 (22 LSAs)	-	100%	22	-	No bid received
	800MHz	73.75 (19 LSAs)	15 (4 LSAs)	79.66%	15	1	3
	900MHz	9.4 (4 LSAs)	-	100.00%	22	-	No bid received
	1800 MHz	221.6 (21 LSAs)	174.8 (19 LSAs)	21.12%	2	7	6
	2100 MHz	360 (22 LSAs)	85 (12 LSAs)	76.39%	10	3	Nil
	2300 MHz	320 (16 LSAs)	320 (16 LSAs)	-	-	3	6
	2500 MHz	600 (22 LSAs)	370 (20 LSAs)	38.33%	2	2	1
<b>2021</b>	700 MHz	660 (22 LSAs)	-	100%	22	-	No bid received
	800MHz	230 (22 LSAs)	150 (19 LSAs)	34.78%	3	2	Nil
	900MHz	98.8 (19 LSAs)	38.4 (9 LSAs)	61.13%	10	2	Nil
	1800 MHz	355 (22 LSAs)	152.2 (21 LSAs)	57.13%	1	3	Nil

	2100 MHz	175 (19 LSAs)	15 (3LSAs)	91.43%	16	1	Nil
	2300 MHz	560 (22 LSAs)	500 (22 LSAs)	10.71%	-	2	Nil
	2500 MHz	230 (12 LSAs)	-	100.00%	22	-	No bid received
<b>2022</b>	600 MHz	660 (22 LSAs)	-	100%	22	0	No bid received
	700 MHz	550 (22 LSAs)	220 (22 LSAs)	60%	-	1	Nil
	800 MHz	136.25 (22 LSAs)	20 (4 LSAs)	85%	18	1	Nil
	900 MHz	74.39 (21 LSAs)	12.8 (3 LSAs)	83%	18	1	Nil
	1800 MHz	267.2 (22 LSAs)	88.4 (10 LSAs)	67%	12	3	2
	2100 MHz	160 (19 LSAs)	35 (7 LSAs)	78%	12	2	Nil
	2300 MHz	60 (6 LSAs)	-	100%	6	-	No bid received
	2500 MHz	230 (12 LSAs)	20 (2 LSAs)	91%	10	1	Nil
	3300 MHz	7260 (22 LSAs)	5490 (22 LSAs)	24%	-	3	Nil
	26 GHz	62700 (22 LSAs)	45350 (22 LSAs)	28%	-	4	Nil
<b>2024</b>	800 MHz	118.75 (19 LSAs)	-	100%	19	-	No bid received
	900 MHz	117.2 (22 LSAs)	60.8 (14 LSAs)	48%	8	2	Nil
	1800 MHz	221.4 (22 LSAs)	50.6 (10 LSAs)	77%	12	3	2
	2100 MHz	125 (15 LSAs)	20 (4 LSAs)	84%	11	1	Nil
	2300 MHz	60 (6 LSAs)	-	100%	6	-	No bid received

	2500 MHz	70 (5 LSAs)	10 (1 LSA)	86%	4	1	Nil
	3300 MHz	1110 (22 LSAs)	-	100%	22	-	No bid received
	26 GHz	8700 (21 LSAs)	-	100%	21	-	No bid received

3.179 Table 3.7 above indicates that over successive auctions there has been a decline in the number of active bidders and that in several bands and LSAs a significant proportion of spectrum has remained unsold or has been acquired at the reserve price.

As per a recent paper on “Evolution of prices for mobile spectrum & possible explanations”<sup>65</sup>, the same phenomena is being observed globally and is being studied. The paper utilizes a global dataset of more than 400 spectrum auction prices from 2007 to 2023 to demonstrate that spectrum prices have generally declined over the past two decades. This has been studied and attributed probabilistically to a range of factors by the authors.

It is held that the demand for additional spectrum is ultimately underpinned by expected growth in mobile data traffic, which requires operators to expand network capacity. As per the paper, industry statistics generally show an accelerating growth rate in data consumption in the early days of 4G, but with a slowing down in the rate of growth in the later 5G era. As per the paper, global data consumption is following an S-shaped curve typical for technological innovation, implying that exponential projections significantly overestimate future data

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<sup>65</sup> “Evolution of prices for mobile spectrum & possible explanations” presented at 24th Biennial Conference of the International Telecommunications Society (ITS), Seoul, 2024 themed “New bottles for new wine: digital transformation demands new policies and strategies”  
<https://www.nera.com/content/dam/nera/publications/2024/PUB ITS Evolution of Prices for Mobile Spectrum and Possible Explanations.pdf>

consumption. The exponential growth forecasts may only be justified if there is a significant future change in how we use phones, such as widespread adoption of data intensive Virtual Reality technology.

Also, it is inferred from the trend of declining spectrum prices that the release of new spectrum has generally kept pace and helped avoid capacity issues on mobile networks. It is found that in most countries, supply has increased by 60% or more since 2017. This increase, combined with the densification of networks in urban areas is, in the view of the authors, the major factor explaining the decline in unit prices.

Further, the trends for different types of spectrum, including low band, lower mid-band, and upper mid-band spectrum, which serve different purposes in mobile networks have been studied. The results indicate an overall decline in spectrum prices, with the steepest decline observed in low band spectrum. As per the authors, this suggests that incremental coverage spectrum is no longer essential, as successive releases of this spectrum have adequately met market demands. Lower mid-band spectrum prices have also decreased, while prices for upper mid-band capacity bands have remained relatively stable, indicating their continued importance in providing capacity.

Another factor examined by the authors is the additional network capacity acquired over the years. As per the authors, during the 4G era, there was strong optimism that rapid growth in data traffic would generate new revenue streams. However, these new sources of revenue have not materialized yet. As spectrum supply continues to expand while mobile revenues remain stagnant, this affects both the intrinsic value of additional spectrum and operators' ability and willingness to pay for it. Moreover, the increase in capacity has not translated into higher revenue per user. This is another reason held by the authors for service providers

being less inclined to heavily invest in acquiring incremental spectrum.

3.180 Thus, it can be seen that a general trend of declining prices of spectrum is a worldwide phenomenon attributable to a host of factors as mentioned at Para 3.171 & 3.179 above and is under study internationally. It appears that such outcomes are in no manner singularly or even significantly attributable to levels of reserve prices. However, the reserve price being a major regulatory tool in hands of the Authority, and considering this trend of declining prices, there is perhaps increased salience of calibrating reserve prices to prevailing market realities so as to avoid sub-optimal allocation of spectrum.

3.181 It is noted that a recalibration of Reserve price vis-à-vis Valuation was undertaken in Recommendations dated 11.04.2022, wherein the general level of reserve price vis-à-vis valuation was reduced from 80% to 70%. The following excerpts from the said Recommendations of 2022 are relevant:

*"the Authority is inclined to consider that a reserve price set at 70% of the average valuation of spectrum band would go a long way in helping discover the market clearing price of the spectrum. As has been stated earlier, a reserve price is a means of achieving price discovery, and the Authority is of the view that a 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.*

*However, in the LSAs where spectrum in a band was completely sold in the auction(s) held in the past two years (i.e., where market clearing prices have been achieved), the reserve price will be the higher of the two prices – (1) 70% of the average valuation; and (2) ADP (duly indexed) of the previous auction."*

- 3.182 Consistent with the Authority's recommendations dated 11.04.2022, 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 keeping the reserve price at 70% of the average valuation arrived at.
- 3.183 In view of the above observations, the Authority is of the view that there is no substantial ground to depart from the general ratio of reserve price to average valuation as prescribed in the past Recommendations dated 11.04.2022 and 04.02.2025. The consistency in ratio of reserve prices vis-à-vis average valuation is expected to facilitate competitive bidding and improve the prospects of discovering market-clearing prices under the prevailing conditions. This approach appropriately balances the need to safeguard public revenue with the objective of encouraging wider participation and ensuring efficient allocation, while recognising that reserve price is only one among several determinants of auction outcomes.
- 3.184 However, a differentiated approach is warranted in respect of LSAs where spectrum in a particular band was put to auction but remained unsold in both the 2022 and 2024 auctions. As has been observed earlier, the fact of spectrum remaining unsold across two successive auctions cannot be attributed to the level of the reserve prices but is a result of multiple techno-economic and commercial factors mentioned in preceding paragraphs, including business strategies, financial capacity, spectrum holdings, technology deployment plans, rollout obligations, and overall market conditions.

Nevertheless, spectrum remaining unsold over two successive auctions does indicate subdued demand in the respective LSA-band combinations and that spectrum has not found market acceptance under the existing

pricing and demand-supply configuration. Most importantly, unsold spectrum results in continued idling of a valuable national resource. In such circumstances, a calibrated intervention in the reserve price can be attempted with the objective of stimulating demand and facilitating productive utilization of the idle spectrum.

3.185 In this regard, several stakeholders have also submitted that LSA-band combinations where spectrum has remained unsold, a recalibration of reserve prices may be warranted in light of subdued demand to better align with prevailing market realities. They have contended that reduction in reserve price in such cases would enhance the prospects of market-driven price discovery, reduce the risk of continued idling of spectrum, and facilitate the timely and productive utilization of valuable national resource.

3.186 Given the public interest in ensuring efficient allocation and avoiding prolonged non-utilization of spectrum, and the fact that reserve prices are the major regulatory tool available with the Authority to influence the demand dynamics, a calibrated reduction in the reserve price can be attempted, in an effort to improve the bidder's participation and enhance competitive dynamics to facilitate productive utilization of the idle spectrum. The current reserve price levels of 70% of the valuation could be lowered further to 60% of the valuation in this attempt to influence demand and bidder participation in these band-LSA combinations where there is a strong indication of subdued demand.

This calibrated reduction is recommended while being fully cognizant of the fact that demand for spectrum, level of participation and auction outcomes are a result of complex interplay of several factors outlined in preceding sections, of which regulatory action through the setting of reserve prices is only one factor. However, since setting reserve prices is

a major regulatory tool the Authority has to influence the market, this reduction of reserve price from 70% to 60% of the valuation is recommended in an attempt to incentivize bidders' participation and prevent idling of a valuable national resource in LSA-band combinations that have been put to auction but gone unsold in both 2022 & 2024, thus exhibiting sustained weak demand.

3.187 Accordingly, in view of above observations and facts, and partly in continuity with the past Recommendations, **the Authority recommends the following:**

**The reserve price for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz should generally be set at 70% of the average valuation, with the following conditions:**

**a) In the LSAs where spectrum in a band was completely sold in the June 2024 auction, the reserve price shall be the higher of the two figures:**

**(1) 70% of the average valuation; and**

**(2) auction determined price of the June 2024 auction, duly indexed.**

**b) For spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz across LSAs where spectrum band was put to auction and remained unsold in both the 2022 and 2024 auctions, the reserve price should be fixed at 60% of the average valuation, *subject to the exceptions set out further.***

**c) To promote investment in telecom infrastructure in the North East and Jammu & Kashmir LSAs, and in line with past recommendations, the Authority recommends a 50% reduction in reserve prices for these LSAs across the 800 MHz, 900 MHz,**

**1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. This concession shall also apply, as relevant, to other spectrum bands.**

3.188 As recommended at Para 3.187 (b) above, the reduction in reserve prices is an effort to stimulate demand for spectrum in band-LSA combinations which have exhibited weak demand, manifested in lack of sale during last two auctions. However, there could be cases where spectrum in particular band-LSA combinations have not been sold in last two auctions, indicating subdued demand in the recent past, but an indicator of likely demand in upcoming auctions has been detected. Since the reduction of reserve prices is only an attempt to stimulate demand to prevent idling of spectrum, it is only logical that such a reduction is not required where newfound source(s) of demand for spectrum have been identified.

Two such new sources of demand are relevant and likely for the upcoming auctions:

a. There could be band-LSA combination(s) where the quantity of spectrum available to be put up for auction in 2024 was not sufficient for a new entrant, considering that the Minimum Bid Quantity for New Entrants in a particular band-LSA is often higher than existing players in the same, due to operational and feasibility reasons. The Minimum Bid Quantities for existing players and new entrants is detailed in Section A(5) of Chapter II of this recommendation for each LSA-band combination.

However, it is noted that as per DoT Reference dated 15.05.2025, there are two sources for additional spectrum in the upcoming auctions:

i. Spectrum assignments set to expire in 2026-27, either of a functional TSP or of the two companies under IBC proceedings viz. M/s Aircel & M/s

RCOM and added to the available spectrum for auction.

ii. Spectrum Refarming of 20 MHz spectrum (in each LSA) in the 2500 MHz band has been carried out and allocated for IMT-based services, which has also added to the available spectrum pool in 2500 MHz.

Further, consequent to the Hon'ble Supreme Court's judgment related to M/s Aircel and M/s RCOM under IBC proceedings, referred to in Chapter II of this recommendation, spectrum in certain LSA-band combinations, set to expire beyond F.Y. 2026-27, may also become available for the upcoming auctions, due to release from IBC proceedings as per the Hon'ble SC Order dated 13.02.2026.

In all three above mentioned cases involving supply of additional spectrum, where the previous available spectrum in 2024 in particular band-LSA was less than the Minimum Bid Quantity for a new entrant, but the resulting quantity of available spectrum is now greater than or equal to the Minimum Bid Quantity applicable for a new entrant, a reasonable opportunity for new entrants to participate in the respective LSA-band combination in the forthcoming auction is created. For this comparison between availability in 2024 vis-à-vis availability for upcoming auction, from the point of view of a new entrant, it is important that only the absence/ presence of 'normal' minimum bid quantity is considered for both 2024 auctions and upcoming auction, which is taken as 5 MHz in 800/900/1800/2100 MHz, 10 MHz in 2300/2500/3300 and 50 Mhz in 26 GHz.

In such cases, there is a likely source of new demand from a probable new entrant in that particular band-LSA combination. Since fresh demand is likely to arise, the subdued demand manifested through absence of sales in 2022 & 2024 auctions need not be given precedence. Here, it is

felt that the attempt to influence demand through the reduction of RP to 60% of valuation is not required, and hence Reserve price can be kept at 70% of the valuations itself.

Accordingly, for additional spectrum from the two sources viz. expiry of spectrum assignment in 1800 MHz band in FY 2026-27, either of operational TSPs or of TSPs under IBC proceedings, and refarming of spectrum in 2500 MHz band, the above condition has been applied while arriving at Reserve prices in the present Recommendations.

Conversely, in LSA-band combinations where the quantity of spectrum available for auction was already equal to or greater than the normal Minimum Bid Quantity even prior to the addition of spectrum due to license expiry, the basic eligibility conditions for new entrants were already satisfied. In such cases, the subsequent addition of spectrum from license expiry does not materially alter the competitive landscape or demand conditions for new entrants. Therefore, in such LSA-band combinations where spectrum put up for auction in both the auctions held in 2022 and 2024 remained unsold, and the quantity of spectrum available for auction was already equal to or greater than the normal Minimum Bid Quantity for New Entrant even prior to addition of spectrum due to license expiry in 2026-27, the calibrated reduction of the reserve price to 60% of the average valuation shall be undertaken.

b. A further distinction is warranted in cases involving expiry of spectrum allotment in a LSA-band combination where the licensee is an operational service provider. Where the spectrum allotment of an operational licensee is due to expire in an LSA-band combination, there is a reasonable expectation of demand arising from the need to ensure continuity of services. In such cases, the demand is not merely prospective or expansion-driven but arises from operational necessity. Accordingly, in

such LSA-band combinations, where spectrum allotment of an existing operational TSP is set to expire in 2026-27, there is a likely source of new demand, irrespective of the subdued demand manifested through absence of sale in 2022 & 2024 auctions. Here, it is felt that the attempt to influence demand through the reduction of RP to 60% of valuation is not required, and hence Reserve price can be kept at 70% of the valuations itself.

In contrast, where spectrum is becoming available due to expiry of allotment of a non-operational service provider, and there is no ongoing service continuity requirement, the addition of such spectrum merely augments the overall supply in the LSA-band combination without generating likely demand. In such cases, where the concerned LSA-band combination put up for auction remained unsold in the previous two auctions, the reserve price shall be fixed at 60% of the average valuation.

3.189 Accordingly, in continuation of the recommendations at Para 3.187 above, **for LSA-band combinations where spectrum was put up for auction but remained unsold in both the 2022 and 2024 auctions, the reserve price shall be fixed at 60% of the average valuation, subject to the exceptions set out below:**

- i. **In a LSA-band combination where quantity of spectrum available in 2024 Auctions was below the normal Minimum Bid Quantity for a new entrant (5 MHz in 800/900/1800/2100 MHz, 10 MHz in 2300/2500/3300 and 50 Mhz in 26 GHz) , and where, upon increase in spectrum availability due to either expiry of spectrum assignments in 2026-27 (in 1800 MHz band as per DoT Reference dated 15.05.2025) or spectrum refarming (in 2500 MHz band as per DoT Reference dated 15.05.2025) or release of spectrum due to Hon'ble SC Order dated**

**13.02.2026, the resulting total quantity of spectrum available for present auction becomes equal to or greater than the normal Minimum Bid Quantity for a new entrant, thereby creating a reasonable possibility of participation by a new entrant in the respective LSA-band combination, the reserve price shall be fixed at 70% of the average valuation.**

- ii. In an LSA-band combination where the spectrum assignment of an operational TSP is due to expire in 2026-27, the reserve price shall be fixed at 70% of the average valuation, irrespective of auction outcomes from the past two auctions of 2022 & 2024.**

3.190 Accordingly, the recommended reserve price of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands spectrum bands for each LSAs is tabulated below:

**TABLE 3.9: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)**

**IN 800 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	181.66	182
Assam	47.47	47
Bihar	107.95	108
Delhi	326.91	327
Gujarat	151.28	151
Haryana	51.14	51

Himachal Pradesh	19.61	20
Jammu & Kashmir	12.29	12
Karnataka	142.27	142
Kerala	81.87	82
Kolkata	81.23	81
Madhya Pradesh	111.08	111
Maharashtra	201.35	201
Mumbai	215.39	215
North East	12.09	12
Orissa	52.68	53
Punjab	68.01	68
Rajasthan	99.42	99
Tamil Nadu	164.04	164
U. P. (East)	193.62	194
U.P. (West)	160.74	161
West Bengal	91.03	91

**TABLE 3.10: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 900 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	216.93	217
Assam	50.35	50
Bihar	124.05	124
Delhi	326.91	327
Gujarat	151.28	151
Haryana	51.14	51
Himachal Pradesh	19.61	20
Jammu & Kashmir	12.70	13
Karnataka	165.55	166
Kerala	81.87	82
Kolkata	101.87	102
Madhya Pradesh	111.08	111
Maharashtra	201.35	201
Mumbai	215.39	215
North East	12.43	12
Orissa	58.98	59
Punjab	119.62	120
Rajasthan	155.28	155
Tamil Nadu	188.22	188
U. P. (East)	213.94	214
U.P. (West)	165.27	165
West Bengal	113.87	114

**TABLE 3.11: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 1800 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	126.60	127
Assam	28.49	28
Bihar	96.68	97
Delhi	214.47	214
Gujarat	108.13	108
Haryana	35.82	36
Himachal Pradesh	13.08	13
Jammu & Kashmir	8.36	8
Karnataka	101.60	102
Kerala	48.95	49
Kolkata	62.00	62
Madhya Pradesh	113.87	114
Maharashtra	141.32	141
Mumbai	165.96	166
North East	8.29	8
Orissa	33.96	34
Punjab	48.53	49
Rajasthan	67.36	67
Tamil Nadu	99.74	100
U. P. (East)	211.64	212
U.P. (West)	80.04	80
West Bengal	67.71	68

**TABLE 3.12: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 2100 MHz BAND (20 years)**

(Rs. in crore)

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	90.06	90
Assam	27.61	28
Bihar	55.59	56
Delhi	191.69	192
Gujarat	93.88	94
Haryana	28.19	28
Himachal Pradesh	9.31	9
Jammu & Kashmir	5.08	5
Karnataka	81.36	81
Kerala	42.52	43
Kolkata	44.11	44
Madhya Pradesh	53.20	53
Maharashtra	100.54	101
Mumbai	118.07	118
North East	4.45	4
Orissa	24.16	24
Punjab	34.53	35
Rajasthan	55.91	56
Tamil Nadu	96.58	97
U. P. (East)	99.04	99
U.P. (West)	67.74	68
West Bengal	39.11	39

**TABLE 3.11: RECOMMENDED RESERVE PRICE PER MHz (UNPAIRED) IN  
2300 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	37.58	38
Assam	8.99	9
Bihar	15.60	16
Delhi	72.81	73
Gujarat	37.18	37
Haryana	11.86	12
Himachal Pradesh	6.76	7
Jammu & Kashmir	3.69	4
Karnataka	43.69	44
Kerala	17.80	18
Kolkata	20.45	20
Madhya Pradesh	16.85	17
Maharashtra	43.54	44
Mumbai	64.64	65
North East	3.60	4
Orissa	10.44	10
Punjab	17.58	18
Rajasthan	15.25	15
Tamil Nadu	55.21	55
U. P. (East)	22.67	23
U.P. (West)	20.31	20
West Bengal	13.88	14

**TABLE 3.12: RECOMMENDED RESERVE PRICE PER MHz (UNPAIRED) IN  
2500 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	38.49	38
Assam	8.06	8
Bihar	17.25	17
Delhi	73.75	74
Gujarat	32.10	32
Haryana	10.41	10
Himachal Pradesh	4.30	4
Jammu & Kashmir	2.48	2
Karnataka	32.73	33
Kerala	16.04	16
Kolkata	19.68	20
Madhya Pradesh	17.77	18
Maharashtra	39.43	39
Mumbai	58.45	58
North East	2.84	3
Orissa	9.47	9
Punjab	13.56	14
Rajasthan	16.05	16
Tamil Nadu	40.07	40
U. P. (East)	26.25	26
U.P. (West)	21.83	22
West Bengal	14.35	14

**TABLE 3.13: RECOMMENDED RESERVE PRICE PER MHz IN 3300MHz BAND  
(UNPAIRED)  
(20 years)**

(Rs. in crore)

(1)	(2)	(3)
LSA	Reserve Price (as calculated)	Recommended Reserve Price (Rounded off)
Andhra Pradesh	19.69	20
Assam	4.10	4
Bihar	9.93	10
Delhi	34.45	34
Gujarat	17.13	17
Haryana	5.04	5
Himachal Pradesh	1.77	2
Jammu & Kashmir	0.82	1
Karnataka	14.68	15
Kerala	7.81	8
Kolkata	10.53	11
Madhya Pradesh	10.70	11
Maharashtra	21.97	22
Mumbai	26.17	26
North East	0.82	1
Orissa	4.51	5
Punjab	7.17	7
Rajasthan	9.36	9
Tamil Nadu	16.96	17
U. P. (East)	14.44	14
U.P. (West)	12.10	12
West Bengal	7.97	8

**TABLE 3.14: RECOMMENDED RESERVE PRICE PER MHZ IN 26 GHz BAND  
(UNPAIRED)  
(20 years)**

**(in Rs. lakhs)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	43.07	43
Assam	8.15	8
Bihar	20.93	21
Delhi	71.17	71
Gujarat	37.58	38
Haryana	10.54	11
Himachal Pradesh	3.95	4
Jammu & Kashmir	1.39	1
Karnataka	31.16	31
Kerala	15.65	16
Kolkata	23.66	24
Madhya Pradesh	22.44	22
Maharashtra	47.92	48
Mumbai	57.93	58
North East	1.38	1
Orissa	9.28	9
Punjab	15.23	15
Rajasthan	19.63	20
Tamil Nadu	36.01	36
U. P. (East)	27.06	27
U.P. (West)	23.90	24
West Bengal	15.72	16

**F. Valuation and Reserve Price of Newly Identified Band: 6425-6725 MHz & 7025-7125 MHz Band**

3.191 The preceding Section E examined various aspects relating to the valuation of spectrum in the existing bands, namely 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2500 MHz, 3300 MHz and 26 GHz. The present section addresses the issues pertaining to valuation of spectrum in the 6425-6725 MHz and 7025-7125 MHz bands.

3.192 With regard to whether the entire spectrum in the 6425-6725 MHz and 7025-7125 MHz bands should be put to auction, the discussion and the Authority's recommendations at paragraphs 2.1 to 2.27 of Chapter II may be referred.

3.193 In respect of valuation of 6425-6725 MHz and 7025-7125 MHz bands, the Authority solicited comments from stakeholders on the following set of questions:

*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 187 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.*

- 3.194 Consequent to the Authority's recommendations at Chapter II, wherein it has been recommended that 6425-6725 MHz and 7025-7125 MHz bands should not be put to auction in the forthcoming auction and the same may be reexamined after the outcome of WRC-27. Therefore, Q32 to Q35 relating to valuation of 6425-6725 MHz and 7025-7125 MHz have not been deliberated further.

**G. Valuation and Reserve Price of 600 MHz Band**

- 3.195 Spectrum in the 600 MHz band was put up for auction in 2022 across 22 LSAs. A total of 660.00 MHz of spectrum was put to auction in 2022 across 22 LSAs. However, no bid was received in any of 22 LSAs in 2022. Consequently, entire spectrum in 600 MHz band remains unsold.
- 3.196 With regard to whether the entire spectrum in the range 526-698 MHz should be put to auction, the discussion and the Authority's recommendations at paragraphs 2.166 to 2.186 of Chapter II may be referred. Hence, the valuation exercise has been conducted for the 600 MHz (3GPP band plan n105) band only.
- 3.197 With respect to the 600 MHz band, DoT, vide its letter dated 15.05.2025, has stated as follows:

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

3.198 Accordingly, DoT has requested TRAI to re-examine the matter and provide fresh recommendations on the auction of spectrum in the 600 MHz band.

3.199 The technical and other related aspects of the 600 MHz band have been discussed in section B of Chapter II of this Recommendation. The present section focuses on the valuation aspects of this band, while the relevant methodology and considerations are discussed in the subsequent paragraphs.

3.200 For the purpose of valuation of the 600 MHz band, the Authority, in its Recommendations dated 11.04.2022, had observed the following:

*"Considering that the technical characteristics of the 600 MHz band are comparable to those of the 700 MHz band, and further considering that the ecosystem in the 600 MHz band is relatively less developed than that of the 700 MHz band, 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."*

3.201 Accordingly, using the technical/spectral efficiency approach, the valuation and consequently the reserve price of the 600 MHz band in Authority's recommendation dated 11.04.2022 was set equal to that of the 700 MHz band. However, as the 600 MHz (612-652/663-703 MHz) band was not put to auction in 2024, and had also remained unsold in the 2022 auction, no auction-determined prices are available for this band. Further, the financial, technical, and other relevant data required for applying conventional valuation models are also not available.

3.202 In view of the above constraints, the following valuation methodologies have been considered for the valuation of the 600 MHz band:

- Technical/Spectral Efficiency approach
- International Benchmarking

These methodologies are discussed in detail in the subsequent sections.

#### **G (1) Valuation of the 600 MHz Band Using Spectral Efficiency Factor**

3.203 This approach is similar to the approach adopted by the Authority in its Recommendation dated 11.04.2022 for the valuation of the 600 MHz band in its recommendation dated 11.04.2022. Under this methodology, the valuation of the 600 MHz band may be estimated using a relative spectral efficiency framework, wherein technical characteristics such as coverage and propagation of a particular spectrum band are compared with those of another reference spectrum band, and a corresponding technical or spectral efficiency factor is derived in the form of a ratio.

3.204 Given the broadly comparable technical characteristics of sub-1 GHz spectrum bands, the Authority, in its Recommendations dated 11.04.2022, had applied a technical efficiency factor of 1 while comparing one sub-1 GHz band with another sub-1 GHz band.

3.205 As noted earlier, in the Recommendations dated 11.04.2022, the Authority had equated the valuation of the 600 MHz band with that of the 700 MHz band by applying the technical/spectral efficiency approach. A similar methodology is considered in the present valuation exercise, wherein the valuation of the 600 MHz band is to be derived using relative technical or spectral efficiency factors with reference to the freshly estimated valuation (where such fresh valuation is undertaken) of other sub-1 GHz bands such as the 800 MHz and 900 MHz bands.

3.206 Alternatively, the valuation of the 600 MHz band may also be inferred from past auction-determined prices of other sub-1 GHz spectrum bands, such as the 700 MHz, 800 MHz, and 900 MHz bands, by applying appropriate relative technical or spectral efficiency factors.

3.207 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

#### **Comments of stakeholders on Q36**

3.208 Many stakeholders have expressed the view that the 600 MHz band should not be auctioned in the forthcoming auction, primarily due to the lack of ecosystem maturity. These stakeholders highlighted that device availability, chipset support, and network equipment readiness for the 600 MHz band remain limited both in India and globally. Premature auctioning, in their view, could lead to weak participation, spectrum remaining unsold, and inefficient utilization of a scarce national resource. Accordingly, they

have recommended deferring the auction by 2-3 years, undertaking periodic ecosystem readiness assessments, and issue a fresh consultation on this subject at a later stage once there is concrete evidence of market and technology preparedness.

- 3.209 Several stakeholders have categorically opposed using auction-determined prices of other bands with spectral efficiency factors as a basis for valuing the 600 MHz band, reiterating that valuation itself would be premature in the absence of a viable ecosystem. These stakeholders emphasized that policy focus should instead be on ecosystem development and long-term planning before considering either valuation or auction.
- 3.210 On the other hand, some stakeholders have supported the use of auction-determined prices of comparable sub-1 GHz bands as a basis for valuation of the 600 MHz band, subject to appropriate technical normalization. They suggested that bands such as 700 MHz, 800 MHz, and 900 MHz are the most relevant anchors due to their similar propagation characteristics, including wide-area coverage and deep indoor penetration. Among these, the 700 MHz band was identified as the closest domestic benchmark, particularly since the 600 MHz band has no market-discovered price in India.
- 3.211 One stakeholder further emphasized the strategic and opportunity value of the 600 MHz band, describing it as the last large contiguous sub-1 GHz band suitable for future technologies, including 6G. This stakeholder argued that, given its superior propagation characteristics and long-term importance for rural, remote, and sensor-heavy networks, the valuation of the 600 MHz band should be significantly higher than the 700 MHz band, suggesting a multiplier over the auction-determined price of the 700 MHz spectrum.

### **Analysis of the issues raised through Q36**

- 3.212 The Authority notes that the 600 MHz band was put to auction for the first time in India in 2022; however, no bids were received and the entire quantum of spectrum offered remained unsold. At the international level as well, only a limited number of jurisdictions have concluded auctions for wireless services in this band. Accordingly, both domestic and international benchmark data for the 600 MHz band are constrained.
- 3.213 Based on the comments received, there appears to be broad consensus among the stakeholders that the 600 MHz band offers superior propagation characteristics and enhanced coverage potential owing to its low-frequency attributes. In its Recommendations dated 11.04.2022 (para 3.163), the Authority had observed that the 600 MHz band is broadly comparable to the 700 MHz band in terms of coverage and propagation and, accordingly, had treated the valuation of the 600 MHz band at par with that of the 700 MHz band by applying a technical efficiency approach.
- 3.214 In this context, it is relevant to recall the approach adopted by the Authority for valuation of the 700 MHz band in its Recommendations dated 11.04.2022 (Paras 3.154-3.155). The Authority had relied upon technical inputs, inter alia, from reports of Huawei and Nokia. The Huawei white paper had highlighted that lower frequency bands such as 700 MHz and 800 MHz exhibit significantly lower propagation losses compared to higher frequency bands (> 1 GHz), and that the coverage area of a single site operating in the 700 MHz band is nearly twice that of the 1800 MHz band. Further, the Nokia Technical Note had indicated that the technical efficiency of the 700 MHz band is considered comparable to that of the 800 MHz band.
- 3.215 Taking into account these technical considerations, the Authority in its

2022 recommendations had determined the valuation of the 700 MHz band using a technical efficiency approach whereby the 700MHz band is valued in two ways: (i) at two times the valuation of the 1800 MHz band, reflecting its superior coverage relative to higher frequency bands; and (ii) equal to that of the 800 MHz band, considering their comparable low-frequency propagation characteristics. Thereafter, the Authority had treated the resulting valuation of the 700 MHz band at par to determine the valuation of the 600 MHz band.

3.216 However, as stated in Para 2.1 of Chapter II of the present Recommendations, the 700 MHz band is not proposed to be put to auction in the forthcoming auction. Consequently, valuation of 700 MHz is not available for forthcoming auction. In view of the above and considering the technical comparability between the 600 MHz and 700 MHz bands as recognised earlier, it would be appropriate to adopt the same technical efficiency approach that was used for valuation of the 700 MHz band in for the present valuation exercise and apply it directly for valuation of the 600 MHz band. Accordingly, the Authority recommends that the valuation of the 600 MHz band be determined using the technical efficiency approach, whereby the 600 MHz band is valued in two ways: (i) at two times the valuation of the 1800 MHz band; and (ii) equal to that of the 800 MHz band.

3.217 Accordingly, the valuations arrived at for the 600 MHz band, based on relative efficiency approach with 1800 MHz & 800 MHz, are placed at Annexure 3.14.

#### **G (2) Valuation of 600 MHz Band Using International Benchmarking**

3.218 The previous Section G (1) examined the technical/spectral efficiency approach for valuation of spectrum in the 600 MHz band. The present section discusses international benchmarking as an alternative approach

for valuation of spectrum in the 600 MHz band.

3.219 The international benchmarking approach entails comparison of auction-determined prices of spectrum across different countries. While applying this method for valuation in a specific national context, cross-country variations in parameters such as GDP, population, subscriber base, and market conditions may require suitable normalization. In its Recommendations dated 11.04.2022, the Authority had examined the ratio of auction prices of the 26 GHz and 3.5 GHz bands across countries where auctions for both bands had taken place. An average international auction price ratio so derived was applied to the estimated valuation of the 3.5 GHz band (from the IMT/5G valuation exercise of 2022) to arrive at the valuation of the 26 GHz band. Further, in its Recommendations dated 04.02.2025 on "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 band and the 24 GHz band in the United States as one of the valuation approaches. Since this comparison involved two bands within the same country, normalization for cross-country differences was not required.

3.220 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*Q37. Should the auction determined price of other countries in 600 MHz band serve as a basis of valuation of 600 MHz 192 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.*

### **Comments of stakeholders on Q37, Q38 & Q39**

- 3.221 Many stakeholders have expressed the view that auction-determined prices of the 600 MHz band in other countries should not be directly used as the basis for valuation of the 600 MHz band in India. These stakeholders emphasized that international auction outcomes reflect country-specific conditions such as market maturity, level of competition, regulatory frameworks, and ecosystem readiness, which differ significantly from India. In particular, it was highlighted that while countries such as the US have a relatively mature 600 MHz device and network ecosystem, India currently lacks such readiness, as evidenced by the absence of bidders in the 2022 auction. Therefore, reliance on international benchmarks could lead to inflated reserve prices and the risk of spectrum remaining unsold.
- 3.222 Several stakeholders further noted that India-specific market realities including lower ARPU, consolidated market structure, financial stress of telecom service providers, and differing regulatory and spectrum allocation contexts make direct international price comparisons unreliable. These stakeholders opined that basing valuation on optimistic foreign benchmarks has, in the past, contributed to high reserve prices and

inefficient spectrum outcomes in India.

- 3.223 On the other hand, one stakeholder acknowledged that international auction prices may provide contextual reference, but only when viewed in conjunction with India's earning potential and demographic scale. It was pointed out that, even though per-MHz-per-pop prices for 600 MHz spectrum in countries like the US appear significantly higher, normalization for India's much larger population and lower revenue potential would need to be taken into account to align valuation closer to domestic sub-GHz spectrum.
- 3.224 With respect to normalization, some stakeholders have supported the view that if international auction prices are considered at all, they must be comprehensively normalized to account for cross-country differences. Suggested normalization parameters included purchasing power parity (PPP), GDP and GDP per capita, population size, subscriber base, auction design, payment terms, and the level of market competition. These stakeholders emphasized that metrics such as price per MHz per capita or per subscriber provide more meaningful comparisons than nominal prices, and that normalization is essential to avoid misleading conclusions and policy distortions.
- 3.225 One stakeholder, by contrast, reiterated that international benchmarks are not an appropriate basis for valuation, even after normalization, given the absence of a mature domestic ecosystem and the risk of overvaluation.

### **Analysis of the issues raised through Q37, Q38 & Q39**

- 3.226 The submissions of stakeholders regarding the suitability of international auction-determined prices of the 600 MHz band as a basis for valuation in the Indian context have been examined. The international

benchmarking approach, as noted earlier, involves comparison of auction outcomes across jurisdictions. However, the applicability of this approach depends on the comparability of market conditions and the availability of reliable and sufficient data, as well as of timing and context of auctions of the bands inter se each other. International auction outcomes reflect country-specific factors such as spectrum availability, competitive intensity, auction design, payment terms, regulatory obligations, device ecosystem maturity, and the overall financial health of operators. These parameters vary significantly across countries and materially influence auction outcomes.

3.227 Further, the specific concerns raised by stakeholders regarding India's market realities, including relatively low ARPU levels and the absence of a mature 600 MHz device and deployment ecosystem, have been duly noted and are of significance. The unsold spectrum in 600 MHz band in 2022 auction indicates that, at the prevailing reserve prices and market conditions, demand for the band did not materialize. This serves as an important contextual factor in assessing the relevance of international benchmarks.

3.228 International auction data may provide a broad contextual reference, particularly in situations where domestic benchmarks are limited or absent. However, such references cannot be adopted mechanically. In particular, metrics such as price per MHz per population or per subscriber may offer relatively more meaningful comparisons than nominal auction prices. However, even the metric of price/MHz/populations, used in standard parlance, would necessarily require robust normalization to account for cross-country as well as cross temporal differences in economic scale, income levels, revenue potential, subscriber base, market structure etc. along with currency differences and timing of auction prices available. This normalization process is inherently very complex and multi-

layered. Moreover, any normalization technique, while mitigating certain differences, cannot fully capture structural distinctions in market dynamics, competitive landscape, and revenue potential.

3.229 The suggestions from some stakeholders regarding usage of the ratio of auction prices of the 600 MHz band vis-à-vis other sub-GHz bands, instead of direct normalization of absolute prices across countries, have been noted. Such intra-country band ratios could, in principle, reduce the impact of macroeconomic differences and focus on relative valuation across comparable spectrum categories. The Authority has, in previous Recommendations on spectrum valuation, employed cross-band ratios derived from international auctions as one of the reference approaches, particularly where domestic data was limited. This approach may offer analytical value where sufficient data for multiple sub-GHz bands within the same jurisdiction is available.

3.230 It is noted that auctions of the 600 MHz band have been conducted in only a limited number of countries, namely the USA (2017), Canada (2019), Saudi Arabia (2024), and Hong Kong (2021). Upon examination, reliable and comparable auction data suitable for pricing related analysis is meaningfully available only for the USA and Canada. Even in these cases, auctions of 600 MHz and other sub-GHz bands were conducted at different points in time and under differing market and regulatory contexts, thereby limiting direct comparability. Further, the absence of recent auction benchmarks for 800 MHz and 900 MHz bands in these jurisdictions constrains the derivation of robust and contemporaneous band-pricing analysis. Auction outcomes of 600 MHz from USA and Canada is discussed below:

**(i) Auction of 600 MHz in USA**

Auction for 600 MHz was held in stages in the FCC Auction 1002 (Incentive Auction) concluding in April 2017, allocating 70 MHz (paired) at about USD

0.88-0.93/ MHz/ pop, with prices reaching USD 1.31/MHz/pop in the competitive regions.

The direct price comparisons with other sub-GHz bands are not possible, since these bands have not been auctioned in same time period. The closest comparison for 600 MHz pricing is to the 700 MHz bands auctioned in 2008 (FCC Auction 73), where the 700MHz band was sold at an average price of USD 1.28/MHz/pop, reaching up to USD 2.26/MHz/pop in some regions. It is seen that there is a substantial time difference of nearly ten years between the auction of 700 MHz and 600 MHz band with significant changes in the technological, economic and market situation. A ratio of these prices at two significantly different points of time would not yield a reliable benchmark.

Further, the other sub-GHz bands i.e. the 800 MHz and 900 MHz bands do not have modern auction benchmark prices in the USA and hence price comparisons are not found to be useful. It has been reported that in the secondary market transactions for 850/900 MHz, the bands sell at a premium over 600MHz band.

## **(ii) Auction of 600 MHz in Canada**

In Canada, the 600 MHz band has been auctioned through a primary round in 2019 and a residual round in early 2023. In the 2019 main auction, 600 MHz fetched a national average price of CAD 1.34/MHz/pop. The average price for National carriers was CAD 1.89/MHz/pop, while the same for set-aside regional licensees was CAD 0.81/MHz/pop. The Canadian auction followed a "set-aside" design, with 30 MHz out of 70 MHz spectrum in each service area reserved for regional smaller players, which constrained the supply available to the three major national operators, which apparently influenced higher bid for the remaining blocks. Thus, prices varied significantly between national carriers and

regional providers due to this "set-aside" rule. In January 2023, residual licenses from various bands, including 600 MHz, were auctioned, and the prices are less indicative of national value due to the limited number of blocks and specific geographic constraints

The other sub-GHz bands have not been auctioned in same time period. The closest comparison is with 700MHz Auction conducted in 2014. However, the context of auctions, including levels of participation, was vastly different from auction of 600 MHz in 2019. The average 2019 prices for 600MHz (CAD 1.89/MHz/pop) have been found to be generally 20-25% lower than for 700MHz sold in 2014, for which the average price was found to be CAD 2.20-2.32 CAD/ MHz/pop. Considering the widely different auction contexts for 600 MHz and 600 MHz, a comparison with the ratio of these prices is not considered a reliable reference.

Similar to USA, the other sub-GHz bands i.e. the 800 MHz and 900 MHz bands do not have modern auction benchmark prices in Canada, and hence price comparisons are not found to be useful.

The international experience also indicates that 600 MHz spectrum has generally been priced at a discount relative to 700/800/900 MHz bands, apparently attributable to ecosystem maturity constraints.

3.231 As can be seen from the discussion above, the limited number of 600 MHz auctions globally along with the different timing of auctions of 600MHz vis-à-vis other sub-GHz bands in the studied jurisdictions, differences in ecosystem maturity, deployment objectives and competition levels constrain the robustness of the band pricing factor method for the 600MHz band to a large extent.

3.232 In view of the above, the Authority is of the considered opinion that

international auction-determined prices of the 600 MHz band or the use of factors derived from ratio of ADPs of 600 MHz vis-à-vis an existing sub-GHz band should not serve as the primary basis for valuation of 600 MHz in India. Due to aforementioned constraints in using international benchmarking for valuation of the 600 MHz band, it may be more appropriate to rely on technical and spectral efficiency-based linkage with other sub-GHz bands in India, which have had a robust determination of valuation based on domestic and contextual techno-economic and market factors. Accordingly, as detailed in paragraph 3.213 of this Chapter, the Authority has decided to determine the valuation of the 600 MHz band on the basis of its relative technical efficiency to the 1800 MHz and 800 MHz bands.

**G (3) Arriving at the Average Valuation of the 600 MHz Spectrum Band**

3.233 As detailed in Para 3.213 of this Chapter, the Authority has decided to approach the valuation of the 600 MHz band on the basis of its relative technical efficiency to the 1800 MHz and 800 MHz bands. Accordingly, the LSA-wise average valuation of 600 MHz spectrum band is tabulated below:

**TABLE 3.15: VALUE PER MHZ OF 600 MHZ BAND (PAIRED)**

(Rs. in crore)

<b>LSA</b>	<b>2 times of average valuation of 1800 MHz band</b>	<b>Technical Efficiency (Equal to average valuation of 800 MHz band)</b>	<b>Average (mean) Value</b>
Andhra Pradesh	361.70	302.77	332.24
Assam	81.41	67.81	74.61
Bihar	199.21	179.92	189.57
Delhi	714.90	544.84	629.87
Gujarat	308.95	252.14	280.55

Haryana	102.35	85.23	93.79
Himachal Pradesh	37.38	32.69	35.04
Jammu & Kashmir	47.75	35.10	41.42
Karnataka	290.29	237.11	263.70
Kerala	163.17	136.46	149.81
Kolkata	177.15	135.38	156.26
Madhya Pradesh	213.65	185.14	199.40
Maharashtra	403.76	335.59	369.68
Mumbai	474.18	358.99	416.58
North East	47.39	34.55	40.97
Orissa	97.04	87.80	92.42
Punjab	138.66	113.35	126.01
Rajasthan	192.46	165.69	179.08
Tamil Nadu	332.47	273.40	302.94
U. P. (East)	340.92	322.70	331.81
U.P. (West)	266.80	229.63	248.22
West Bengal	169.37	151.71	160.54

#### **G (4) Estimation of Reserve Price of 600 MHz Spectrum Band**

3.234 On a detailed examination of stakeholders' submissions and considering the above analysis, the Authority notes that the 600 MHz band is presently confronted with limited device ecosystem maturity, uncertain immediate deployment plans, and the likelihood of a delayed monetization cycle. It is anticipated that a TSP acquiring spectrum in this band may not be in a position to monetize it effectively during the initial three to four years following assignment. In such circumstances, providing a one-time enabling measure becomes necessary to stimulate participation in the auction and to ensure efficient utilization of this valuable low-frequency spectrum. Conceptually, this enabling measure could take two alternative

forms: (i) reduction in the reserve price, or (ii) extension of the validity period to compensate for the reduced monetization window during the initial period of assignment.

3.235 In this regard, the Authority, in Chapter II of present Recommendation, has recommended extending the validity period of the 600 MHz band to 24 years (i.e., 20 years of monetization plus an additional four years), along with deferment of roll-out obligations for the initial four years. This extension of the validity period effectively enhances the economic value available to the successful bidder by allowing recovery and monetization over a longer time horizon without a proportionate increase in spectrum charges, thereby acting as a built-in financial concession. Therefore, the extension of validity from 20 years to 24 years improves the internal rate of return and spreads the bid amount over a longer effective usage period, thereby offsetting the impact of delayed initial cash flows.

3.236 While one approach to addressing the ecosystem constraints could have been a reduction in the reserve price, the Authority is of the view that the recommended 24-year validity itself provides a significant benefit. Further, it is noted that 600MHz is one of the upcoming bands with significant technical advantages, and its usage is picking up the world over as a focal point for 5G coverage.

On a balance of considerations, fixing the reserve price at 70% of the arrived valuation while providing a longer allotment period with delayed payment, strikes a balance by recognizing the current ecosystem and monetization challenges of the 600 MHz band while also noting its superior technical characteristics and anticipated increase in deployment.

3.237 In view of the above discussion, the Authority recommends that

- i. the reserve price for the 600 MHz band be fixed at 70% of the

arrived valuation.

- ii. To promote investment in telecom infrastructure in the North-East and Jammu & Kashmir LSAs, and in line with past recommendations, and recommendation at para 3.183 (b) the Authority recommends a 50% reduction in reserve prices for North-East and Jammu & Kashmir LSAs in the 600 MHz band.

3.238 Thus, **the recommended reserve price of the 600 MHz spectrum bands for each LSA are given below:**

**TABLE 3.16: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN THE 600 MHz (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	232.57	233
Assam	52.23	52
Bihar	132.70	133
Delhi	440.91	441
Gujarat	196.38	196
Haryana	65.65	66
Himachal Pradesh	24.53	25
Jammu & Kashmir	14.50	14
Karnataka	184.59	185
Kerala	104.87	105
Kolkata	109.38	109
Madhya Pradesh	139.58	140
Maharashtra	258.77	259
Mumbai	291.61	292

North East	14.34	14
Orissa	64.69	65
Punjab	88.20	88
Rajasthan	125.35	125
Tamil Nadu	212.06	212
U. P. (East)	232.27	232
U.P. (West)	173.75	174
West Bengal	112.38	112

#### **H. Payment Terms & Associated Conditions**

- 3.239 For the proposed auction of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz and 600 MHz bands, it is necessary for the Authority to examine and determine the appropriate payment terms and associated conditions. These payment-related provisions form an integral part of the auction framework and have a direct bearing on bidder participation, financial sustainability of the sector, and realization of the economic value of spectrum.
- 3.240 It is pertinent to note that several elements of the payment structure such as the number of instalments, the rate of interest applied to preserve the net-present value (NPV) of the bid amount, the extent of upfront payment, and the availability of moratorium are intrinsically linked to the validity period of the spectrum assignment. Issues relating to the validity period of spectrum assigned through auction have been discussed in detail in Chapter II of this recommendation.
- 3.241 In this regard, this section focuses on key aspects of the payment terms, including the upfront payment requirements, moratorium provisions, the total number of instalments for recovery of deferred payments, and the interest rate to be applied for safeguarding the NPV of the bid amount.
- 3.242 In this context, reference may be drawn to the payment terms stipulated in the Notice Inviting Applications (NIA) dated 08.03.2024 for the auction

of spectrum in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands, where the validity period of spectrum assignment was 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.

- 3.243 In view of the above and considering the inclusion of additional spectrum bands in the forthcoming auction, it is necessary to re-examine the appropriateness of these payment terms and associated conditions.
- 3.244 In this context, the Authority solicited comments from stakeholders on the following set of questions:

*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.*

#### **Comments of stakeholders on Q43 & Q44**

- 3.245 On the issue of upfront payment, a majority of stakeholders, proposed for elimination of any mandatory upfront payment requirement. These stakeholders highlighted that substantial upfront payments place considerable stress on the cash flows of telecom service providers, particularly in light of the long gestation period associated with network investments and monetization of new technologies such as 5G and beyond. It was argued that imposing significant upfront payments would dilute the benefits of the telecom reforms announced by the Government in 2021, which were aimed at improving liquidity and financial sustainability of the sector. These stakeholders suggested that operators

should be allowed to pay the entire bid amount through annual instalments, while retaining flexibility to make voluntary prepayments at any stage. In contrast, few stakeholders supported continuation of the payment framework prescribed under the NIA dated 08.03.2024, which provides bidders with an option of either full/partial upfront payment or deferred payment through instalments.

3.246 With regard to the moratorium period, several stakeholders favoured a longer moratorium to align spectrum payments with the investment and revenue cycles of telecom networks. Few stakeholders proposed a moratorium period of at least six years, citing the time required for network rollout, customer acquisition, and generation of cash flows from new services. These stakeholders emphasized that a longer moratorium would ease financial pressure during the initial years and enable operators to focus on capital expenditure and efficient spectrum utilization. Few stakeholders supported continuation of the moratorium provisions as applicable in previous auctions.

3.247 On the number of instalments for recovery of deferred payments, stakeholders broadly suggested spreading payments over the remaining validity period of the spectrum after the moratorium. Some stakeholders proposed recovery of deferred payments through 14 annual instalments following a six-year moratorium, corresponding to a 20-year spectrum tenure and suggested flexibility in the number of instalments, including options of 20 or 40 annual instalments depending on the tenure selected, while few stakeholders supported continuation of the 20-instalment structure as provided under NIA 2024.

3.248 Regarding the applicable interest rate for protecting the NPV of the bid amount, there were divergent views among the stakeholders. One stakeholder contended that no interest should be levied on deferred

spectrum payments. However, if interest is to be charged, several other stakeholders proposed to align interest rate with the RBI repo rate, as this would adequately protect the time value of money without imposing additional financial burden. In contrast, one stakeholder recommended continuation of the payment terms followed in previous auctions.

### **Analysis of the issues raised through Q43 & Q44**

3.249 It is noted that the payment terms prescribed in recent auctions, including the auctions conducted in 2022 and the Notice Inviting Application issued in March 2024, were framed after extensive consultation and keeping in view the objectives of ensuring revenue certainty for the Government, protecting the net present value of the bid amount, and at the same time providing flexibility and liquidity to telecom service providers. Further, to address the liquidity requirements of TSPs, the Government has also announced the extension of moratorium/ deferment of due payments of spectrum purchased in past auctions (excluding the auction of 2021) for up to four years, with NPV protected at the interest rate stipulated in the respective auction. The Government has also dispensed with the requirement for the successful bidder to submit a Financial Bank Guarantee of an amount equal to one annual instalment and Performance Bank Guarantee for roll-out obligations etc.

3.250 The Authority is conscious of the capital-intensive nature of the telecom sector, the long gestation period associated with network roll-out, and the need for TSPs to maintain adequate liquidity for sustained investment in network expansion and quality of service. At the same time, complete elimination of upfront payment or charging no interest on deferred payments may not be consistent with the principle of protecting the time value of money and ensuring fiscal prudence. The existing framework, which provides multiple payment options with NPV protection, strikes a

reasonable balance between the financial requirements of the exchequer and the cash flow needs of TSPs. The Authority is of the opinion that maintaining continuity and predictability in payment terms is desirable, as frequent changes in the framework may introduce uncertainty and affect bidding behaviour.

3.251 In view of the above, and taking into account the comments of stakeholders as well as the experience of recent auctions, the Authority is of the considered opinion that the existing payment terms, as provided in the recent 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<sup>66</sup> for validity of 20 years, already provide adequate flexibility to bidders through the choice between upfront and deferred payment options, availability of moratorium linked to upfront payment, and spreading of payments over the license period with NPV protection.

3.252 Accordingly, **the Authority recommends that the following payment terms and conditions, based on NIA of 2022 & 2024 auctions, shall be applicable to the successful bidders for assignment of spectrum bands in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz Bands**

**a) Successful Bidders shall make the payment (in Indian Rupees) in accordance with any of the following two options:**

**Option I: Full or part upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. 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**

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<sup>66</sup> <https://www.dot.gov.in/static/uploads/2025/07/2d3a956120dccd49e7ef1078163811cf.pdf>

**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. The annual instalments shall become due and payable on the effective date anniversary of each following year.**

**Option II: 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 calendar days from the issuance of Demand Note. The balance 19 instalments shall become due and payable on the effective date anniversary of each following year.**

3.253 The continuation of the existing payment framework as prescribed in the Recommendations dated 11.04.2022 and 04.02.2025, with a 20-year validity period, adequately addresses the concerns raised by stakeholders regarding liquidity and investment requirements, while safeguarding the interests of the exchequer and ensuring orderly and efficient assignment of spectrum.

3.254 The Authority, in the above section at para 3.250, has recommended the payment options for the successful bidder for assignment of spectrum bands in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz Bands. However, sperate payment payment options for the successful bidder in assignment of 600 MHz is required in view of discussion at Chapter II of this recommendation.

3.255 The Authority notes that the 600 MHz band presents a unique market

situation distinct from other spectrum bands proposed to be auctioned. As discussed in Chapter II of present recommendation, deployment and ecosystem development for 600 MHz band in India have not commenced yet and TSP acquiring spectrum in the 600 MHz band may not be in a position to meaningfully monetize the spectrum during the initial three to four years following assignment. In order to address this transitional challenge and to incentivize participation in the forthcoming auction, the Authority has recommended extending the validity period of the 600 MHz band to 24 years (i.e., 20 years of monetization period plus an additional four years). In view of this differentiated validity period and deferred monetization of 600 MHz band, the Authority is of the considered opinion that separate and suitably aligned payment terms are warranted for the 600 MHz band.

3.256 Accordingly, **the Authority recommends the following payment options for successful bidders for assignment of spectrum in the 600 MHz band (with a validity period of 24 years):**

**Option I:**

**Full or part upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. 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. The annual instalments shall become due and payable on the effective date anniversary of each following year.**

**Option II:**

**Buyer should deposit 5% upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. Further, there should be a moratorium period of four years (i.e. no payment is required to be made from the 2nd year to the 5th year), and the balance amount should be payable in equal annual instalments over the remaining 19 years' period (starting from the beginning of the 6th year), payable in advance at the beginning of each year, after the period of moratorium, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.**

3.257 The following chapter provides a summary of recommendations.

## **Chapter IV: Summary of Recommendations**

### **4.1 The Authority recommends that –**

- (a) Entire available spectrum in the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands should be put to auction in the forthcoming auction.**
- (b) DoT should immediately initiate action for taking back the spectrum held with the telecom service providers, which are engaged in corporate insolvency resolution process under Insolvency and Bankruptcy Code, 2016, and such spectrum should be put to auction in the forthcoming spectrum auction.**

**[Para 2.51]**

### **4.2 The Authority recommends that -**

- (a) TRAI's earlier recommendations w.r.t. creation of a separate authorization under Unified License for Access Network Provider (network layer) to provide network services on a wholesale basis, recommended through the Recommendations dated 19.08.2021 on "Enabling Unbundling of Different Layers Through Differential Licensing", should be reconsidered for strengthening competition.**
- (b) Digital Connectivity Infrastructure Provider (DCIP) authorisation and Cloud-hosted Telecom Network (CTN) Provider authorisations, proposed by DoT in the draft "Telecommunications (Authorisation for Telecommunication Network) Rules, 2025" dated 09.10.2025 should be expeditiously introduced under the**

**Telecommunications Act, 2023.**

**[Para 2.56]**

**4.3 The Authority recommends that the band plans already adopted for the existing frequency bands, viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands in India, should be continued in the forthcoming auction.**

**[Para 2.62]**

**4.4 The Authority recommends that the access spectrum in the existing frequency 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.**

**[Para 2.80]**

**4.5 The Authority recommends that for existing bands the block size and minimum amount of spectrum that a bidder is required to bid for should be prescribed as given below:**

<b>Spectrum Band</b>	<b>Block Size (MHz)</b>	<b>Minimum amount of spectrum that a bidder is required to bid for</b>	
		<b>Existing licensees (MHz)</b>	<b>New Entrants (MHz)</b>
<b>800 MHz</b>	<b>1.25 (Paired)</b>	<b>1.25</b>	<b>5, 1.25 (where less than 5 MHz is available)</b>
<b>900 MHz</b>	<b>0.20 (paired)</b>	<b>0.2</b>	<b>5, 0.2 (where less than 5 MHz is</b>

			<b>available)</b>
<b>1800 MHz</b>	<b>0.20 (paired)</b>	<b>0.2</b>	<b>5, 0.2 (where less than 5 MHz is available)</b>
<b>2100 MHz</b>	<b>5 (paired)</b>	<b>5</b>	<b>5</b>
<b>2300 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>2500 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>3300 MHz</b>	<b>10 (unpaired)</b>	<b>10</b>	<b>10</b>
<b>26 GHz</b>	<b>50 (unpaired)</b>	<b>50</b>	<b>100</b>

**Note: Any existing Access Service authorisation holder should be treated as 'New Entrant' in the LSA(s) for the frequency bands in which it does not presently hold spectrum.**

**[Para 2.89]**

**4.6 The Authority recommends that-**

- (a) The eligibility conditions for participation in the forthcoming spectrum auction as prescribed in Notice Inviting Application (NIA) 2024, should be continued for all IMT frequency bands put to auction (including 37-40 GHz band) i.e. authorisation to provide access service.**
- (b) Certain quantum of spectrum in Time Division Duplexing (TDD)-based frequency bands (identified for IMT such as 2300 MHz/ 2500 MHz/ 3300 MHz/ 26 GHz/ 37-40 GHz bands should be set aside for Internet Service Providers (ISPs), Machine-to-Machine (M2M) providers and Captive Non-Public Networks (CNPNS).**

**(c) After identification of suitable IMT frequency band(s) to be set aside for ISPs, M2M providers and CNPNs, DoT should send a reference to TRAI for seeking recommendations on the terms and conditions including reserve price for assignment of such spectrum.**

**[Para 2.99]**

**4.7 The Authority recommends that for the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands, the net-worth requirement of Rs. 50 crore per Licensed Service Area (Rs. 25 crore each for Jammu & Kashmir and North East Licensed Service Areas) should be made applicable for new entrants in the forthcoming auction of IMT spectrum. Further, the same net-worth requirement should also be made applicable for the auction of spectrum in 37-40 GHz band.**

**[Para 2.105]**

**4.8 The Authority recommends that the rollout obligation for the existing frequency bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz bands should be the same as those prescribed for respective frequency bands in the Notice Inviting Applications (NIA) 2024.**

**[Para 2.119]**

**4.9 The Authority recommends that the following scheme should be launched so that access service providers are incentivized to expand their mobile network coverage in the areas which have no mobile network coverage and are not covered under the schemes of Universal Service Obligation Fund (USOF) [renamed as Digital Bharat Nidhi (DBN)]. The broad contours of the scheme**

are given below:

- (a) Once the spectrum auction is concluded, the successful bidders of the spectrum should be permitted to opt for a reduction in the spectrum cost [upto 10% of the auction determined price (ADP)]. This option should be available for all Licensed Service Areas and for all frequency bands.**
- (b) In lieu of the reduction in the spectrum cost, the TSP should deploy new unique base stations sites to provide mobile broadband services (using 4G/ 5G technologies) using the spectrum in any of its frequency bands (existing/ newly acquired) at the locations identified by DoT (coverage holes) within a specific period of say one year from the date of identification of such locations.**
- (c) The number of unique base station sites to be deployed may be worked out by dividing the reduction in the spectrum cost by the estimated cost of deploying a new base station site. For estimation of cost of deploying a new base station site, one of the options could be to consider the cost of site (capex + opex for five years) as estimated under the latest USOF (DBN) projects. In case DoT is of the view that the cost under USOF (DBN) projects is on a higher side, the same may be rationalized to make it more realistic for a pan-India scenario.**
- (d) For the sites so deployed, mandatory site sharing at a reasonable and non-discriminatory price should also be prescribed to ensure that coverage of multiple TSPs is available in such areas.**
- (e) In case a licensed service area is found to have fewer coverage holes and thereby lower requirement of new base station sites in the licensed service area, telecom service providers should be asked to deploy unique base**

**station sites at the locations identified by DoT in other licensed service areas.**

**[Para 2.124]**

**4.10 The Authority recommends that –**

**(a) For the forthcoming auction, the spectrum caps for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz, and 37-40 GHz bands should be kept as follows:**

- (i) A spectrum cap of 35% on the combined spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in the 700 MHz, 800 MHz and 900 MHz bands**
- (ii) A spectrum cap of 35% on the combined spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands**
- (iii) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 3300 MHz band (rounded off considering the block size in this band)**
- (iv) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access**

services) in 26 GHz band (rounded off considering the block size in this band)

(v) A spectrum cap of 35% on the total spectrum available for access services (including the spectrum assigned to private TSPs, and the spectrum assigned to/ reserved for PSU operators - for providing access services) in 37-40 GHz band (rounded off considering the block size in this band)

(b) In line with the provision of NIA 2024, in case a TSP has already acquired spectrum that exceeds the spectrum cap of 35%, the TSP should not be asked to surrender right to use of any spectrum which it already holds.

[Para 2.140]

**4.11** The Authority recommends that, to the extent possible, the TSPs should be assigned spectrum in a contiguous manner and DoT should carry out harmonization exercise immediately after conducting the auction, and such exercise should be completed within a time frame of not more than six months from the date of conclusion of the auction.

[Para 2.154]

**4.12** The Authority recommends the following in respect of 600 MHz band-

(a) The entire available spectrum in the 600 MHz frequency band (3GPP band plan n105) should be put to auction in the forthcoming auction on LSA (Telecom Circle/ Metro) basis.

(b) While the spectrum charge may be levied for a period of 20 years, the validity period of the spectrum should be increased by four years, i.e., the usual 20 years *plus* 4

**years.**

- (c) Frequency band n105 (600 MHz band) should be auctioned with a block size of 2 x 5 MHz, and the minimum number of blocks for bidding should be one. Further, DoT should ensure that in case a telecom service provider acquires more than one block, entire spectrum assigned to a telecom service provider is in a contiguous manner.**
- (d) Band-specific spectrum cap for the frequency band n105 (600 MHz band) should be kept as 2 x 15 MHz (35% of the total spectrum, rounded off considering the block size).**
- (e) The rollout obligations for the spectrum in 600 MHz band should be the same as that applicable for other sub-1 GHz bands. However, it should be delayed by four years, i.e., no rollout obligations for the initial four years, and the applicable rollout obligations should begin after an initial period of four years.**
- (f) In addition to the upfront payment option, an additional payment option should be made available for the spectrum in the 600 MHz band, as given below:  
  
5% upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. The buyer should be given a moratorium period of four years (i.e. no payment is required to be made from the 2<sup>nd</sup> year to the 5<sup>th</sup> year), and the balance amount should be payable in equal annual instalments over the remaining 19 years' period (starting from the beginning of the 6<sup>th</sup> year), payable in advance at the beginning of each year, after the period of moratorium, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.**
- (g) Eligibility conditions and associated eligibility conditions**

**should be the same as those recommended for the existing frequency bands.**

**[Para 2.177]**

**4.13 The Authority recommends the following in respect of the spectrum in the 6 GHz (upper) band -**

- (a) Considering the importance of 6 GHz (upper) band, it should be kept reserved for IMT.**
- (b) The available frequency ranges in the 6 GHz (upper) band, viz. 6425-6725 MHz and 7025-7125 MHz should not be put to auction in the forthcoming auction. The issue of auctioning the spectrum in 6 GHz (upper) band should be re-examined after considering the outcome of WRC-27.**
- (c) DoT may carry out a plan (involving all TSPs) to conduct trials around all 34 locations where satellite uplink stations are located in the relevant frequencies (in-band and adjacent frequencies) to determine the requirement of the keep-out distance of IMT base stations from satellite uplink stations. The outcome of the trials may also be shared with TRAI**

**[Para 2.201]**

**4.14 The Authority recommends that –**

- (a) The matter relating to the adoption of an appropriate band plan for 1427-1518 MHz frequency range should be re-examined after the Government decides to put this band to auction.**
- (b) DoT may explore the possibility of taking up the matter with the regional and global standardization bodies for the creation of a suitable band plan for utilizing the frequency range for 1427-1518 MHz for Supplementary Uplink (SUL).**

**The action taken and the outcome of the same may be shared with the Authority.**

- (c) While allocating a 24 MHz block to the Government user, DoT should ensure that a contiguous 67 MHz block is available for IMT services.**

**[Para 2.220]**

**4.15 The Authority recommends that the Simultaneous Multiple Round Auction (SMRA)-based spectrum auction should be continued.**

**[Para 2.233]**

**4.16 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 should 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,**
  - i. 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.**
  - ii. 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.**

**[Para 3.40]**

**4.17 The Authority recommends that DoT should prepare a comprehensive report analysing the outcomes of each forthcoming auction to be shared with the Authority within 90 days of conclusion of the auction.**

**[Para 3.43]**

**4.18 The Authority recommends the following:**

**The reserve price for the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz should generally be set at 70% of the average valuation, with the following conditions:**

- a) In the LSAs where spectrum in a band was completely sold in the June 2024 auction, the reserve price shall be the higher of the two figures:
  - (1) 70% of the average valuation; and**
  - (2) auction determined price of the June 2024 auction, duly indexed.****
- b) For spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz across LSAs where spectrum band was put to auction and remained unsold in both the 2022 and 2024 auctions, the reserve price should be fixed at 60% of the average valuation,**

*subject to the exceptions set out further.*

- c) To promote investment in telecom infrastructure in the North East and Jammu & Kashmir LSAs, and in line with past recommendations, the Authority recommends a 50% reduction in reserve prices for these LSAs across the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. This concession shall also apply, as relevant, to other spectrum bands.

[Para 3.187]

**4.19** For LSA-band combinations where spectrum was put up for auction but remained unsold in both the 2022 and 2024 auctions, the reserve price shall be fixed at 60% of the average valuation, subject to the exceptions set out below.

- i. In a LSA-band combination where quantity of spectrum available in 2024 Auctions was below the normal Minimum Bid Quantity for a new entrant (5 MHz in 800/900/1800/2100 MHz, 10 MHz in 2300/2500/3300 and 50 Mhz in 26 GHz) , and where, upon increase in spectrum availability due to either expiry of spectrum assignments in 2026-27 (in 1800 MHz band as per DoT Reference dated 15.05.2025) or spectrum refarming (in 2500 MHz band as per DoT Reference dated 15.05.2025) or release of spectrum due to Hon'ble SC Order dated 13.02.2026, the resulting total quantity of spectrum available for present auction becomes equal to or greater than the normal Minimum Bid Quantity for a new entrant, thereby creating a reasonable possibility of participation by a new entrant in the respective LSA-band combination, the reserve price shall be fixed at 70% of the average valuation.

- ii. In an LSA-band combination where the spectrum assignment of an operational TSP is due to expire in 2026-27, the reserve price shall be fixed at 70% of the average valuation, irrespective of auction outcomes from the past two auctions of 2022 & 2024.

[Para 3.189]

4.20 The recommended reserve price of 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands spectrum bands for each LSAs is tabulated below:

**TABLE 3.9: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)**

**IN 800 MHz BAND (20 years)**

(Rs. in crore)

(1)	(2)	(3)
LSA	Reserve Price (as calculated)	Recommended Reserve Price (Rounded off)
Andhra Pradesh	181.66	182
Assam	47.47	47
Bihar	107.95	108
Delhi	326.91	327
Gujarat	151.28	151
Haryana	51.14	51
Himachal Pradesh	19.61	20
Jammu & Kashmir	12.29	12
Karnataka	142.27	142
Kerala	81.87	82
Kolkata	81.23	81
Madhya Pradesh	111.08	111
Maharashtra	201.35	201

<b>Mumbai</b>	<b>215.39</b>	<b>215</b>
<b>North East</b>	<b>12.09</b>	<b>12</b>
<b>Orissa</b>	<b>52.68</b>	<b>53</b>
<b>Punjab</b>	<b>68.01</b>	<b>68</b>
<b>Rajasthan</b>	<b>99.42</b>	<b>99</b>
<b>Tamil Nadu</b>	<b>164.04</b>	<b>164</b>
<b>U. P. (East)</b>	<b>193.62</b>	<b>194</b>
<b>U.P. (West)</b>	<b>160.74</b>	<b>161</b>
<b>West Bengal</b>	<b>91.03</b>	<b>91</b>

**TABLE 3.10: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 900 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	<b>216.93</b>	<b>217</b>
<b>Assam</b>	<b>50.35</b>	<b>50</b>
<b>Bihar</b>	<b>124.05</b>	<b>124</b>
<b>Delhi</b>	<b>326.91</b>	<b>327</b>
<b>Gujarat</b>	<b>151.28</b>	<b>151</b>
<b>Haryana</b>	<b>51.14</b>	<b>51</b>
<b>Himachal Pradesh</b>	<b>19.61</b>	<b>20</b>
<b>Jammu &amp; Kashmir</b>	<b>12.70</b>	<b>13</b>
<b>Karnataka</b>	<b>165.55</b>	<b>166</b>
<b>Kerala</b>	<b>81.87</b>	<b>82</b>
<b>Kolkata</b>	<b>101.87</b>	<b>102</b>
<b>Madhya Pradesh</b>	<b>111.08</b>	<b>111</b>
<b>Maharashtra</b>	<b>201.35</b>	<b>201</b>
<b>Mumbai</b>	<b>215.39</b>	<b>215</b>
<b>North East</b>	<b>12.43</b>	<b>12</b>
<b>Orissa</b>	<b>58.98</b>	<b>59</b>

<b>Punjab</b>	<b>119.62</b>	<b>120</b>
<b>Rajasthan</b>	<b>155.28</b>	<b>155</b>
<b>Tamil Nadu</b>	<b>188.22</b>	<b>188</b>
<b>U. P. (East)</b>	<b>213.94</b>	<b>214</b>
<b>U.P. (West)</b>	<b>165.27</b>	<b>165</b>
<b>West Bengal</b>	<b>113.87</b>	<b>114</b>

**TABLE 3.11: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 1800 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
Andhra Pradesh	126.60	127
Assam	28.49	28
Bihar	96.68	97
Delhi	214.47	214
Gujarat	108.13	108
Haryana	35.82	36
Himachal Pradesh	13.08	13
Jammu & Kashmir	8.36	8
Karnataka	101.60	102
Kerala	48.95	49
Kolkata	62.00	62
Madhya Pradesh	113.87	114
Maharashtra	141.32	141
Mumbai	165.96	166
North East	8.29	8
Orissa	33.96	34
Punjab	48.53	49
Rajasthan	67.36	67

Tamil Nadu	99.74	100
U. P. (East)	211.64	212
U.P. (West)	80.04	80
West Bengal	67.71	68

**TABLE 3.12: RECOMMENDED RESERVE PRICE PER MHz (PAIRED)  
IN 2100 MHz BAND (20 years)**

(Rs. in crore)

(1)	(2)	(3)
LSA	Reserve Price (as calculated)	Recommended Reserve Price (Rounded off)
Andhra Pradesh	90.06	90
Assam	27.61	28
Bihar	55.59	56
Delhi	191.69	192
Gujarat	93.88	94
Haryana	28.19	28
Himachal Pradesh	9.31	9
Jammu & Kashmir	5.08	5
Karnataka	81.36	81
Kerala	42.52	43
Kolkata	44.11	44
Madhya Pradesh	53.20	53
Maharashtra	100.54	101
Mumbai	118.07	118
North East	4.45	4
Orissa	24.16	24
Punjab	34.53	35
Rajasthan	55.91	56

<b>Tamil Nadu</b>	<b>96.58</b>	<b>97</b>
<b>U. P. (East)</b>	<b>99.04</b>	<b>99</b>
<b>U.P. (West)</b>	<b>67.74</b>	<b>68</b>
<b>West Bengal</b>	<b>39.11</b>	<b>39</b>

**TABLE 3.11: RECOMMENDED RESERVE PRICE PER MHz (UNPAIRED) IN  
2300 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	<b>37.58</b>	<b>38</b>
<b>Assam</b>	<b>8.99</b>	<b>9</b>
<b>Bihar</b>	<b>15.60</b>	<b>16</b>
<b>Delhi</b>	<b>72.81</b>	<b>73</b>
<b>Gujarat</b>	<b>37.18</b>	<b>37</b>
<b>Haryana</b>	<b>11.86</b>	<b>12</b>
<b>Himachal Pradesh</b>	<b>6.76</b>	<b>7</b>
<b>Jammu &amp; Kashmir</b>	<b>3.69</b>	<b>4</b>
<b>Karnataka</b>	<b>43.69</b>	<b>44</b>
<b>Kerala</b>	<b>17.80</b>	<b>18</b>
<b>Kolkata</b>	<b>20.45</b>	<b>20</b>
<b>Madhya Pradesh</b>	<b>16.85</b>	<b>17</b>
<b>Maharashtra</b>	<b>43.54</b>	<b>44</b>
<b>Mumbai</b>	<b>64.64</b>	<b>65</b>
<b>North East</b>	<b>3.60</b>	<b>4</b>
<b>Orissa</b>	<b>10.44</b>	<b>10</b>
<b>Punjab</b>	<b>17.58</b>	<b>18</b>
<b>Rajasthan</b>	<b>15.25</b>	<b>15</b>

<b>Tamil Nadu</b>	<b>55.21</b>	<b>55</b>
<b>U. P. (East)</b>	<b>22.67</b>	<b>23</b>
<b>U.P. (West)</b>	<b>20.31</b>	<b>20</b>
<b>West Bengal</b>	<b>13.88</b>	<b>14</b>

**TABLE 3.12: RECOMMENDED RESERVE PRICE PER MHz (UNPAIRED) IN  
2500 MHz BAND (20 years)**

**(Rs. in crore)**

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	<b>38.49</b>	<b>38</b>
<b>Assam</b>	<b>8.06</b>	<b>8</b>
<b>Bihar</b>	<b>17.25</b>	<b>17</b>
<b>Delhi</b>	<b>73.75</b>	<b>74</b>
<b>Gujarat</b>	<b>32.10</b>	<b>32</b>
<b>Haryana</b>	<b>10.41</b>	<b>10</b>
<b>Himachal Pradesh</b>	<b>4.30</b>	<b>4</b>
<b>Jammu &amp; Kashmir</b>	<b>2.48</b>	<b>2</b>
<b>Karnataka</b>	<b>32.73</b>	<b>33</b>
<b>Kerala</b>	<b>16.04</b>	<b>16</b>
<b>Kolkata</b>	<b>19.68</b>	<b>20</b>
<b>Madhya Pradesh</b>	<b>17.77</b>	<b>18</b>
<b>Maharashtra</b>	<b>39.43</b>	<b>39</b>
<b>Mumbai</b>	<b>58.45</b>	<b>58</b>
<b>North East</b>	<b>2.84</b>	<b>3</b>
<b>Orissa</b>	<b>9.47</b>	<b>9</b>
<b>Punjab</b>	<b>13.56</b>	<b>14</b>
<b>Rajasthan</b>	<b>16.05</b>	<b>16</b>

<b>Tamil Nadu</b>	<b>40.07</b>	<b>40</b>
<b>U. P. (East)</b>	<b>26.25</b>	<b>26</b>
<b>U.P. (West)</b>	<b>21.83</b>	<b>22</b>
<b>West Bengal</b>	<b>14.35</b>	<b>14</b>

**TABLE 3.13: RECOMMENDED RESERVE PRICE PER MHZ IN 3300MHZ BAND  
(UNPAIRED)  
(20 years)**

(Rs. in crore)

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	<b>19.69</b>	<b>20</b>
<b>Assam</b>	<b>4.10</b>	<b>4</b>
<b>Bihar</b>	<b>9.93</b>	<b>10</b>
<b>Delhi</b>	<b>34.45</b>	<b>34</b>
<b>Gujarat</b>	<b>17.13</b>	<b>17</b>
<b>Haryana</b>	<b>5.04</b>	<b>5</b>
<b>Himachal Pradesh</b>	<b>1.77</b>	<b>2</b>
<b>Jammu &amp; Kashmir</b>	<b>0.82</b>	<b>1</b>
<b>Karnataka</b>	<b>14.68</b>	<b>15</b>
<b>Kerala</b>	<b>7.81</b>	<b>8</b>
<b>Kolkata</b>	<b>10.53</b>	<b>11</b>
<b>Madhya Pradesh</b>	<b>10.70</b>	<b>11</b>
<b>Maharashtra</b>	<b>21.97</b>	<b>22</b>
<b>Mumbai</b>	<b>26.17</b>	<b>26</b>
<b>North East</b>	<b>0.82</b>	<b>1</b>

<b>Orissa</b>	<b>4.51</b>	<b>5</b>
<b>Punjab</b>	<b>7.17</b>	<b>7</b>
<b>Rajasthan</b>	<b>9.36</b>	<b>9</b>
<b>Tamil Nadu</b>	<b>16.96</b>	<b>17</b>
<b>U. P. (East)</b>	<b>14.44</b>	<b>14</b>
<b>U.P. (West)</b>	<b>12.10</b>	<b>12</b>
<b>West Bengal</b>	<b>7.97</b>	<b>8</b>

**TABLE 3.14: RECOMMENDED RESERVE PRICE PER MHz IN 26 GHz BAND  
(UNPAIRED)  
(20 years)**

(in Rs. lakhs)

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	<b>43.07</b>	<b>43</b>
<b>Assam</b>	<b>8.15</b>	<b>8</b>
<b>Bihar</b>	<b>20.93</b>	<b>21</b>
<b>Delhi</b>	<b>71.17</b>	<b>71</b>
<b>Gujarat</b>	<b>37.58</b>	<b>38</b>
<b>Haryana</b>	<b>10.54</b>	<b>11</b>
<b>Himachal Pradesh</b>	<b>3.95</b>	<b>4</b>
<b>Jammu &amp; Kashmir</b>	<b>1.39</b>	<b>1</b>
<b>Karnataka</b>	<b>31.16</b>	<b>31</b>
<b>Kerala</b>	<b>15.65</b>	<b>16</b>
<b>Kolkata</b>	<b>23.66</b>	<b>24</b>
<b>Madhya Pradesh</b>	<b>22.44</b>	<b>22</b>
<b>Maharashtra</b>	<b>47.92</b>	<b>48</b>
<b>Mumbai</b>	<b>57.93</b>	<b>58</b>

<b>North East</b>	<b>1.38</b>	<b>1</b>
<b>Orissa</b>	<b>9.28</b>	<b>9</b>
<b>Punjab</b>	<b>15.23</b>	<b>15</b>
<b>Rajasthan</b>	<b>19.63</b>	<b>20</b>
<b>Tamil Nadu</b>	<b>36.01</b>	<b>36</b>
<b>U. P. (East)</b>	<b>27.06</b>	<b>27</b>
<b>U.P. (West)</b>	<b>23.90</b>	<b>24</b>
<b>West Bengal</b>	<b>15.72</b>	<b>16</b>

[Para 3.190]

**4.21** The recommended reserve price of the 600 MHz spectrum bands for each LSA are given below:

**TABLE 3.16: RECOMMENDED RESERVE PRICE PER MHZ (PAIRED)  
IN THE 600 MHZ (20 years)**

(Rs. in crore)

<b>(1)</b>	<b>(2)</b>	<b>(3)</b>
<b>LSA</b>	<b>Reserve Price (as calculated)</b>	<b>Recommended Reserve Price (Rounded off)</b>
<b>Andhra Pradesh</b>	232.57	233
<b>Assam</b>	52.23	52
<b>Bihar</b>	132.70	133
<b>Delhi</b>	440.91	441
<b>Gujarat</b>	196.38	196
<b>Haryana</b>	65.65	66
<b>Himachal Pradesh</b>	24.53	25
<b>Jammu &amp; Kashmir</b>	14.50	14
<b>Karnataka</b>	184.59	185
<b>Kerala</b>	104.87	105

<b>Kolkata</b>	<b>109.38</b>	<b>109</b>
<b>Madhya Pradesh</b>	<b>139.58</b>	<b>140</b>
<b>Maharashtra</b>	<b>258.77</b>	<b>259</b>
<b>Mumbai</b>	<b>291.61</b>	<b>292</b>
<b>North East</b>	<b>14.34</b>	<b>14</b>
<b>Orissa</b>	<b>64.69</b>	<b>65</b>
<b>Punjab</b>	<b>88.20</b>	<b>88</b>
<b>Rajasthan</b>	<b>125.35</b>	<b>125</b>
<b>Tamil Nadu</b>	<b>212.06</b>	<b>212</b>
<b>U. P. (East)</b>	<b>232.27</b>	<b>232</b>
<b>U.P. (West)</b>	<b>173.75</b>	<b>174</b>
<b>West Bengal</b>	<b>112.38</b>	<b>112</b>

[Para 3.238]

**4.22 The Authority recommends that the following payment terms and conditions, based on NIA of 2022 & 2024 auctions, shall be applicable to the successful bidders for assignment of spectrum bands in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz Bands**

**a) Successful Bidders shall make the payment (in Indian Rupees) in accordance with any of the following two options:**

**Option I: Full or part upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. 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. The annual instalments shall become due and payable on the effective date anniversary of each following year.**

**Option II: 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 calendar days from the issuance of Demand Note. The balance 19 instalments shall become due and payable on the effective date anniversary of each following year.**

**[Para 3.252]**

**4.23 The Authority recommends the following payment options for successful bidders for assignment of spectrum in the 600 MHz band (with a validity period of 24 years):**

**Option I:**

**Full or part upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. 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. The annual instalments shall become due and payable on the effective date anniversary of each following year.**

**Option II:**

**Buyer should deposit 5% upfront payment of the bid amount within 10 calendar days from the issuance of Demand Note. Further, there should be a moratorium period of four years (i.e. no payment is required to be made from the 2nd year to the 5th year), and the balance amount should be payable in equal annual instalments over the remaining 19 years' period (starting from the beginning of the 6th year), payable in advance at the beginning of each year, after the period of moratorium, duly protecting the Net Present Value (NPV) of the bid amount at the applicable rate of interest.**

**[Para 3.256]**

## 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

6<sup>th</sup> 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 विनियमन प्राधिकरण  
जलेश, एशोक रोड, नई दिल्ली-110001  
संचार विभाग सं.  
969  
20 MAY 2025  
ई ऑफिस 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**.

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**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:

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

*\*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."*

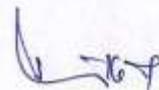
5. Considering the above-mentioned facts, the LSA-wise quantum of the spectrum available with the Government in the existing and new IMT bands, excluding the spectrum reserved for BSNL and spectrum released due to expiry of the service licenses during 2026-2027 are attached as **Annexure-V**. The details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

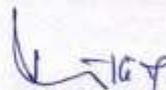
- (a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in the existing bands viz. 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz bands.
- (b) explore the possibilities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



**Department of Telecommunications**

**Report on Spectrum Auction Results – 2023-24**

**20<sup>th</sup> December, 2024**

**Sanchar Bhawan  
Ashoka Road  
New Delhi - 110001**

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## 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
<b>Total</b>	<b>10522.35</b>	<b>96238.45</b>	<b>141.40</b>	<b>11340.79</b>

3.3 The Bidder-wise details of quantum of spectrum acquired in the auction is as follows:

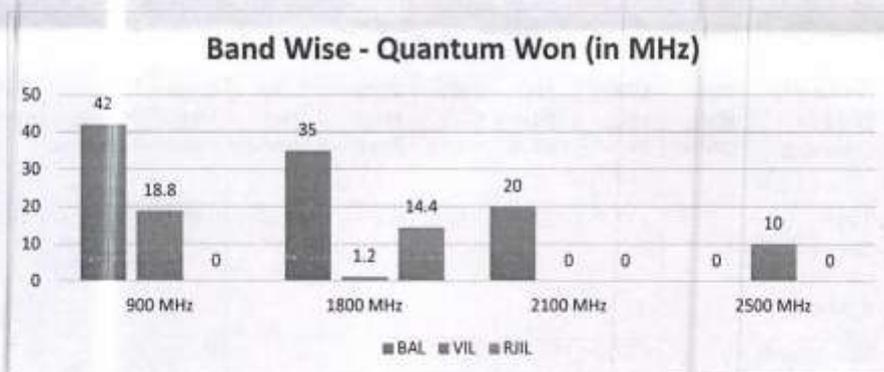
**Table 2: Bidder-wise details of quantum of spectrum acquired in the auction**

Name of Bidder/ Operator	Band								Total (in MHz)
	800 MHz (paired)	900 MHz (paired)	1800 MHz (paired)	2100 MHz (paired)	2300 MHz (unpaired)	2500 MHz (unpaired)	3300 MHz (unpaired)	26 GHz (unpaired)	
<b>Total Spectrum put to auction</b>	118.75	117.20	221.40	125.00	60.00	70.00	1110.00	8700.00	10522.35
<b>M/s Bharti Airtel Limited</b>	0	42.00	35.00	20.00	0	0	0	0	97.00
<b>M/s Vodafone Idea Limited</b>	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

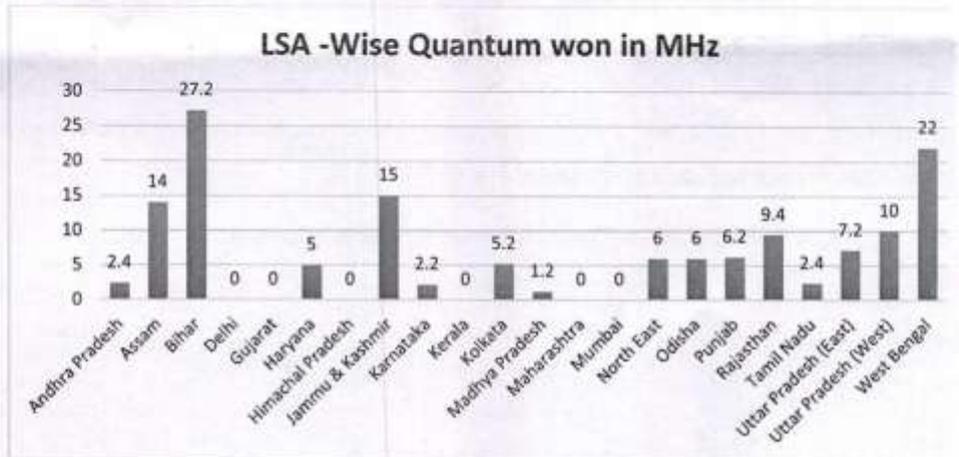
3.3.1 The below graph shows the band-wise quantum won (in MHz) by each of the three operators viz. M/s BAL, M/s VIL and M/s RJIL.

**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**



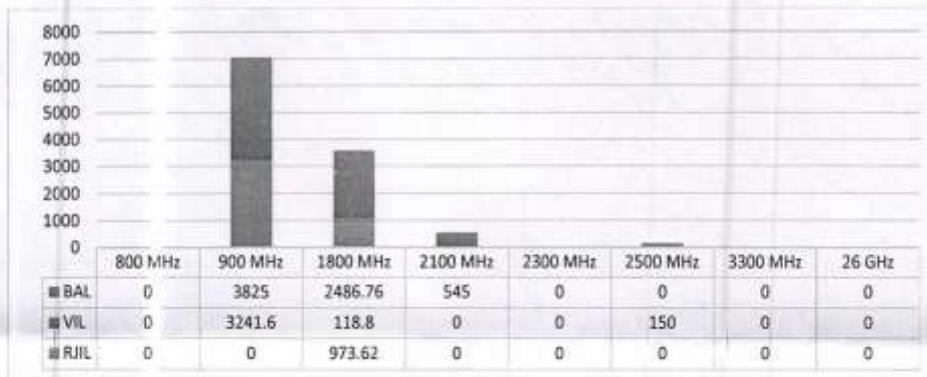
3.4 The Bidder-wise details of amount payable for the quantum of spectrum acquired in the auction is as follows:

**Table 3: Bidder-wise details of amount payable for the quantum of spectrum acquired in the auction**

Name of Bidder/ Operator	Band				Total (in Rs. Cr)
	900 MHz (in Rs. Cr)	1800 MHz (in Rs. Cr)	2100 MHz (in Rs. Cr)	2500 MHz (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
<b>Total (in Rs. Cr)</b>	<b>7066.6000</b>	<b>3579.1940</b>	<b>545.0000</b>	<b>150.0000</b>	<b>11340.7940</b>

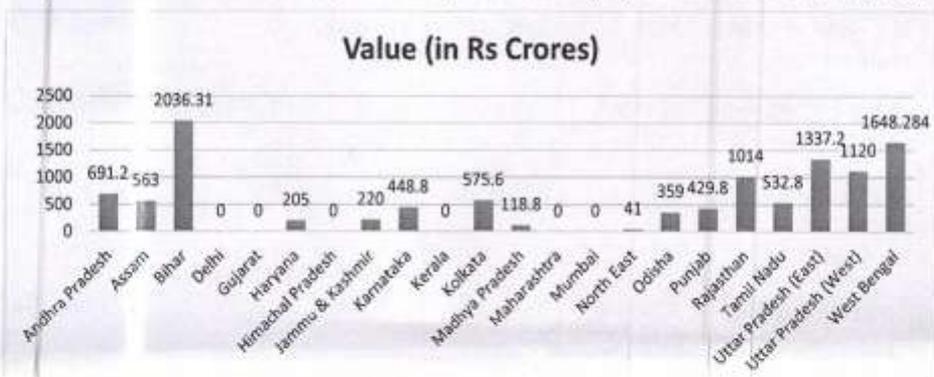
3.4.1 The Auction proceeds of 2023-24 are split into band-wise and operator-wise in the graph shown below. In this, it can be seen that M/s BAL had bid for 900 MHz, 1800 MHz and 2100 MHz bands for an amount of Rs.3825 Cr, Rs. 2486.7660 Cr and Rs.545 Cr respectively. M/s VIL had bid for 900 MHz, 1800 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)**



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	-
<b>Total</b>			<b>239.2</b>	<b>141.4</b>		

#### 4. Observations on Spectrum Auction Results 2023-24

4.1 The 9<sup>th</sup> 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		
<b>Total</b>	<b>42</b>	<b>18.8</b>	<b>35</b>	<b>1.2</b>	<b>14.4</b>	<b>20</b>	<b>10</b>
<b>Band Wise Total</b>	<b>60.8</b>		<b>50.6</b>			<b>20</b>	<b>10</b>
<b>Grand Total</b>			<b>141.4</b>				

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
<b>Total</b>	<b>1,13,40,79,40,000</b>		

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
<b>Total</b>	<b>97,36,28,000</b>	<b>905,87,10,127</b>	
<b>Grand Total</b>	<b>1003,23,38,127</b>		

\* 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](https://dot.gov.in/sites/default/files/Auction_2024_Provisional_FAR.pdf)

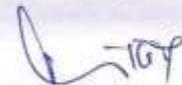
**Annexure-II**

**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
1800 MHz	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

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	



भारत सरकार  
अन्तरिक्ष विभाग  
उपग्रह संचार कार्यक्रम कार्यालय  
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**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

भारतीय अन्तरिक्ष अनुसंधान संगठन



Indian Space Research Organisation

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.

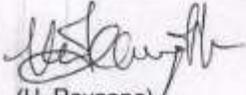
3. The required EIRP density of Hub/Feeder/TTC Earth stations for all services are provided below:

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**

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
<b>Total</b>		<b>880.00</b>	<b>0</b>	<b>118.75</b>	<b>56.40</b>	<b>170.80</b>	<b>105.00</b>	<b>60.00</b>	<b>500.00</b>	<b>1110.00</b>	<b>8800.00</b>	<b>8700.00</b>

*Handwritten signature/initials*

**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

6<sup>th</sup> 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](https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2025/02/GSMA-Spectrum-Policy-Trends-2025-1.pdf)) mentioned that:

<sup>1</sup> <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'.*

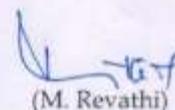
China has also allocated this band for IMT service (Reference: [China allocates 6 GHz spectrum band for 5G, 6G services](#)<sup>2</sup>). Further, USA, Canada, South Korea and Saudi Arabia etc. implemented this band for Wi-Fi application (Reference: [Spectrum Needs of Wi-Fi](#)<sup>3</sup>). Extract 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.



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<sup>2</sup> <https://www.rcwireless.com/20230629/featured/china-allocates-6-ghz-spectrum-band-for-5g-6g-services>

<sup>3</sup> <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

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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.	ISA	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	450
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

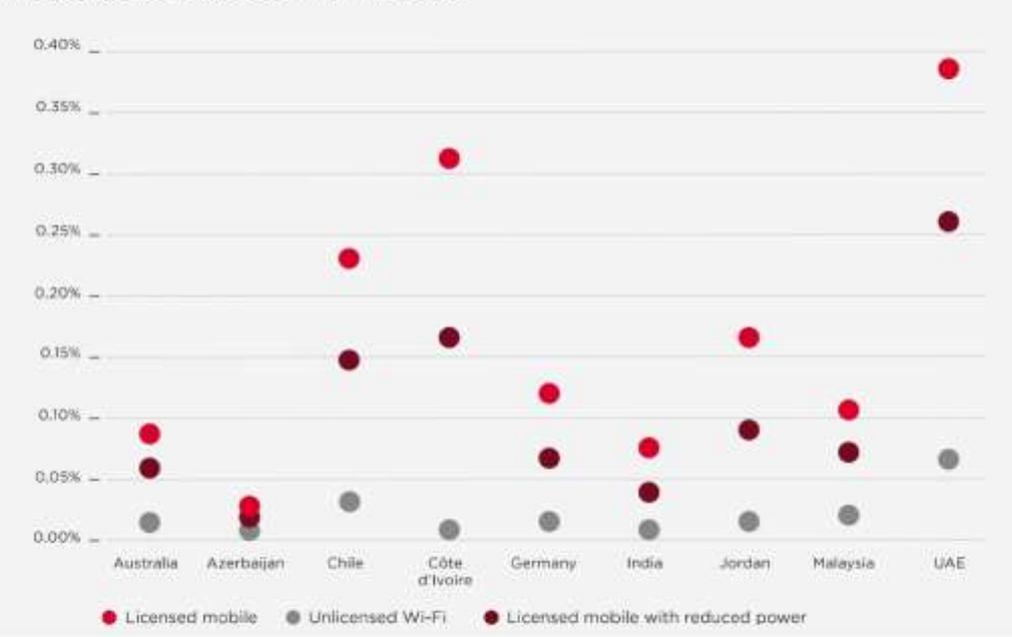
Names of the TSPs sharing the spectrum		Name of the LSAs where spectrum is being shared	Spectrum band in which spectrum is being shared	Amount of shared spectrum	
TSP1	TSP2			TSP1	TSP2
NIL					

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.

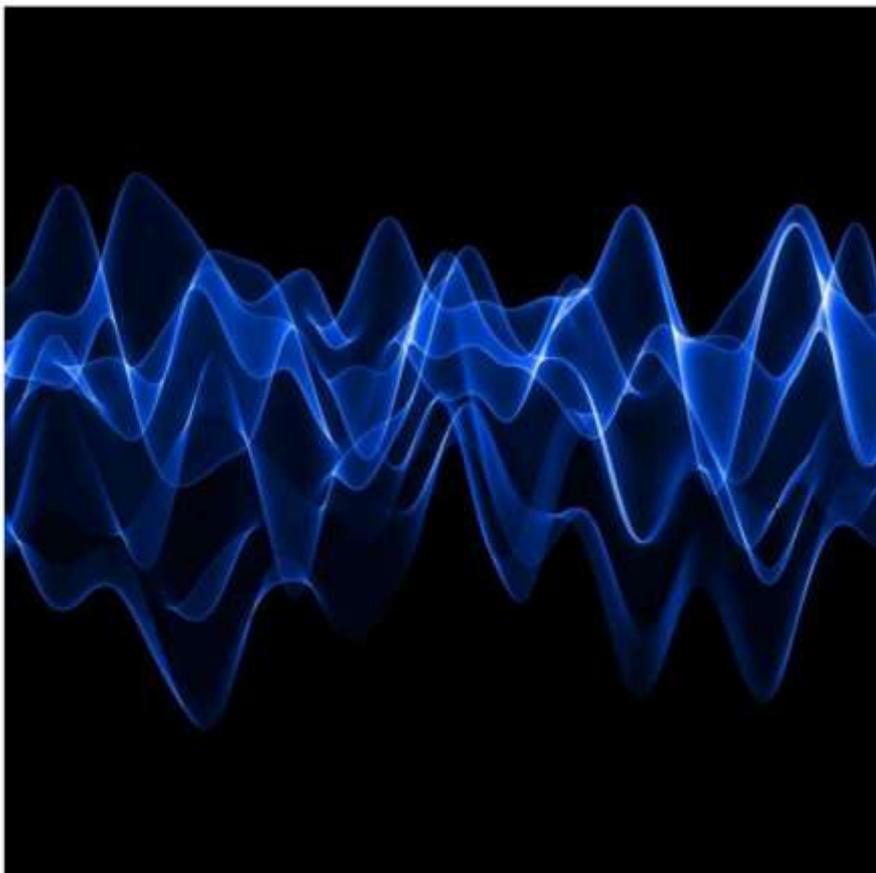


Image: 123RF

## 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.

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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.

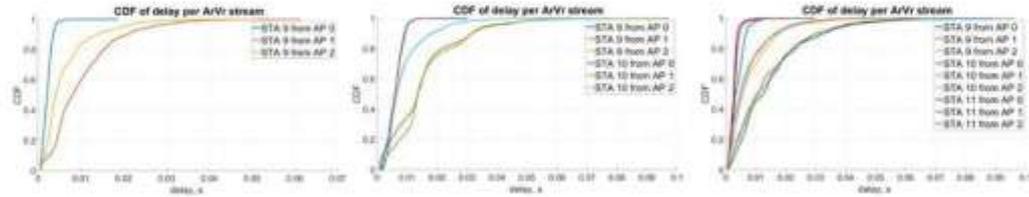
6 GHz spectrum is the largest remaining contiguous block of mid-band spectrum that can be allocated to licensed mobile in most markets. The 6 GHz spectrum could therefore provide more capacity and performance. At the same time, the broad contiguous 6 GHz band could reduce the



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**

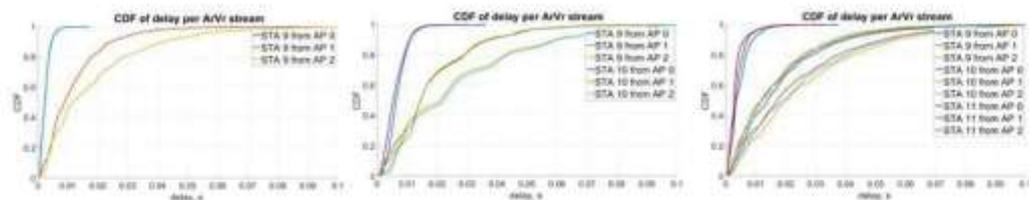


**Figure B-4.** Statistics of delay for SC pair (c3) with three APs sharing a single 320 MHz channel with 50% and 75% spectral overlap

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

### Models and Approaches previously used for Spectrum Valuation Exercises

Spectrum Band	Valuation Approach/ Methodology	Date and Para/ Annexure Number of Recommendation on Valuation and Reserve Price of Spectrum
<b>1800 MHz</b>	<b>Producer Surplus Model</b>	Annexure 4.2 of September 2013 Recommendations Para 3.38 of August 2018 Recommendations Annexure 3.6 of April 2022 Recommendations
	<b>Production Function Model</b>	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
	<b>Revenue Surplus Model</b>	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
	<b>Use of Last auction determined price</b>	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
	<b>Market Data Analysis: Single variable correlation (Trend Line) or Multiple Regression</b>	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

<b>800 MHz</b>	<b>Producer Surplus Model</b>	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
	<b>Technical Efficiency Approach</b>	Para 4.45 to 4.47 of September 2013 recommendations Para 3.22 of August 2018 Recommendations Annexure 3.9 of April 2022 Recommendations
	<b>Use of last auction determined prices</b>	Para 3.29 of August 2018 Recommendations Annexure 3.9 of April 2022 Recommendations
	<b>Potential Growth in Data Services</b>	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
	<b>Use of Auction Determined Prices of 900 MHz in valuation of 800 MHz band</b>	Para 3.68 of February 2014 Recommendations Para 3.42 of January 2016 Recommendations
	<b>Market Data Analysis: Single variable correlation or multiple regression</b>	Annexure 4.1 of September 2013 Recommendations Para 3.16 of January 2016 Recommendations Annexure 3.9 of April 2022 Recommendations
<b>900 MHz</b>	<b>Technical Efficiency Approach</b>	Para 4.45 to 4.47 of September 2013 Recommendations Para 3.45 of August 2018 Recommendations Annexure 3.8 of April 2022 Recommendations
	<b>Economic Efficiency Approach</b>	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
	<b>Use of Last Auction Determined Prices</b>	Para 3.42 of January 2016 Recommendations Para 3.45 of August 2018 Recommendations Annexure 3.8 of April 2022 Recommendations

	<b>Market Data Analysis: Single variable correlation or multiple regression</b>	Annexure 4.1 of September 2013 Recommendations Para 3.16 of January 2016 Recommendations
<b>2100 MHz</b>	<b>Technical Efficiency Approach</b>	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
	<b>Data Usage Growth Model</b>	Para 3.20 - 3.21 December 2014 Consultation Paper Annexure 3.4 of December 2014 Recommendations Para 3.49 of January 2016 Recommendations
	<b>Producer Surplus Model</b>	Annexure 3.3 of December 2014 Recommendations
	<b>Use of Last auction determined price</b>	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
<b>700 MHz</b>	<b>Use of Reserve Price of 1800 in valuation of 700 MHz band</b>	Para 3.75 of January 2016 Recommendations Para 3.98 of August 2018 Recommendations Annexure 3.13 of April 2022 Recommendations
<b>2300 MHz</b>	<b>Use of past Auction Determined Price</b>	Para 3.80 to 3.81 of January 2016 Recommendations Para 3.71 of August 2018 Recommendations
	<b>Technical efficiency of 2300 MHz band (TDD) with respect to the spectrum in 1800 MHz band (FDD)</b>	Annexure 3.11 of April 2022 Recommendations
	<b>Equal to last recommended Reserve Price</b>	Para 3.71 of August 2018 Recommendations

	<b>Market Data Analysis: Single variable correlation or multiple regression</b>	Annexure 3.11 of April 2022 Recommendations
<b>2500 MHz</b>	<b>Equal to recommended Reserve Price of 2300 MHz</b>	Para 3.85 of January 2016 Recommendations Annexure 3.12 of April 2022 Recommendations
	<b>Indexation of last available auction prices</b>	Para 3.80 of August 2018 Recommendations Annexure 3.12 of April 2022 Recommendations
	<b>Equal to last recommended Reserve Price</b>	Para 3.80 of August 2018 Recommendations Annexure 3.12 of April 2022 Recommendations
<b>3300 - 3600 MHz</b>	<b>Technical efficiency approach</b>	Para 3.129 to 3.130 of August 2018 Recommendations Annexure 3.15 of April 2022 Recommendations
<b>mmWave 24.25 GHz – 28.5 GHz Band</b>	<b>International benchmarking</b>	Annexure 3.16 of April 2022 Recommendations

## Valuation of spectrum in 1800 MHz band through Multiple Regression Approach

### a. Introduction

1. Multiple regression is a statistical technique used to examine the relationship between one dependent variable and two or more independent (explanatory) variables. It extends the simple linear regression model by allowing multiple predictors to be included in the analysis. A multiple regression equation can be expressed as follows:

$$Y = \beta_0 + \beta_1 * X_1 + \beta_2 * X_2 + \dots + \beta_n * X_n + \varepsilon$$

Where Y is the dependent variable.

$X_1, X_2, X_n \dots$ , are the explanatory variables.

$\beta_0$  is the intercept.

$\beta_1, \beta_2, \dots, \beta_n$  are the coefficients of explanatory variables.

$\varepsilon$  is the error term.

2. Regression analysis evaluates the significance of explanatory variables using statistical measures such as the p-values of the estimated coefficients and the adjusted R-squared of the model. The impact of each explanatory variable is further assessed by examining the magnitude and sign of its estimated coefficient ( $\beta$ ).

### a) Methodology

3. In the present exercise, a multiple regression model has been used to forecast the price per MHz of spectrum in the 1800 MHz band for the upcoming auction.

For this purpose, the auction-determined price (hereinafter referred to as ADP) observed in past 1800 MHz auctions has been regressed on selected economic and market variables that are likely to be linked to spectrum demand and, consequently, to spectrum prices.

4. In the model, the ADP of the past auctions has been taken as the dependent variable. It has been regressed upon the following explanatory variables:
  - a) Number of mobile subscribers in an LSA
  - b) GSDP per capita Estimate of an LSA
  - c) Data usage in an LSA
5. GSDP per capita is used as a proxy for revenue potential and, consequently, for spectrum demand. Subscriber base and wireless data usage directly capture the scale and intensity of telecom demand in an LSA. Wireless data usage is reintroduced in the current framework as a direct measure of demand intensity, and it has also been used in previous valuations.
6. Population Density is omitted from the explanatory variables as it did not yield statistical results in the present exercise.
7. For this purpose, a panel data set for the dependent variable (ADP) from the year 2012 to 2024 and the explanatory variables for the corresponding years was prepared for each LSA.
8. The following regression model was run for ADP for the spectrum in 1800 MHz band

$$\ln (ADP)_{it} = \beta_0 + \beta_1 * \ln (GSDPperCap)_{it} + \beta_2 * \ln \ln (SUB)_{it} + \beta_3 * Datausage + \beta_4 * Dmet + \varepsilon_{it}$$

Where,

$i'$  is an index for the LSAs;

$t'$  is an index for the time of the auction;

'ADP' stands for the auction determined price of the past auctions in an LSA.

GSDPperCap' stands for Gross domestic product (GSDP) per Capita estimate of an LSA

SUB stands for mobile subscriber base of an LSA;

Datausage stands for the Data Usage for an LSA.

Dmet is a metro fixed effect dummy variable. It equals 1 for metro LSAs and 0 for non-metro LSAs.

Dmet is 0 for non-metro LSAs ; and

Dmet is 1 metro LSAs.

9. Multicollinearity was assessed using the Variance Inflation Factor (VIF). All variables recorded VIF values well below the conventional threshold.
10. The results of the Multiple Regression model for the 1800 MHz band were examined using the values of the Adjusted R-squared and the p-values of each coefficient. The results indicated that the overall model, as well as each explanatory variable, was statistically significant for the regression of ADP for

the 1800 MHz spectrum. Accordingly, the explanatory variables have been included in the Multiple Regression model for forecasting ADP per MHz for the 1800 MHz spectrum in the upcoming auction.

11. The analysis was conducted for all bands; however, only the 1800 band was included for valuation purposes, as it demonstrated statistical significance.
  
12. The forecasted values of ADPs per MHz of 1800 MHz band have been termed as valuation per MHz of spectrum in 1800 MHz band respectively for a period of 20 years through the Multiple Regression model.

**Valuation of spectrum in 1800 MHz band and 2300 MHz band through  
the Trend-Line Approach**

**A. Introduction**

1. Trend-line approach is a statistical method which identifies and fits any systematic time patterns which may be present in the variable of interest through a time-series analysis. It helps to identify the overall pattern or direction in the data without being influenced by short-term fluctuations.
2. The Auction Determined Prices (hereinafter, referred to as 'ADPs') in the previously held auctions have been considered by the Authority as one of the possible valuations of spectrum. Under the trend-line approach, a linear relationship is established between the ADPs observed in previously held auctions and time (t), as given below:

$$\mathbf{ADP = a + b \times t \dots \text{Equation (1)}}$$

3. In a trend-line fitted between ADPs and time (t), 'a' is the intercept of the trendline (the point at which the trend-line crosses the y-axis), and 'b' is the slope of the trend-line (the change in ADP per unit time).
4. Under the Trend-line approach, using the time-series information on ADPs per MHz (spectrum band-wise and LSA-wise) in the spectrum auctions held from the year

2010 (the auction of 3G and BWA spectrum) to the year 2024, (the latest auction of spectrum), the constant 'a' and the coefficient 'b' is estimated using linear regression technique. The values of constant 'a' and the coefficient 'b' estimated from the linear regression is then plugged in the above equation (1) to forecast the value of ADP per MHz in the spectrum band in the forthcoming auction.

## **B. Methodology**

5. At present, there are 22 Licensed Service Areas (LSAs) in the country. In the valuation exercise using the trend-line approach in 2022, LSAs had been initially classified into Metro, Category A, Category B and Category C. However, upon re-estimating the regression for the 1800 MHz band after incorporating data points (ADPs) from the 2022 and 2024 auctions, the coefficient of time in the trend-line was found to be statistically insignificant. While this does not, by itself, conclusively establish the absence of inter-category differences, it indicated that the existing categorisation was not adding meaningful explanatory power to the model and therefore warranted reconsideration.
  
6. It was also observed that the original basis of this classification lay in differences in licensing terms and conditions, including differential rates of License Fees, under the pre–Unified Licence (UL) regime, which reflected historical variations in market maturity and infrastructure. Under the present Unified Licence framework, licensing terms and conditions are uniformly applicable across all LSAs, and access service authorisations are granted without any regulatory distinction based on such

categories. In view of this structural shift, the earlier categorisation did not seem to have support from the prevailing licensing framework.

7. In view of the above, the categorical classification has been discontinued in the present exercise, and a single regression specification incorporating LSA fixed effects has been adopted for the trendline analysis. Accordingly, linear regressions between ADPs and time (t) have been carried out by pooling data across all LSAs with LSA-wise fixed effects, which incorporates time-invariant differences across LSAs, while also taking care of the impact these trends have on each other.
8. Using this approach, trend-line regressions between ADPs and time (t) have been estimated for spectrum in the 1800 MHz band as well as the 2300 MHz band.
9. The estimated linear regressions produced statistically significant results, indicating clear and consistent time-related trends in LSA-wise ADPs per MHz of spectrum in the 1800 MHz and 2300 MHz bands. The analysis was conducted for all bands; however, only the 1800 and 2300 bands were included for valuation purposes, as only these yielded statistically significant and robust results.
10. Based on the estimated values of the constant 'a' and the coefficient 'b' from the trend-line regressions, the Authority has derived the expected LSA-wise ADPs per MHz of spectrum in the 1800 MHz and 2300 MHz bands for the forthcoming

auction. These expected ADP values per MHz may be treated as the valuation per MHz of spectrum in the 1800 MHz and 2300 MHz bands, respectively, for a license period of 20 years under the trend-line approach.

**Valuation of spectrum in 1800 MHz band through Producer Surplus Model**

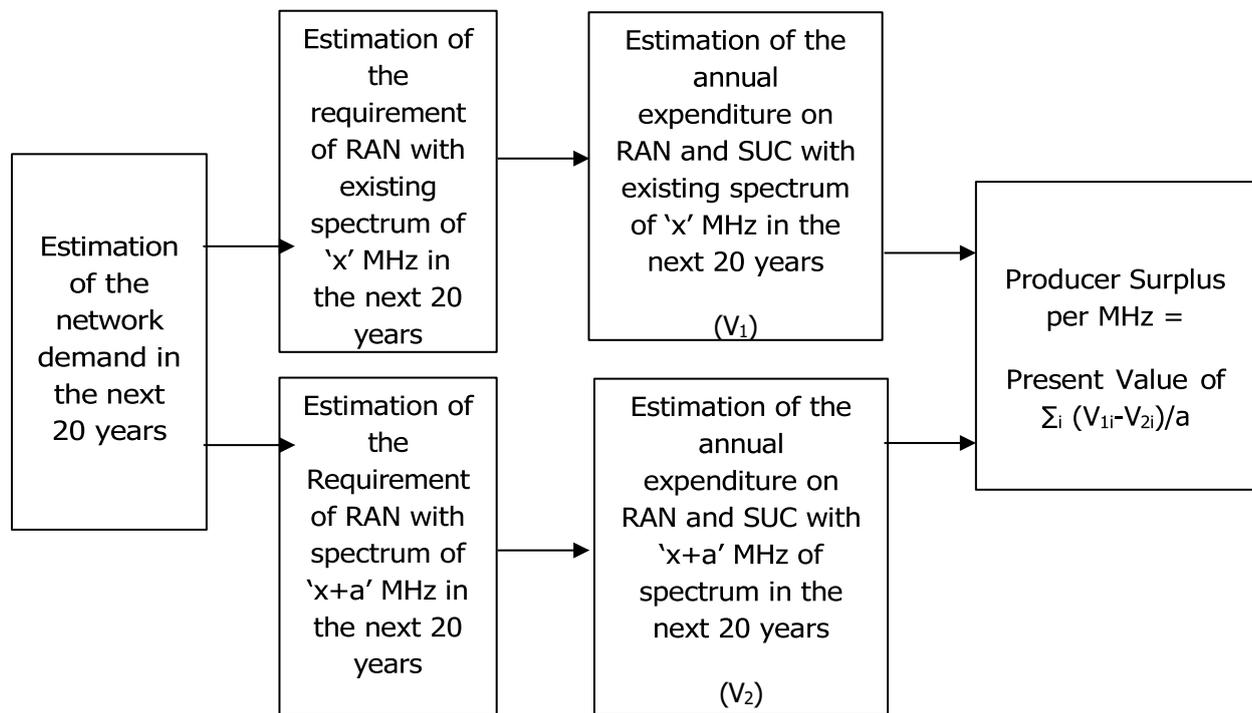
**A. Introduction**

1. Spectrum can be valued as the producer surplus that arises when additional spectrum is allotted to an existing telecom service provider (TSP). As there is an inverse relationship between the quantum of spectrum allocated and the expenditure on the radio access network (RAN) required for serving a particular level of demand, the allocation of additional spectrum to an existing TSP will create a producer surplus.
2. Let us consider a TSP offering wireless access services has 'x' MHz of spectrum. The TSP has drawn its long-term demand model and thereby it has made projections of (i) geographical coverage requirements and (ii) network capacity requirements in each year with 'x' MHz of spectrum available to it. In order to fulfill its requirements of coverage and capacity, the TSP will have to make capital expenditure on the network apart from incurring operating expenditure to run the network every year. Accordingly, the TSP has estimated the total expenditure on the network to be incurred in each year during the next 'y' years, which will be required to fulfill its projected demand. If the TSP obtains an additional spectrum of 'a' MHz today, the capital investment on the network and operating expenditure to run the network required to fulfill the same demand, will be lower owing to the inverse relationship between the spectrum available and the expenditure on the network. It is expected that the value that the TSP

places on the additional spectrum is approximately equal to the cost savings upon acquiring the additional spectrum.

3. Essentially, the Producer Surplus model is an approach to determine the predicted net savings to an average TSP on expenditure (CAPEX + OPEX) in the RAN and spectrum usage charge (SUC) in the next 20 years upon getting additional spectrum. The savings on SUC arise with allotment of additional spectrum, due to continued effects of Telecom Reforms undertaken in 2021, specifically the reduction of SUC rate for spectrum allotted in spectrum auctions after 2021 to NIL. The predicted net savings in expenditure made by the TSP has been termed as 'Producer Surplus'. The producer surplus so obtained is treated as the valuation of spectrum.
4. A block schematic diagram of the Producer Surplus model is given below:

**FIGURE-A:  
BLOCK SCHEMATIC DIAGRAM OF THE PRODUCER SURPLUS MODEL**



5. For the purpose of estimation of producer surplus per MHz in 1800 MHz band, annualized expenditure comprising of capital expenditure (CAPEX) and operating expenditure (OPEX) on RAN in urban areas and SUC in the two scenarios viz. (i) with existing spectrum of 'x' MHz in 1800 MHz band, and (ii) with 'x+a' MHz of spectrum in 1800 MHz band needs to be estimated. It is noteworthy that for this purpose, only the expenditure upon RAN in urban areas is relevant for the following reasons:

- (a) There is an inverse relationship between the quantum of spectrum allocated and the expenditure on RAN required to serve a particular level of demand. In case, additional spectrum is allocated to a TSP, it would be able to save upon the expenditure on RAN. On the other hand,

additional spectrum would have no impact on the expenditure on core network.

(b) RAN consists of base stations which connect end-user devices. A base station operating in a particular spectrum band (such as 1800 MHz band) in a particular network technology (such as 4G and 5G) is characterized by (a) coverage, and (b) traffic carrying capacity.

(c) An existing TSP would install a new base station to cater to either or both -

(i) capacity constraint, if the existing cluster of base stations in a geographical area is not able to cater to the increased traffic;

(ii) coverage constraint, if the existing cluster of base stations is not able to cover the populated area adequately.

(d) Generally, the urban areas have much higher population densities than the rural areas. Therefore, the capacity constraints owing to increased traffic arise mainly in urban areas. On the other hand, situations of coverage constraints arise mainly in rural areas which remain uncovered/ under-covered by the existing clusters of base stations. Hence, the urban areas are generally capacity constrained while rural areas are generally coverage constrained. For this reason, a TSP would, generally, install a new base station in order to meet – (i) new capacity requirements in urban areas; and (ii) new coverage requirements in rural areas.

(e) The TSPs in India have already been allotted spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 3500 MHz and 26 GHz spectrum bands. At present, the spectrum in 700 MHz, 800 MHz band and 900 MHz is generally used for catering to the coverage constraints. An existing TSP, which holds spectrum in 700 MHz, 800 MHz and/or 900 MHz band, would get no additional benefit of coverage in case it gets additional spectrum in 1800 MHz band. However, owing to an inverse relationship between the quantum of spectrum available and number of base stations required to meet a particular level of demand, the TSP would need to install fewer additional base stations in future in capacity constrained areas (i.e. urban areas) in case it gets additional spectrum in 1800 MHz band. Clearly, additional spectrum in 1800 MHz band would help an existing TSP in reducing its expenditure mainly on the base stations in urban areas only.

6. Accordingly, requirement of the base stations in urban areas in the next 20 years needs to be estimated in the two scenarios viz. (i) with existing spectrum of 'x' MHz in 1800 MHz band, and (ii) with 'x+a' MHz of spectrum in 1800 MHz band, in order to arrive at the savings in the expenditure on RAN upon obtaining additional spectrum of 'a' MHz in 1800 MHz band.
7. As per the existing SUC regime in the country, the SUC is levied on a TSP on the basis of weighted average of SUC rates across all spectrum assigned to a TSP in all access spectrum bands. Accordingly, the SUC payable in the next 20

- years needs to be estimated in the two scenarios viz. (i) with existing spectrum of 'x' MHz, and (ii) with 'x+a' MHz of spectrum,
8. The value of producer surplus would vary with the TSPs depending upon their respective projected data traffic demands (i.e. subscriber base and mobile traffic per subscriber), annual expenditure on required base stations (CAPEX plus OPEX), spectrum holdings and profile of subscribers in various LSAs. Therefore, the average of the values of producer surplus for various TSPs would best capture the expected value of producer surplus upon acquiring additional spectrum in 1800 MHz band for a typical TSP. Accordingly, in order to arrive at the expected value of producer surplus per MHz, an average TSP having an average level of projected demand (i.e. subscriber base and mobile traffic per subscriber), average annual expenditure on base stations, average spectrum holdings and average profile of subscribers in each LSA has been considered.
  9. At present, the 4th generation (4G) and 5th Generation (5G) networks cater to the most of mobile traffic in the country. Accordingly, the Producer Surplus model has been run for a mix of 4G and 5G network. Data has either been provided by the TSPs or industry benchmarks have been adopted.
  10. In the model, the present values (PVs) of the expenditures (CAPEX plus OPEX) on base stations (mix of 4G and 5G) in urban areas and SUC to be incurred during the next 20 years for the two cases described above viz. (a) with 'x' MHz of spectrum in 1800 MHz band, and (b) with 'x+a' MHz of spectrum in 1800

MHz band have been estimated for an average TSP. The difference of the PVs in the two cases is the producer surplus.

*Producer Surplus on acquiring 'a' MHz of spectrum in 1800 MHz band*

*= (Present Value of expenditure on 4G and 5G base stations in urban areas and SUC during the next 20 years with 'x' MHz of spectrum in 1800 MHz band) minus (Present Value of expenditure on 4G and 5G base stations and SUC during the next 20 years with 'x+a' MHz of spectrum in 1800 MHz band)*

## B. **Methodology**

11. As indicated earlier, in the present exercise, the Producer Surplus model has been run for an average TSP offering a combination of 4G and 5G network-based mobile services in the country. For this purpose, information in respect of the top-three TSPs which offer a mix of 4G and 5G network based mobile services in the country have been used in the model.
12. The following steps have been taken for estimation of producer surplus in case a TSP acquired 'a' MHz of spectrum in 1800 MHz band ('a' has been taken as 5 MHz in the model):
  - (a) Estimation of the mix of 4G and 5G network demand in urban areas of an average TSP
  - (b) Estimation of the number of 4G and 5G base stations in urban areas in the two scenarios-
    - (i) with average spectrum holding of 'x' MHz in 1800 MHz band;and

(ii) with average spectrum holding of 'x' MHz in 1800 MHz band plus  
( 'a' MHz in 1800 MHz band)

(c) Estimation of the annual expenditure on 4G and 5G base stations in urban areas and SUC in the two scenarios

(d) Estimation of producer surplus per MHz of spectrum in 1800 MHz band

(a) **Estimation of Network Demand for mix of 4G and 5G in Urban Areas of an Average TSP**

13. LSA-wise combined 4G and 5G network demand in urban areas in an LSA in the Financial Year 2025-26 in respect of an average TSP has been estimated as below:

*Busy hour demand for the mix of 4G and 5G network in urban areas in an LSA in respect of an average TSP*

*= Number of urban 4G and 5G subscribers of the average TSP in the LSA \*  
Amount of Busy Hour 4G and 5G mobile traffic per 4G and 5G subscriber in the LSA*

14. The number of urban 4G and 5G subscriber of the average TSP in an LSA has been estimated using the Herfindahl-Hirschman Index (HHI) as below:

*Number of urban 4G and 5G subscribers of the average TSP in an LSA*

*= Total number of urban 4G and 5G subscribers in the LSA \* HHI of the urban 4G and 5G subscribers market in the LSA/10000*

15. For this purpose, the LSA-wise number of 4G and 5G urban subscribers of the top-three TSPs has been estimated as below:

*Number of urban 4G and 5G subscribers of a TSP*

*= (Number of urban subscribers of the TSP divided by Number of total subscribers of the TSP) multiplied by Number of 4G and 5G subscribers of the TSP*

16. The LSA-wise Busy Hour 4G and 5G mobile traffic (comprising of 4G and 5G data download, voice MOU and SMS) as a percentage of monthly 4G and 5G mobile traffic has been estimated on the basis of information on traffic handled by 4G and 5G network on hourly basis for each LSA obtained from TSPs. Based on this information, amount of 4G and 5G mobile traffic per 4G and 5G subscriber in busy hour in each LSA in respect of the average TSP has been estimated as below:

*Amount of Busy Hour 4G and 5G mobile traffic (in Mbps) per 4G and 5G subscriber in an LSA in respect of the average TSP*

*= Busy Hour voice minutes of usage (MOU) per subscriber converted to data (in Mbps) plus Busy Hour SMS per subscriber converted to data (in Mbps) plus Busy Hour 4G and 5G data download per 4G and 5G subscriber (in Mbps)*

17. For the purpose of estimation of the Busy Hour 4G and 5G mobile traffic per 4G and 5G subscriber in the following 20 years (from F.Y. 2026-27 to 2045-46), the

annual rate of growth in (a) number of subscribers, (b) voice MOU per subscriber per month, (c) SMS per subscriber per month and (d) data per subscriber per month apart from (e) revenue have been considered as below:

**TABLE-A:  
PROJECTED GROWTH RATES**

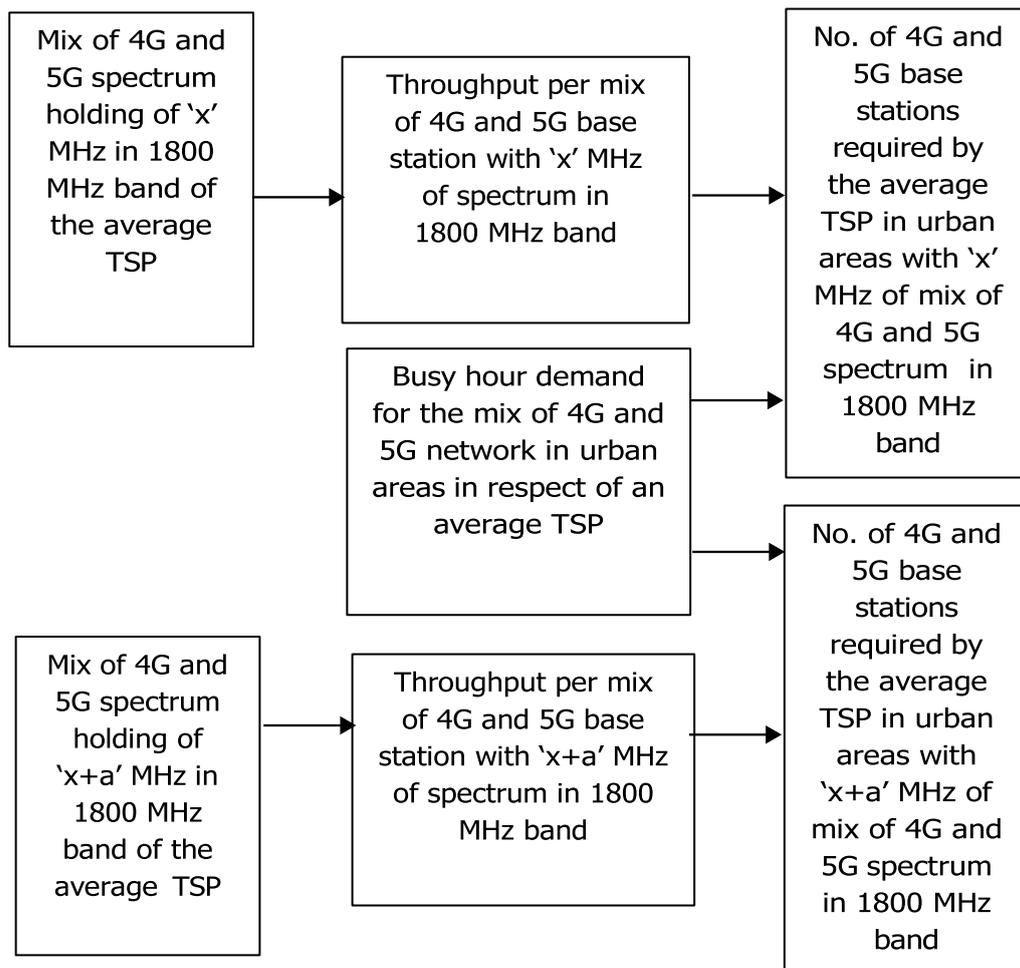
<b>Year</b>	<b>Data Growth Rate</b>	<b>Data Subscriber Growth</b>	<b>MOU Growth</b>	<b>SMS growth</b>	<b>Revenue Growth rate (%)</b>
<b>2026-27</b>	15%	2.00%	2.5%	0.0%	12.0%
<b>2027-28</b>	12%	1.67%	2.0%	0.0%	10.8%
<b>2028-29</b>	12%	1.25%	1.5%	0.0%	9.6%
<b>2029-30</b>	10%	1.25%	1.5%	0.0%	8.4%
<b>2030-31</b>	10%	0.83%	1.0%	0.0%	8.4%
<b>2031-32</b>	10%	0.83%	1.0%	0.0%	7.2%
<b>2032-33</b>	7%	0.63%	0.8%	0.0%	6.0%
<b>2033-34</b>	7%	0.63%	0.8%	0.0%	6.0%
<b>2034-35</b>	7%	0.42%	0.5%	0.0%	4.8%
<b>2035-36</b>	5%	0.42%	0.5%	0.0%	4.8%
<b>2036-37</b>	5%	0.42%	0.5%	0.0%	4.8%
<b>2037-38</b>	5%	0.42%	0.5%	0.0%	4.8%
<b>2038-39</b>	2%	0.42%	0.5%	0.0%	2.4%
<b>2039-40</b>	2%	0.42%	0.5%	0.0%	2.4%
<b>2040-41</b>	2%	0.42%	0.5%	0.0%	1.2%
<b>2041-42</b>	2%	0.42%	0.5%	0.0%	1.2%
<b>2042-43</b>	2%	0.42%	0.5%	0.0%	1.2%
<b>2043-44</b>	2%	0.42%	0.5%	0.0%	1.2%
<b>2044-45</b>	2%	0.42%	0.5%	0.0%	1.2%
<b>2045-46</b>	2%	0.42%	0.5%	0.0%	1.2%

**(b) Estimation of the number of mix of 4G and 5G Base Stations Required by the Average TSP in Urban Areas in each LSA in the two Scenarios**

18. Prior to estimating the number of 4G and 5G base stations in urban areas required by the average TSP in each LSA, the equivalent 4G and 5G spectrum

holding of the average TSP in 1800 MHz band has been estimated. The 4G and 5G spectrum holding of a TSP refers to the spectrum which has been put to use by the TSP in its 4G and 5G network. In respect of each TSP, the 4G and 5G spectrum holdings of the TSP in various spectrum bands have been converted into the equivalent 4G and 5G spectrum holding in 1800 MHz band on the basis of download capacity of the respective spectrum bands. Thereafter, the equivalent 4G and 5G spectrum holding of the average TSP in 1800 MHz band in an LSA has been estimated as the weighted average of the equivalent 4G and 5G spectrum holdings in the 1800 MHz band of the three TSPs in the LSA, weighted with TSP-wise 4G and 5G subscriber base in the LSA. It is understood that deployment in the 26 GHz band has not yet started by TSPs. Hence, the spectrum holdings in the 26 GHz band are not considered in this calculation.

19. Based on the estimated equivalent 4G and 5G spectrum holding in 1800 MHz band of the average TSP, the number of 4G and 5G base stations has been estimated in both the scenarios i.e. (a) with additional spectrum, and (b) without additional spectrum. A block schematic diagram depicting the method to determine the number of 4G and 5G base stations required by the average TSP in urban areas in each LSA is given below:



**Figure-B:**

**Schematic for estimation of the number of 4G & 5G base stations required by the average TSP in urban areas in each LSA**

**(c) Estimation of Annual Expenditure on 4G and 5G base Stations in Urban Areas and SUC in the two Scenarios**

20. In order to estimate the total annual expenditure (CAPEX plus OPEX) on the mix of 4G and 5G base stations in urban areas in each LSA in respect of the average TSP, the following steps have been taken:

(a) The capital cost (Gross Block) and annual operating cost (RAN) as on 31.03.2025 per mix of 4G and 5G base station has been estimated on the basis

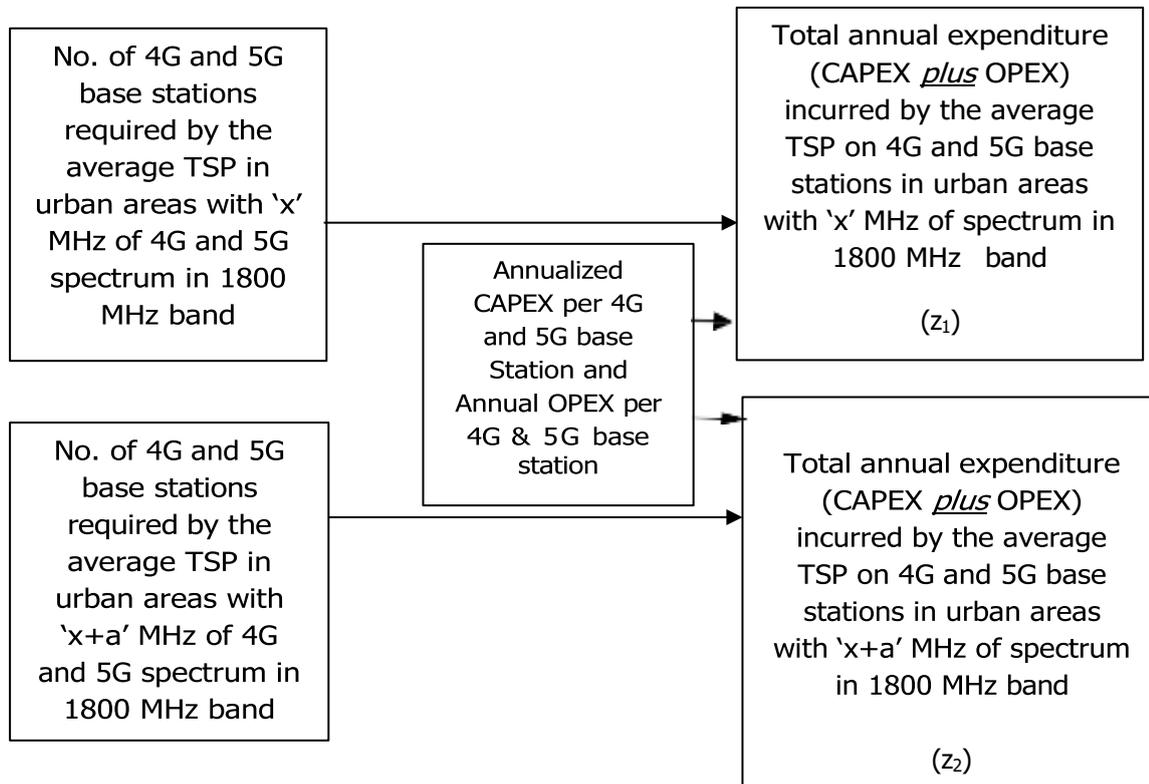
of the Accounting Separation Report (ASR) for the financial year (F.Y.) 2024-25. Further, the capital cost per mix of 4G and 5G base station has been assumed to be reducing by 5% year-on-year (Y-o-Y) and annual operating cost per mix of 4G and 5G base station has been assumed to be increasing by 1% on Y-o-Y basis for the next 20 years. Useful Life of mix of 4G and 5G Base station equipment has been taken as 10 years.

(b) Based on the number of mix of 4G and 5G base stations required in urban areas in an LSA in the next 20 years to cater to the projected 4G and 5G network demand, and the capital cost (Gross Block) per mix of 4G and 5G base station in the LSA, the total capital cost of the mix of 4G and 5G base stations in urban areas in the LSA has been calculated. Further, straight line depreciation @10% per year and prevalent cost of capital @15% have been applied to estimate annualized CAPEX of the mix of 4G and 5G base stations in urban areas for the average TSP in each LSA in the next 20 years.

(c) Based on the number of mix of 4G and 5G base stations required in urban areas in an LSA in the next 20 years, and annual operating cost per mix of 4G and 5G base station in the LSA, the total annual OPEX of the mix of 4G and 5G base stations in urban areas for the average TSP in each LSA in the next 20 years has been estimated.

(d) The total annual expenditure on the mix of 4G and 5G base stations in urban areas in each LSA in the next 20 years in respect of the average TSP has been estimated by way of adding the annualized CAPEX and annual OPEX for the respective years.

21. The annual expenditure on 4G and 5G base stations in urban areas for the average TSP in the next 20 years in the two scenarios has been estimated as per the following block schematic diagram:



**Figure C:**

**Schematic diagram for estimation of total expenditure (CAPEX+OPEX) on 4G & 5G base stations in urban areas in two scenarios**

22. As indicated before, the SUC is levied on a TSP on the basis of weighted average of SUC rates across all spectrum assigned to the TSP in all access spectrum bands. For computing the SUC payable by the average TSP in each LSA for the next 20 years in the two scenarios i.e. with 'x' MHz of spectrum and 'x+a' MHz of spectrum, the following steps have been taken:

(a) The SUC rate for the average TSP in an LSA in the first scenario (i.e. with 'x' MHz of spectrum) has been taken to be equal to the average SUC rate of access service providers in the F.Y. 2024-25 in the LSA, computed on the basis of information provided by the TSPs (providing a mix of 4G and 5G services in the country) in the Adjusted Gross Revenue (AGR) reports and Accounting Separation Reports (ASR) for the F.Y. 2024-25.

(b) The SUC rate in the second scenario (i.e. with 'x+a' MHz of spectrum) has been computed with the help of the weighted average SUC formula, with proportional decrease in rate with allotment of 'a' MHz

The total SUC payable over next twenty years has been calculated using two different methods described below, and both have yielded nearly same results:

### **Method 1**

(c) The annual rate of growth in average revenue per user (ARPU) in the next 20 years (from F.Y. 2026-27 to 2045-46) has been computed on the basis of (a) the projected rate of growth in revenue, and (b) the projected rate of growth in the subscriber base in the next 20 years, indicated in the Table-A above; and

(d) SUC payable by the average TSP in the next 20 years in the two scenarios has been estimated on the basis of (a) weighted average SUC rate in the two scenarios (b) 4G and 5G subscriber base and (c) ARPU in the next 20 years for the average TSP.

### **Method 2**

(e) The revenue for wireless services is taken based on Adjusted Gross Revenue (AGR) reports/ ASR submissions and the annual rate of growth for revenue in the next 20 years (from F.Y. 2026-27 to 2045-46) has been taken as indicated in the Table-A above; and

(f) SUC payable by the average TSP in the next 20 years in the two scenarios has been estimated on the basis of (a) weighted average SUC rate in the two scenarios, (b) 4G and 5G subscriber base, and (c) Revenue in the next 20 years for the average TSP.

**(4) Estimation of Producer Surplus per MHz of Spectrum in 1800 MHz Band**

23. In order to arrive at the present value of the expenditure on mix of 4G and 5G base stations, a discounting rate of 12.5% has been used.

24. The producer surplus per MHz of spectrum in 1800 MHz band has been estimated as below:

*Producer Surplus per MHz of spectrum in 1800 MHz band*

*= (Present Value of the expenditure on 4G and 5G base stations in urban areas and SUC during the next 20 years with 'x' MHz of spectrum in 1800 MHz band)*

*minus*

*(Present Value of the expenditure on 4G and 5G base stations and SUC during the next 20 years with 'x+a' MHz of spectrum in 1800 MHz band)*

*divided by 'a' MHz*

25. Producer Surplus per MHz of spectrum in 1800 MHz band so obtained is termed as Valuation per MHz of spectrum in 1800 MHz band for a period of 20 years through the Producer Surplus model.

**Valuation of spectrum in 1800 MHz band through Production Function Model**

**A. Introduction**

1. The Production Function model estimates the economic value of spectrum using the Cobb–Douglas production function, wherein spectrum and base stations are treated as two key factor inputs used for generating mobile traffic. The Cobb–Douglas production function is a widely adopted functional form for capturing the relationship between multiple inputs and output. The production function is specified as under:

$$X = A \cdot y^{\alpha} \cdot z^{\beta}$$

2. The above formulation is based on the premise that the two inputs namely, the quantum of spectrum holding (y) and the number of base stations (z) are substitutable to a certain extent in producing a given level of output, i.e., mobile traffic (X). An increase in spectrum prices would incentivize TSPs to substitute spectrum with relatively cheaper base stations for producing the same level of mobile traffic, and vice versa. One approach to estimating the value of spectrum involves constructing a panel data set comprising mobile traffic, allocated spectrum, and base stations across different Licensed Service Areas over multiple time periods and estimating the coefficients of the production function through regression analysis. These estimated coefficients can then be used, subject to reasonable assumptions, to derive the value of spectrum for each LSA.

3. The estimated value of spectrum varies across TSPs depending upon their projected mobile traffic and existing spectrum holdings. Therefore, the expected value of spectrum is best represented by the average of the predicted values across TSPs. Accordingly, for estimating the valuation per MHz of spectrum, an average TSP characterised by average mobile traffic and average spectrum holding in each LSA has been considered. At present, mobile traffic in the country is predominantly carried over Fourth Generation (4G) and Fifth Generation (5G) networks. In view of this, the Production Function model has been applied to both 4G and 5G network-based services. The required data inputs have been obtained either directly from TSPs or adopted from relevant industry benchmarks.

**B. Brief Description of the Model**

4. The Production Function model is grounded in the principle of opportunity cost and relies on the assumed substitutability between spectrum and base stations, which are considered the two essential inputs for the provision of mobile services. The Cobb–Douglas production function used in the analysis is specified as follows:

$$X = A \cdot y^{\alpha} \cdot z^{\beta} \dots (1)$$

5. In the present analysis, mobile traffic constitutes the dependent variable (X), while the explanatory variables are the allocated amount of spectrum (y) and the number of base stations deployed by a TSP (z). The parameters  $\alpha$  and  $\beta$  represent the responsiveness of output to a unit change in each input and A represents the efficiency factor.

6. For estimation purposes, the production function specified in equation (1) has been linearised by taking natural logarithms on both sides, resulting in the following log-linear form:

$$\ln X = \ln A + \alpha \ln y + \beta \ln z \dots (2)$$

7. The log-linearised model (equation 2) enables the derivation of the optimal input mix of spectrum and base stations using standard calculus techniques. The condition for optimality is that the marginal productivity, yielded per rupee, for both the inputs viz. spectrum & base stations, is the same. The same is expressed as:

$$\frac{MP_y}{P_y} = \frac{MP_z}{P_z} \dots (3)$$

where:

- $MP_y$  denotes the marginal productivity of spectrum,
- $MP_z$  denotes the marginal productivity of base stations, and
- $P_y$  and  $P_z$  represent the prices of spectrum and base stations respectively.

8. The above condition implies that, at the optimum, a TSP allocates its expenditure between spectrum and base stations considering that the marginal productivity per rupee spent on each input is equal.
9. The marginal productivities of spectrum and base stations are obtained by differentiating the production function specified in equation (1), as given below:

$$MP_y = \alpha \cdot A \cdot y^{\alpha-1} \cdot z^{\beta} / y \dots (4)$$

$$MP_z = \beta \cdot A \cdot y^{\alpha} \cdot z^{\beta-1} / z \dots (5)$$

10. Using the optimality condition in equation (3), along with the expressions for  $MP_y$  and  $MP_z$  derived above (equations 4 and 5), the value of spectrum ( $P_y$ ) is obtained as follows:

$$P_y = \frac{\alpha \cdot z}{\beta \cdot y} \cdot P_z \dots (6)$$

where:

- $P_y$  denotes the value per MHz of spectrum (the variable of interest),
- $P_z$  is the known price of a base station,
- $z$  represents the number of base stations deployed,
- $y$  denotes the quantum of spectrum allocated, and
- $\alpha$  and  $\beta$  are the estimated coefficients of the production function.

### **C. Methodology**

11. As indicated earlier, the Production Function model has been applied for an average TSP providing mobile services over both 4G and 5G networks in the country. For this purpose, information pertaining to the top three TSPs offering 4G and 5G network-based mobile services has been used.
12. To operationalise the Production Function model, data relating to mobile traffic (comprising data download, voice minutes of usage (MOU), and SMS), number of base stations, and spectrum holdings of different TSPs across all LSAs for the period

from 2022 to 2025 has been collected. Spectrum holding refers to the total quantum of spectrum across various frequency bands utilised by a TSP for its 4G and 5G networks. For each TSP, the spectrum holdings across different bands have been converted into equivalent 4G and 5G spectrum holdings in the 1800 MHz band, based on the respective download capacities of those bands.

13. Using the data on mobile traffic, base stations, and equivalent spectrum holdings in the 1800 MHz band for different TSPs across all LSAs for the period from 2022 to 2025, the weighted average mobile traffic, weighted average number of base stations, and weighted average of spectrum holding in the 1800 MHz band have been computed for an average TSP for each LSA for the financial years 2021-22 to 2024-25. The TSP-wise mobile subscribers in each LSA has been used as weights for computing these averages.
14. Based on the resulting panel data set comprising LSA-wise mobile traffic, base stations, and spectrum holdings for the average TSP for the financial years 2021-22 to 2024-25, regression analysis has been carried out on equation (2) to estimate the coefficients  $\alpha$  and  $\beta$ . Two separate regressions have been conducted for the following groups:
  - (a) LSAs falling under the Metro category
  - (b) LSAs falling under the non-metro category
15. After estimating the coefficients  $\alpha$  and  $\beta$  for the two groups of LSAs, the following steps have been followed to estimate the value of  $(z \cdot P_z)$ , which represents the

present value of total expenditure incurred by the average TSP base stations over a period of 20 years:

a) The LSA-wise mobile traffic of an average TSP has been projected for the next 20 years based on mobile traffic observed in FY 2024-25

b) Based on the projected mobile traffic for each of the next 20 years and the estimated value of the coefficient  $\beta$ , the number of base stations required for each year has been estimated using the following relationship derived from equation (1) through marginal analysis:

$$\left( \frac{4G/5G \text{ Base Stations}_n}{4G/5G \text{ Base Stations}_{n-1}} \right)^\beta = \frac{4G/5G \text{ Mobile Traffic}_n}{4G/5G \text{ Mobile Traffic}_{n-1}}$$

c) The capital cost (gross block) as on 31.03.2025 and annual operating cost per 4G/5G base station has been estimated based on the Accounting Separation Report (ASR) for FY 2024-25. Further, the capital cost has been assumed to decline at 5% per annum, while the annual operating cost has been assumed to increase at 1% per annum over the next 20 years. The useful life of unique base station equipment has been assumed to be 10 years.

d) Using the projected number of base stations required in each LSA over the next 20 years and the corresponding capital cost, the total capital cost of base stations has been estimated. Straight-line depreciation at 10% per annum and a cost of capital of 15% have been applied to derive the annualised CAPEX for the average TSP in each LSA.

e) Based on the projected number of base stations and the annual operating cost, the total annual OPEX of base stations for the average TSP in each LSA

over the next 20 years has been estimated.

f) The total annual expenditure on base stations in each LSA for the average TSP has been computed by summing the annualised CAPEX and annual OPEX for the respective years.

g) To determine the present value of total expenditure on base stations over the next 20 years, a discount rate of 12.5% has been applied.

h) The present value of total expenditure incurred on 4G and 5G base stations over the next 20 years constitutes the value of  $(z \cdot P_z)$  used in equation (6).

16. Finally, using the estimated coefficients  $\alpha$  and  $\beta$ , the computed value of  $(z \cdot P_z)$ , and the spectrum holding in the 1800 MHz band ( $y$ ) for the average TSP in each LSA, the valuation per MHz of spectrum in the 1800 MHz band has been estimated using equation (6).

**Valuation of spectrum in 1800 MHz band through Revenue Surplus Model**

**A. Introduction**

1. The Revenue Surplus Model for valuation of spectrum in 1800 MHz is premised on the assumption that the Net Present Value (NPV) of the projected revenue surplus over a 20-year period represents the maximum amount that a Telecom Service Provider (TSP) would be willing to pay for additional spectrum in the 1800 MHz band.
2. The business models adopted by different TSPs would influence the respective valuations if firm-level calculations were to be adopted. Hence, a full industry approach using aggregate data of wireless access service segment has been used in the present valuation exercise.

**B. Revenue Surplus Equation**

3. NPV of Revenue Surplus of the wireless access service segment in an LSA for a period of 20 years (from F.Y. 2026-27 to F.Y. 2045-46) has been computed as:

= NPV of [(Projected Total Revenue) minus (all Projected Operating Expenditures) minus (all Projected Capital expenditures excluding spectrum related capital expenditures)] of all wireless access service providers in the LSA for a period of 20 years

4. Valuation of 1 MHz of spectrum in an LSA for a period of 20 years has been derived as:

= (NPV of Revenue Surplus of wireless access services segment in the LSA) divided by (total spectrum holding of all access service providers providing wireless service in the LSA)

### **C. Methodology**

5. The following methodology has been adopted to arrive at the valuation per MHz of spectrum in the 1800 MHz band for a period of 20 years using the Revenue Surplus Model:

- a) Calculations were made individually for each LSA.
- b) LSA-wise Gross Revenue from wireless access services has been taken from the Accounting Separation Reports (ASR) for the financial year (F.Y.) 2024-25 submitted by access service providers to the Authority. The annual growth rate of revenue for F.Y. 2025-26 has been assumed at 14.4% with respect to F.Y. 2024-25. The annual growth rates for (i) revenue and (ii) subscribers for the subsequent 20 years (from F.Y. 2026-27 to F.Y. 2045-46) have been taken as those tabulated in the Producer Surplus Model described in Annexure 3.4 of these recommendations.
- c) The EBITDA (Earning Before Interest, Tax, Depreciation and Amortization) margin of 30% has been derived by taking the total EBITDA of TSPs over the past ten years and dividing it by their total Gross Revenue for the same period, based on data reported in their ASR.
- d) The capital cost per mobile subscriber is calculated as Rs. 4,400, based on the average of capital costs per subscriber of TSPs, as reported in their ASR

for FY 2024-25, excluding spectrum-related capital cost such as spectrum acquisition prices.

- e) Initial capital investment in an LSA has been computed as total number of mobile subscribers in the LSA multiplied by the capital cost per subscriber. For subsequent years, incremental capital investment has been estimated based on annual additions to the subscriber base, as follows:

Capital investment in the 0<sup>th</sup> year in an LSA =  $N_{s(0)} * I_s$

Capital investment in the n<sup>th</sup> year in an LSA =  $[N_{s(n)} - N_{s(n-1)}] * I_s$

Where  $N_{s(n)}$  is the total number of mobile subscribers in the n<sup>th</sup> year in an LSA and  $I_s$  is the capital cost per mobile subscriber.

- f) Useful life for capital investments has been assumed to be 10 years. Straight line depreciation @10% per year has been assumed.
- g) Return on capital investment has been allowed @ 15%.
- h) Annualized Capital Expenditure (CAPEX) for each year has been computed based on the above-mentioned depreciation rate and return on capital investment.
- i) Revenue surplus of wireless access service segment in an LSA for each year has been calculated as:  
= EBITDA for the year minus Annualized CAPEX\*for the year (excluding spectrum-related CAPEX)

As indicated earlier, EBITDA for each year has been taken as 30% of the annual Gross Revenue from wireless access service segment.

\*Annualized Capex is computed as the sum of Depreciation and Return on Capital Investment

- j) Net present value (NPV) of the revenue surplus over the 20-year period has been computed using a discount rate of 12.5%.
  - k) The NPV of revenue surplus for the next 20 years in an LSA represents the blended present value of surplus generated from spectrum holdings in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz and 3300 MHz bands. To work out the valuation of spectrum in the 1800 MHz band, the spectrum holdings in various bands have been converted into equivalent 1800 MHz spectrum holdings using appropriate technical efficiency factors relative to the 1800 MHz band.
6. The LSA-wise valuation per MHz of spectrum in the 1800 MHz band for a period of 20 years has been estimated by dividing the NPV of revenue surplus of each LSA by the total equivalent spectrum holding in the 1800 MHz band in that LSA. The resulting figure is referred to as the 'Valuation per MHz of spectrum in the 1800 MHz band for a period of 20 years through the Revenue Surplus Model'.

**Annexure 3.7**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES – 1800 MHz SPECTRUM (20 YEARS)**

**(Rs. in crore)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>Multiple Regression Approach</b>	<b>Trend Line Approach</b>	<b>Producer Surplus Model</b>	<b>Production Function Model</b>	<b>Revenue Surplus Model</b>	<b>Average (mean) Value</b>
Andhra Pradesh	193.00	252.99	242.04	89.02	166.82	141.24	180.85
Assam	36.81	56.25	50.98	17.57	46.79	35.83	40.71
Bihar	96.68	125.45	81.00	70.48	130.65	93.39	99.61
Delhi		961.74	426.62	125.13	134.80	138.96	357.45
Gujarat	168.00	176.54	239.93	108.49	126.51	107.39	154.48
Haryana	47.16	87.55	62.80	26.53	47.32	35.71	51.18
Himachal Pradesh	16.00	19.86	33.17	6.27	20.35	16.50	18.69
Jammu & Kashmir		23.66	32.77	12.42	29.59	20.93	23.87
Karnataka		216.28	170.81	83.00	120.11	135.53	145.15
Kerala		134.83	96.08	33.48	79.82	63.71	81.59
Kolkata	125.37	158.19	138.59	32.58	35.64	41.09	88.57
Madhya Pradesh	113.87	171.05	93.44	80.37	135.47	46.74	106.83
Maharashtra	213.00	216.37	294.34	110.30	185.81	191.48	201.88
Mumbai	264.00	554.92	406.57	44.36	52.08	100.62	237.09
North East		21.95	33.56	11.37	28.56	23.03	23.69
Orissa	44.86	81.23	45.35	21.26	65.02	33.39	48.52
Punjab	70.16	97.20	87.25	41.52	61.74	58.11	69.33
Rajasthan	96.62	148.43	87.02	57.13	104.79	83.39	96.23

Tamil Nadu		182.94	217.83	119.91	166.93	143.56	166.24
U. P. (East)	211.64	199.83	141.93	62.10	301.37	105.91	170.46
U.P. (West)		101.60	121.37	64.87	298.87	80.29	133.40
West Bengal	67.71	139.45	59.40	56.28	112.90	72.37	84.69

**Valuation of spectrum in 800 MHz & 900 MHz band: Economic Premium Model**

**A. Introduction**

1. Economic Premium Model derives relative valuations for different spectrum bands based on cost trade-offs when operations are switched from a technically more efficient band to a technically less efficient band.
  
2. In 2022, this Model was used for valuation of 900 MHz band only. The Authority is of that view that the 800 MHz band exhibits similar propagation and technical characteristics as compared to the 900 MHz band, as discussed in the present Recommendations. Accordingly, the Economic Premium Model may also be applied for the purpose of valuation of spectrum in the 800 MHz band, providing an additional tool for valuation of 800MHz, and lending greater robustness to the same. Principles and assumptions as applied to the 900 MHz band have been considered for the 800 MHz band as well, since the crux of the model is the savings on RAN which occur while shifting from 1800MHz band to 900 MHz, which are likely to be same while shifting from 1800Mhz band to 800MHz band.
  
3. Due to superior propagation characteristics and technical parameters, spectrum in both 800 MHz and 900 MHz bands are considered as technically more efficient band than spectrum of 1800 MHz band. Higher technical efficiency of the 800 MHz and 900 MHz band leads to greater economic efficiency in the form of lesser

expenditure (CAPEX and OPEX) on Radio Access Network, as compared to operations in the 1800 MHz band.

4. Accordingly, this model derives a relative valuation of the spectrum in 800 MHz/ 900 MHz band from the valuation of spectrum in 1800 MHz band by estimating savings in the expenditure (CAPEX and OPEX) on radio access network.
5. The saving accruing to a TSP operating in 800 MHz/ 900 MHz is represented by the additional/ incremental cost per MHz incurred by TSP operating in 1800 MHz band. These savings may be viewed as the economic premium that a TSP would be willing to pay for acquiring spectrum in 800 MHz/ 900 MHz band vis-à-vis the 1800 MHz band.
6. Other things being equal, the maximum price that a TSP is willing to pay for 1 MHz of spectrum in 800 MHz/ 900 MHz band would be equal to the price of 1 MHz of spectrum in 1800 MHz band plus the savings in the expenditure (CAPEX and OPEX) on the radio access network by switching its operations from 1800 MHz band to 800 MHz/ 900 MHz band, i.e.

For 900 MHz band :  **$V_{900 \text{ MHz}} \leq V_{1800 \text{ MHz}} + \Delta \text{ CAPEX} + \Delta \text{ OPEX}$**

For 800 MHz band :  **$V_{800 \text{ MHz}} \leq V_{1800 \text{ MHz}} + \Delta \text{ CAPEX} + \Delta \text{ OPEX}$**

B. **Methodology:**

7. For the purpose of arriving at the valuation of the 800 MHz band, it is assumed that the same assumptions and methodology as applied for the valuation of the 900 MHz band through Economic Premium Model, shall also be applicable for the valuation of the 800 MHz band.
  
8. At present, both 4<sup>th</sup> Generation (4G) and 5<sup>th</sup> Generation (5G) networks cater to most of the mobile traffic in the country. Accordingly, the premium per 1 MHz of spectrum in 800 MHz or 900 MHz band over 1 MHz of spectrum in 1800 MHz band has been estimated for an average TSP providing 4G and 5G network based mobile services in the country.
  
9. The number of 4G and 5G base stations in 1800 MHz band required by an average TSP in the next 20 years (from F.Y. 2026-27 to F.Y. 2045-46) has been estimated through the Production Function model (a model for valuation of spectrum in 1800 MHz band). For details of the Production Function model, please refer to Annexure 3.5 of these Recommendations. It has been assumed that the number of 4G and 5G base stations in 1800 MHz band deployed by an average TSP for each year in the next 20 years (from F.Y. 2026-27 to F.Y. 2045-46) to be the same as that derived in the Production Function Model.

**(i) Calculation of Additional Expenditure per MHz**

10. The additional expenditure (CAPEX and OPEX) per MHz associated with operations in the 1800 MHz band as compared to the 800 MHz/ 900 MHz for the next 20 years (beginning with the Financial Year 2026-27) has been calculated for each LSA separately based on the following assumptions:

- a. Since disaggregated information on the number of 4G and 5G base stations into urban and rural base stations (4G and 5G) is not available, the following urban-rural ratios, based on rural-urban wireless subscriber ratio<sup>67</sup> in each LSA, have been used to estimate the number of 4G and 5G base stations in Urban and Rural areas:

<b>Service Area</b>	<b>Share of Urban Subscribers/BTS</b>	<b>Share of Rural Subscribers/BTS</b>
Andhra Pradesh	51%	49%
Assam	35%	65%
Bihar	33%	67%
Delhi	96%	4%
Gujarat	62%	38%
Haryana	55%	45%
Himachal Pradesh	35%	65%
Jammu & Kashmir	50%	50%
Karnataka	62%	38%
Kerala	56%	44%
Kolkata	93%	7%

<sup>67</sup> Wireless Rural-Urban Subscriber base reported in TRAI's Indian Telecom Services-Yearly Performance Indicators Report for the FY 2024-25

Madhya Pradesh	53%	47%
Maharashtra	56%	44%
Mumbai	96%	4%
North-East	47%	53%
Odisha	34%	66%
Punjab	66%	34%
Rajasthan	45%	55%
Tamil Nadu	69%	31%
U.P.(E)	38%	63%
U.P.(W)	51%	49%
West Bengal	39%	61%

- b. It has been assumed that the number of 4G and 5G base stations would have to be increased by 10% in urban areas and by 75% in rural areas if operations are shifted from 900 MHz band to 1800 MHz band. The additional requirement of 4G and 5G base stations in urban areas would be comparatively lower than that in rural areas as there is a concentration of population in urban areas and 4G and 5G base stations have already been installed at comparatively close distances to cater to traffic loads.
- c. The Capital Cost (Gross Block) as on 31.03.2025 per 4G and 5G base station and Annual Operating Cost (OPEX) per 4G and 5G base station has been estimated based on the Accounting Separation Report (ASR) for the financial year (F.Y.) 2024-25.
- d. It has been assumed that the capital cost per 4G and 5G base station decreases by 5% on year-on-year (Y-o-Y) basis and annual operating cost

per 4G and 5G base station increases by 1% on Y-o-Y basis for the next 20 years.

- e. Depreciation has been calculated at 10% per annum, using the Straight-line method and prevalent weighted average cost of capital @15% have been applied to estimate annualized CAPEX of the additional 4G and 5G base stations. The useful life of 4G and 5G base station equipment has been assumed to be 10 years.
- f. For the calculation of Net Present Value (NPV), it is assumed that the total additional expenditure over 20 years will be discounted at 12.5%.

**(ii) Valuation per MHz of 800MHz/ 900 MHz band for a period of 20 years through the Economic Premium model**

- 11. The total additional expenditure, comprising both CAPEX and OPEX, has been estimated over a period of 20 years (from F.Y. 2026-27 to F.Y. 2045-46) based on the above-mentioned assumptions.
- 12. Thereafter, NPV of the total additional expenditure over a period of 20 years has been computed using a discount rate of 12.5%.
- 13. This additional expenditure per MHz may be termed as 'per MHz economic premium of 800MHz/ 900 MHz band over 1800 MHz band for a period of 20 years.

It is calculated by dividing NPV of total additional expenditure so obtained by the equivalent 4G and 5G spectrum holding of the average TSP in 1800 MHz band, as obtained in the Production Function Model.

14. After adding the per MHz economic premium of 900 MHz band over 1800 MHz band to the average valuation per MHz of 1800 MHz band, the valuation per MHz of 900 MHz band has been obtained as below:

**Valuation per MHz of 800MHz/ 900 MHz band for a period of 20 years through the Economic Premium model**

= (Average valuation per MHz of 1800 MHz band for a period of 20 years) **plus** (Per MHz economic premium of 800/ 900 MHz band over 1800 MHz band for a period of 20 years)

**Annexure 3.9**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES - 900 MHz BAND (20 YEARS)**

**(Rs. in crore)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>Economic Premium over 1800 MHz band plus average valuation of 1800 MHz band</b>	<b>2 times of average valuation of 1800 MHz band</b>	<b>1.5 times of average valuation of 1800 MHz band</b>	<b>Average (mean) Value</b>
Andhra Pradesh	331.26	275.33	361.70	271.28	309.89
Assam	72.46	72.79	81.41	61.06	71.93
Bihar	169.08	191.14	199.21	149.41	177.21
Delhi		383.46	714.90	536.17	544.84
Gujarat		215.74	308.95	231.72	252.14
Haryana		76.56	102.35	76.76	85.23
Himachal Pradesh		32.64	37.38	28.04	32.69
Jammu & Kashmir	20.70	40.85	47.75	35.81	36.28
Karnataka	234.65	203.32	290.29	217.72	236.49
Kerala		123.82	163.17	122.38	136.46
Kolkata	175.98	96.12	177.15	132.86	145.53
Madhya Pradesh		181.53	213.65	160.24	185.14
Maharashtra		300.18	403.76	302.82	335.59
Mumbai		247.14	474.18	355.64	358.99
North East	18.40	40.72	47.39	35.54	35.51
Odisha	73.61	93.59	97.04	72.78	84.25
Punjab	119.62	97.39	138.66	104.00	114.92
Rajasthan	155.28	160.27	192.46	144.35	163.09
Tamilnadu	255.35	238.37	332.47	249.36	268.89
U. P. (East)	213.94	371.50	340.92	255.69	295.51
U.P. (West)	174.83	302.66	266.80	200.10	236.10
West Bengal	113.87	158.73	169.37	127.03	142.25

**Annexure 3.10**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES – 800 MHz BAND (20 YEARS)**

(Rs. in crore)

LSA	Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 & sold in 2022)	Economic Premium over 1800 MHz band plus average valuation of 1800 MHz band	2 times of average valuation of 1800 MHz band	1.5 times of average valuation of 1800 MHz band	Average (mean) Value
Andhra Pradesh		275.33	361.70	271.28	302.77
Assam	56	72.79	81.41	61.06	67.81
Bihar		191.14	199.21	149.41	179.92
Delhi		383.46	714.90	536.17	544.84
Gujarat		215.74	308.95	231.72	252.14
Haryana		76.56	102.35	76.76	85.23
Himachal Pradesh		32.64	37.38	28.04	32.69
Jammu & Kashmir	16	40.85	47.75	35.81	35.10
Karnataka		203.32	290.29	217.72	237.11
Kerala		123.82	163.17	122.38	136.46
Kolkata		96.12	177.15	132.86	135.38
Madhya Pradesh		181.53	213.65	160.24	185.14
Maharashtra		300.18	403.76	302.82	335.59
Mumbai		247.14	474.18	355.64	358.99
North East	14.56	40.72	47.39	35.54	34.55
Orissa		93.59	97.04	72.78	87.80
Punjab		97.39	138.66	104.00	113.35
Rajasthan		160.27	192.46	144.35	165.69
Tamil Nadu		238.37	332.47	249.36	273.40
U. P. (East)		371.50	340.92	255.69	322.70
U.P. (West)	148.96	302.66	266.80	200.10	229.63
West Bengal		158.73	169.37	127.03	151.71

**Annexure 3.11**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES – 2100 MHz BAND (20 YEARS)**

**(Rs. in crore)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>0.83 times of average valuation of 1800 MHz band</b>	<b>Average (mean) Value</b>
Andhra Pradesh		150.11	150.11
Assam**	27.61	33.79	30.70
Bihar	76.16	82.67	79.42
Delhi	251.00	296.68	273.84
Gujarat	140.00	128.22	134.11
Haryana	38.08	42.48	40.28
Himachal Pradesh		15.51	15.51
Jammu & Kashmir**	9.20	19.81	14.51
Karnataka	112.00	120.47	116.24
Kerala	53.76	67.72	60.74
Kolkata		73.52	73.52
Madhya Pradesh		88.67	88.67
Maharashtra		167.56	167.56
Mumbai		196.79	196.79
North East**	5.75	19.67	12.71
Orissa		40.27	40.27
Punjab		57.54	57.54
Rajasthan		79.87	79.87
Tamil Nadu		137.98	137.98
U. P. (East)		141.48	141.48
U.P. (West)	82.82	110.72	96.77
West Bengal	41.44	70.29	55.86

**Annexure 3.12**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES – 2300 MHz BAND (20 YEARS)**

(Rs. in crore)

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>Trend Line Approach</b>	<b>Technical efficiency factor of 0.5 for 2300 MHz band (TDD) with respect to the spectrum in 1800 MHz band (FDD)</b>	<b>Average (mean) Value</b>
Andhra Pradesh		80.07	45.21	62.64
Assam		15.52	10.18	12.85
Bihar		19.68	24.90	22.29
Delhi		153.32	89.36	121.34
Gujarat		67.60	38.62	53.11
Haryana		21.08	12.79	16.94
Himachal Pradesh		14.65	4.67	9.66
Jammu & Kashmir		15.12	5.97	10.54
Karnataka		109.36	36.29	72.82
Kerala		30.47	20.40	25.43
Kolkata		46.02	22.14	34.08
Madhya Pradesh		21.45	26.71	24.08
Maharashtra		73.92	50.47	62.19
Mumbai		156.19	59.27	107.73
North East		14.66	5.92	10.29
Orissa		17.70	12.13	14.91
Punjab		32.89	17.33	25.11
Rajasthan		19.52	24.06	21.79
Tamil Nadu		142.46	41.56	92.01
U. P. (East)		22.15	42.62	32.38
U.P. (West)		24.68	33.35	29.02
West Bengal		18.49	21.17	19.83

**Annexure 3.13**

**VALUATION (PER MHz) USING DIFFERENT APPROACHES – 2500 MHz BAND (20 YEARS)**

**(Rs. in crore)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>Technical efficiency factor of 0.5 for 2500 MHz band (TDD) with respect to the spectrum in 1800 MHz band (FDD)</b>	<b>Technical Efficiency with respect to 2300 MHz band (Equal to average valuation of 2300 MHz band)</b>	<b>Average (mean) Value</b>
Andhra Pradesh	57.12	45.21	62.64	54.99
Assam		10.18	12.85	11.51
Bihar	17.25	24.90	22.29	21.48
Delhi		89.36	121.34	105.35
Gujarat		38.62	53.11	45.86
Haryana		12.79	16.94	14.87
Himachal Pradesh		4.67	9.66	7.17
Jammu & Kashmir		5.97	10.54	8.26
Karnataka		36.29	72.82	54.55
Kerala		20.40	25.43	22.92
Kolkata		22.14	34.08	28.11
Madhya Pradesh		26.71	24.08	25.39
Maharashtra		50.47	62.19	56.33
Mumbai		59.27	107.73	83.50
North East		5.92	10.29	8.11
Orissa		12.13	14.91	13.52
Punjab	15.68	17.33	25.11	19.38
Rajasthan		24.06	21.79	22.92
Tamil Nadu		41.56	92.01	66.78
U. P. (East)		42.62	32.38	37.50
U.P. (West)		33.35	29.02	31.18
West Bengal		21.17	19.83	20.50

**Annexure 3.14**

**VALUATION (PER MHz) OF 600 MHz BAND (20 YEARS)**

**(Rs. in crore)**

<b>LSA</b>	<b>2 times of average valuation of 1800 MHz band</b>	<b>Technical Efficiency Factor (Equal to average valuation of 800 MHz band)</b>	<b>Average (mean) Value</b>
Andhra Pradesh	361.70	302.77	332.24
Assam	81.41	67.81	74.61
Bihar	199.21	179.92	189.57
Delhi	714.90	544.84	629.87
Gujarat	308.95	252.14	280.55
Haryana	102.35	85.23	93.79
Himachal Pradesh	37.38	32.69	35.04
Jammu & Kashmir	47.75	35.10	41.42
Karnataka	290.29	237.11	263.70
Kerala	163.17	136.46	149.81
Kolkata	177.15	135.38	156.26
Madhya Pradesh	213.65	185.14	199.40
Maharashtra	403.76	335.59	369.68
Mumbai	474.18	358.99	416.58
North East	47.39	34.55	40.97
Orissa	97.04	87.80	92.42
Punjab	138.66	113.35	126.01
Rajasthan	192.46	165.69	179.08
Tamil Nadu	332.47	273.40	302.94
U. P. (East)	340.92	322.70	331.81
U.P. (West)	266.80	229.63	248.22
West Bengal	169.37	151.71	160.54

**Annexure 3.15**

**VALUATION PER MHz IN THE 3300MHz BAND (TDD) (20 years)**

**(Rs. in crore)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>Technical efficiency factor of 3300MHz band TDD w.r.t. 1800 MHz band FDD (30 % of average valuation of 1800 MHz FDD band)</b>	<b>Average (mean) Value</b>
Andhra Pradesh	29.12	27.13	28.12
Assam	5.6	6.11	5.85
Bihar	13.44	14.94	14.19
Delhi	44.8	53.62	49.21
Gujarat	25.76	23.17	24.47
Haryana	6.72	7.68	7.20
Himachal Pradesh	2.24	2.80	2.52
Jammu & Kashmir	1.12	3.58	2.35
Karnataka	20.16	21.77	20.97
Kerala	10.08	12.24	11.16
Kolkata	16.8	13.29	15.04
Madhya Pradesh	14.56	16.02	15.29
Maharashtra	32.48	30.28	31.38
Mumbai	39.2	35.56	37.38
North East	1.12	3.55	2.34
Orissa	5.6	7.28	6.44
Punjab	10.08	10.40	10.24
Rajasthan	12.32	14.43	13.38
Tamil Nadu	23.52	24.94	24.23
U. P. (East)	15.68	25.57	20.62
U.P. (West)	14.56	20.01	17.29
West Bengal	10.08	12.70	11.39

**Annexure 3.16**

**VALUATION PER MHz IN THE 24.25 GHz – 28.5 GHz Band (TDD) (20 years)**

**(in Rs. lakhs)**

<b>LSA</b>	<b>Duly indexed 2024 ADP (sold in 2024) or non-indexed 2024 RP (unsold in 2024 &amp; sold in 2022)</b>	<b>2.10% of the average valuation of 3300 - 3670 MHz band</b>	<b>Average (mean) Value</b>
Andhra Pradesh	64	59.06	61.53
Assam	11	12.29	11.65
Bihar	30	29.80	29.90
Delhi	100	103.34	101.67
Gujarat	56	51.38	53.69
Haryana	15	15.12	15.06
Himachal Pradesh	6	5.30	5.65
Jammu & Kashmir	3	4.94	3.97
Karnataka	45	44.03	44.51
Kerala	21.28	23.43	22.36
Kolkata	36	31.59	33.80
Madhya Pradesh	32	32.11	32.06
Maharashtra	71	65.90	68.45
Mumbai	87	78.50	82.75
North East	3	4.91	3.95
Orissa	13	13.52	13.26
Punjab	22	21.50	21.75
Rajasthan	28	28.09	28.05
Tamil Nadu	52	50.88	51.44
U. P. (East)	34	43.31	38.66
U.P. (West)	32	36.30	34.15
West Bengal	21	23.92	22.46

## List of Acronyms

2G	Second Generation
3GPP	3rd Generation Partnership Project
4G	Fourth Generation
5G	Fifth Generation
5G-NR	5G-New Radio
6G	Sixth Generation
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
AWG	Asia Pacific Telecommunity Wireless Group
B2B	Business-to-Business
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
CAPEX	Capital Expenditure
CCA	Combinatorial Clock Auctions
CDMA	Code Division Multiple Access
CNPN	Captive Non-Public Networks
CPE	Customer-premises Equipment
CST	Communications, Space and Technology Commission
CTN	Cloud Hosted Telecom Network
CTNaaS	Cloud-Hosted Telecommunication Network-as-a-Service
DCIP	Digital Connectivity Infrastructure Provider
DEA	Department of Economic Affairs
DHQ	District Headquarters
DoS	Department of Space
DoT	Department of Telecommunications
EMD	Earnest Money Deposit
EB	Exabyte
EC	European Commission
ECC	Electronic Communications Committee
EIRP	Effective Isotropic Radiated Power
ETCS	European Train Control System
EU	European Union

FCC	Federal Communications Commission
FDD	Frequency Division Duplexing
FDI	Foreign Direct Investment
FR	Frequency Range
FS	Fixed Service
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GAGAN	GPS Aided GEO Augmented Navigation
GEO	Geostationary Earth Orbit
GHz	Giga Hertz
GPS	Global Positioning System
GSA	Global Mobile Suppliers Association
GSM	Global System for Mobile
GSMA	Global System for Mobile Communications Association
HPB	Hierarchical Package Bidding
Hz	Hertz
IAB	Integrated Access Backhaul
IBC	Insolvency and Bankruptcy Code
IBS	In-Building Solution
IMC	Indian Mobile Congress
IMT	International Mobile Telecommunications
IoT	Internet of Things
IR	Indian Railways
ISP	Internet Service Provider
ITU	International Telecommunication Union
ITU-R	ITU - Radiocommunication
ITU-RR	ITU Radio Regulations
J&K	Jammu and Kashmir
KHz	Kilo Hertz
LIPD	Low Interference Potential Devices
LSA	Licensed Service Area
LTE	Long Term Evolution
M2M	Machine to Machine
MCPTT	Mission-Critical Push-To-Talk
MFCNSDL	Mobile/ Fixed Communications Networks Supplemental Downlink
MHz	Mega Hertz
MIMO	Multiple-Input Multiple-Output
mmWave	Millimeter Wave
MNO	Mobile Network Operator
MSME	Micro, Small, and Medium Enterprises
MSS	Mobile Satellite Service
MTNL	Mahanagar Telephone Nigam Limited
mW	Milliwatt
NavIc	Navigation with Indian Constellation
NCLT	National Company Law Tribunal

NCRTC	National Capital Region Transport Corporation
NDCP	National Digital Communication Policy
NE	North-East
NFAP	National Frequency Allocation Plan
NHAI	National Highways Authority of India
NIA	Notice Inviting Application
NPV	Net Present Value
NR	New Radio
NSA	Non-Standalone
NTN	Non-Terrestrial Networks
ODM	Original Device Manufacturers
OEM	Original Equipment Manufacturer
OFC	Optical Fiber Cable
OFCA	Office of the Communications Authority
Ofcom	Office of Communications
OHD	Open House Discussion
OPEX	Operating expense
PSU	Public Sector Undertaking
QoS	Quality of Service
QoE	Quality of Experience
RAN	Radio Access Network
RF	Radio Frequency
RFIC	Radio Frequency Integrated Circuit
RLAN	Radio Local Area Networks
RSM	Radio Spectrum Management
RSPG	Radio Spectrum Policy Group
SA	Standalone
SAA	Simultaneous Ascending Auction
SDCA	Short Distance Charging Area
SDL	Supplementary Downlink
SKU	Stock Keeping Unit
SMRA	Simultaneous Multiple-Round Auction
STC	Saudi Telecommunication Company
SUL	Supplementary Uplink
TDD	Time Division Duplex
TDRA	Telecommunications and Digital Government Regulatory Authority
TRAI	Telecom Regulatory Authority of India
TSP	Telecom Service Provider
TTC	Telecommunication Technology Committee
TT&C	Telemetry Tracking And Command
UAE	United Arab Emirates
UASL	Unified Access Service License
UHF	Ultra High Frequency
UK	United Kingdom
UL	Unified License

USA	United States of America
USOF	Universal Service Obligation Fund
UT	User Terminal
VNO	Virtual Network Operator
WAN	Wide Area Network
WAS	Wireless Access Systems
WAWBB	Wide Area Wireless Broadband
WiFi	Wireless Fidelity
WPC	Wireless Planning & Coordination
WRC	World Radiocommunication Conference
ZTE	Zhongxing Telecommunication Equipment