भारतीय दूरसंचार विनियामक प्राधिकरण

Telecom Regulatory Authority of India

Recommendations on the Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT

New Delhi, India

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CONTENTS

Chapter I: Introduction

A. DoT's Reference Dated 02.08.2023

1.1 The Department of Telecommunications (DoT), Ministry of Communications, Government of India, through the letter No. L-14006/01/2023-IMT dated 02.08.2023 (**Annexure-1.1**) (hereinafter, also referred to as "Reference dated 02.08.2023") sent a reference under the terms of clause 11(1)(a) of TRAI Act, 1997 (as amended) and requested the Telecom Regulatory Authority of India (hereinafter, also referred to as "TRAI", or "the Authority") to provide recommendations for the auction of spectrum in the frequency bands identified for International Mobile Telecommunications (IMT). The afore-mentioned Reference dated 02.08.2023 is reproduced below:

"In response to DoT's reference dated 13.09.2021, TRAI had provided its recommendations dated 11.04.2022 on various issues involved in the auction of spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. Based on the TRAI recommendations dated 11.04.2022 and its subsequent response dated 09.05.2022 on DoT's back-reference, Government conducted auction of spectrum in the above frequency bands during July-August, 2022.

(i) A total of 72097.85 MHz spectrum in different band-LSA combinations worth Rs. 4,31,605 crores (at Reserve Price) were made available for bidding. A quantum of 51236.2 MHz worth Rs. 150173.3 crores were sold in the auction. However, no bids were received in the 600 MHz and 2300 MHz bands during the auction. As per the TRAI recommendations, a comprehensive report (Annexure-I) analysing the outcomes of the above auction was also communicated on 14.12.2022 to the TRAI.

2. Further, the following developments took place after the completion of the spectrum auctions held during July-August 2022:

(i) Indian Railways surrendered 1.6 MHz of paired spectrum in the 900 MHz band in the Jammu & Kashmir LSA, which can be included in the next auction.

(ii) Based on the recommendations of TRAI on Spectrum Requirements of National Capital Region Transport Corporation (NCRTC) for Train Control System for RRTS Corridors dated 28.12.2022, 5 MHz of paired spectrum has been assigned to NCRTC on provisional basis in the 700 MHz band. The same will be regularised after the final decision is taken on the above TRAI Recommendations.

(iii) Recently, as per the decision taken by the Union Cabinet in its meeting held on 07.06.2023, the Department has reserved for BSNL's 5G purpose, 10 MHz (paired) spectrum in the 700 MHz band in all 22 LSAs in lieu of the 10 MHz (paired) spectrum previously reserved in the 600 MHz band, additional 30 MHz spectrum to the already reserved 40 MHz in the 3300 MHz band in all 22 LSAs, additional 400 MHz to the already reserved 400 MHz in the 26 GHz band in all but Kerala LSA. In Kerala LSA, 250 MHz in addition to already reserved 400 MHz in 26 GHz band is being kept reserved for 5G services of BSNL.

(iv) Further, the Cabinet in its above meeting, has also decided to allot additional 20 MHz of spectrum in the Andhra Pradesh, Karnataka, Kolkata, Tamil Nadu, Delhi and Mumbai LSAs and 10 MHz of spectrum in Gujarat and Maharashtra LSAs to BSNL in the 2500 MHz band for the roll out of 4G services, in addition to already reserved spectrum in various bands for them for 4G services through the Cabinet decision of 2019.

These additional spectrum provisions for BSNL need to be kept out of the next auction.

2.1 In addition to above, Department of Telecommunications (DoT) has decided to make available the following new frequency bands as detailed below for IMT, which can be made available for bidding in the next auction.

Sl. No	*Applications/ Services*	*Frequency bands*
1.	*IMT*	*37 - 37.5 GHz*
2.	*IMT (to share with Satellite Gateway Earth Stations with suitable protection)*	*37.5 - 40 GHz, 42.5 - 43.5 GHz*

2.2 The LSA-wise quantum available with the Government in the existing bands after the auction, taking into consideration the facts mentioned in the paras 2 (i) to (iv) and 2.1 above is given in Annexure-II.

2.3 Moreover, part of the administratively assigned spectrum to various TSPs, including that of BSNL, will be expiring during the year 2024; the same may also be included in the next auction. The LSA-wise details of such spectrum (2024 expiring) is placed at Annexure-III.

2.4 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.

3. Considering the above, the competent authority has decided that the spectrum mentioned at Para 2.2 and 2.3 above (Annexure-II and Annexure-III respectively) may be made available for bidding in the next auction for IMT. 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.

4. 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 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.

(b) 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."

B. TRAI's Response Dated 01.09.2023 to the DoT's Reference Dated 02.08.2023

1.2 Earlier, the Authority in its recommendations on 'Auction of Spectrum in frequency bands identified for IMT/5G' dated 11.04.2022[1] (hereinafter, also referred to as "Recommendations dated 11.04.2022"), had recommended, *inter-alia*, as below:

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

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

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

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

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

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

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

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

1.3 Subsequently, DoT, through a Back Reference dated 29.04.2022, mentioned, *inter-alia*, as below:

"DoT is of the view that given the fast-changing techno-commercial ecosystem, spectrum valuation at shorter intervals may be desirable. For instance, in LSAs/ bands where spectrum remains unsold, there could be a case for reduction in reserve prices. Alternatively, there could be a spectrum band which may become more valuable due to a technological breakthrough. Hence, it is proposed that recommendations of TRAI on spectrum pricing would be sought before conduct of every auction."

1.4 With respect to the DoT's Back Reference dated 29.04.2022, TRAI provided its response to DoT on 09.05.2022 and mentioned, *inter-alia*, as below:

"DoT, in its letter dated 23.09.2021, inter alia, conveyed the Government's decision regarding the regular conduct of spectrum auction on annual basis, normally in the last quarter of every financial year and at shorter intervals whenever necessary. The Authority has, in this context, factored in this Government decision while making the recommendation at paragraph 6.42. The detailed rationale for this recommendation is given at paragraph 3.39 of the Authority's Recommendations dated 11.04.2022. As stated therein, the Authority undertakes spectrum valuation exercises using various models/ approaches that use different datasets of technical, market and economic data, updated periodically. These parameters do not change much in a short time span. At the same time, the Authority had noted that there is a need to evaluate

the techno-economic context at regular intervals to reckon for changes. The Authority had also noted in this context that annual valuation exercises may not be necessary.

As such, the Authority does not agree with DoT's proposal to seek the Authority's recommendations before conduct of every (annual/ shorter interval) auction, as this would not be necessary unless DoT comes to a conclusion that the changes in the techno-commercial ecosystem and other factors warrants a fresh valuation. The Authority reiterates its recommendation given at paragraph 6.42 of the Recommendations dated 11.04.2022. As recommended at sub-paragraph (IV) thereof, in case DoT would like to seek the Authority's recommendations for existing spectrum bands in the interim period between periodic valuation exercises conducted once every three years, it may do so with a full and reasoned justification for the same. For new spectrum bands to be put to auction for the first time, the recommendation at subparagraph (III) of paragraph 6.42 would be applicable."

1.5 In view of the above, and in the absence of full and reasoned justification by DoT for seeking fresh reserve prices from the Authority for the existing bands, TRAI, through its response letter dated 01.09.2023 (**Annexure 1.2**) (hereinafter, also referred to as "Response dated 01.09.2023") to DoT, informed *inter-alia*, as below:

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

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

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

1.6 Keeping in view the DoT's Reference dated 02.08.2023, and the TRAI's Response dated 01.09.2023, the Authority decided to initiate a consultation process for providing recommendations for the new referred bands viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands.

1.7 Considering that the frequency range 40-42.5 GHz is not a part of the frequency ranges identified for IMT by DoT, TRAI through its letter dated 20.02.2024 requested DoT to inform as to whether the frequency range 40-42.5 GHz has been identified for some other application(s) in India. In response, DoT, through its letter dated 13.03.2024, informed that the Government has decided the following apportionment/ sharing of the spectrum in the frequency range from 37-43.5 GHz between IMT and space based services:

Sl. No.	**Application/ Service**	**Frequency Bands**
1.	IMT	37-37.5 GHz
2.	IMT and Satellite Gateway links	37.5-40 GHz
3.	Satellite User/ Gateway links	40-42.5 GHz*
4.	IMT and Satellite Gateway links	42.5-43.5 GHz

** The frequency band 40.0-42.5 GHz (Space to Earth) is predominantly for satellite user links. However, this frequency band may also be used for Satellite Gateway links without causing any harmful interference to the satellite user links operating in these bands.*

1.8 Based on the TRAI's response dated 01.09.2023, the Government conducted 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 in June 2024[2]. A total quantum of 141.4 MHz spectrum across 22 LSAs of worth Rs 11,340 Crores was sold. Frequency band-wise details of the spectrum put to auction across 22 LSAs and spectrum sold in the spectrum auction held in June 2024 are given in the table below:

Frequency band	**Quantum of spectrum put to auction across 22 LSAs (MHz)[3]**	**Spectrum sold (in MHz)**
800 MHz (paired)	118.75	-
900 MHz (paired)	117.2	60.8
1800 MHz (paired)	221.4	50.6
2100 MHz (paired)	125	20
2300 MHz (unpaired)	60	-
2500 MHz (unpaired)	70	10
3.5 GHz (unpaired)	1110	-
26 GHz (unpaired)	8700	-
Total	**10,522.35**	**141.4**

C. TRAI's Consultation Paper Dated 04.04.2024

1.9 In respect of the DoT's Reference dated 02.08.2023, and in view of the TRAI's response dated 01.09.2023, the Authority issued a consultation paper on 'Auction of Frequency Spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT' on 04.04.2024[4] (hereinafter, also referred to as,

[2] https://pib.gov.in/PressReleasePage.aspx?PRID=2028885
[3] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2028407
[4] https://www.trai.gov.in/sites/default/files/CP_04042024.pdf

"the Consultation Paper dated 04.04.2024") to solicit views of the stakeholders on the subject. Written comments were invited from stakeholders by 02.05.2024 and counter-comments by 16.05.2024. At the request of stakeholders, the last date for furnishing comments and counter-comments was extended on two occasions. On the first occasion it was extended by two weeks, and on the second occasion it was extended by one week. After these extensions, the last dates for furnishing comments and counter-comments were 24.05.2024 and 06.06.2024, respectively.

1.10 In response to the issues raised in the Consultation Paper dated 04.04.2024, comments were received from 12 stakeholders and counter comments from 4 stakeholders. The comments and counter-comments have been placed on the TRAI's website. An Open House Discussion (OHD) with stakeholders through online mode was held on 10.07.2024.

D. The Present Recommendations

1.11 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. These recommendations comprise of three chapters. Chapter I provides an introduction and background to the subject. Chapter II presents an examination of the auction-related issues. Chapter III presents an examination of the issues relating to valuation and payment terms. Chapter IV provides a summary of the recommendations of the Authority on the subject.

Chapter II: Examination of Auction Related Issues

A. Background

2.1 Through the Consultation Paper dated 04.04.2024, the Authority solicited the views of stakeholders on the following broad issues related to auction of frequency spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands Identified for IMT:

(a) Quantum of spectrum to be put to auction and band plan
(b) Validity period and the license service area
(c) Block size for the assignment of spectrum
(d) Spectrum cap for the assignment of spectrum
(e) Rollout obligations for the assigned spectrum
(f) Eligibility conditions and associated conditions for participation in the auction
(g) Interference mitigation in TDD bands
(h) Coexistence of IMT and Satellite Earth Station Gateways
(i) Valuation of spectrum
(j) Payment terms

B. Quantum of Spectrum and Band Plan

2.2 Through the Reference dated 02.08.2023, DoT conveyed that it *"has decided to make available the following new frequency bands as detailed below for IMT, which can be made available for bidding in the next auction:*

Sl. No.	*Applications/ Services*	*Frequency bands*
1.	*IMT*	*37 - 37.5 GHz*
2.	*IMT (to share with Satellite Gateway Earth Stations with suitable protection)*	*37.5 - 40 GHz, 42.5 - 43.5 GHz"*

2.3 In total, 4,000 MHz of frequency spectrum will be available in each licensed service area (LSA) in the afore-mentioned frequency ranges as tabulated below:

Table 2.1: Quantum of spectrum available

Sl. No.	Frequency range	Quantum of spectrum available in each LSA (in MHz)
1.	37.0-37.5 GHz	500
2.	37.5-40.0 GHz	2,500
3.	42.5-43.5 GHz	1,000

2.4 As per the band plans identified by 3GPP[5], there is no single band plan which covers all the frequency ranges viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz. However, there are two band plans, i.e., n259 (39.5-43.5 GHz) and n260 (37-40 GHz) in the frequency ranges referred by the DoT. Both the band plans defined by 3GPP viz. n259 and n260 for these frequency ranges are based on Time Division Duplexing (TDD) configuration. The frequency range 39.5-40 GHz is covered under both the band plans.

2.5 As far as the availability of device ecosystem for the referred frequency ranges is concerned, it is noted that the device ecosystem is available in the n260 band (37-40 GHz); however, it is not readily available in the n259 band (39.5-43.5 GHz). Ofcom, UK mentioned in its consultation paper[6] on 'Enabling mmWave spectrum for new uses' dated 09.05.2022 that the availability of mobile technology equipment and devices in the adjacent 39 GHz band[7], which has similar technical properties to the 40 GHz[8] band, may facilitate the development of 40 GHz equipment for new uses.

2.6 From the study of international scenario regarding the adoption of the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-

[5] 3GPP TS 38.101-2 V17.11.0 (2023-09)
Source: https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3284
[6] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/237258/mmwave-spectrum-condoc.pdf
[7] As per FCC, USA, 39 GHz band is from 38.6-40 GHz frequency range
[8] As per Ofcom, UK, 40 GHz band is from 40.5-43.5 GHz frequency range

43.5 GHz, it was observed that in some of these frequency ranges, only Federal Communication Commission (FCC), USA auctioned spectrum; Innovation, Science and Economic Development (ISED), Canada has released a consultation paper, and Ofcom, UK has issued a statement after due consultation process.

2.7 As per the GSA report[9] on 'mmWave Bands: Global Licensing and Usage for 5G' of November 2020, *"Band n260, covering 37–40 GHz, is also used, with 32 companies in six countries/territories investing in licences for, or networks using this spectrum. Of those, 31 hold licences. (The majority of those are based in the USA and its territories.) Three operators in the USA have launched 5G using Band n260"*.

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

Q1. Whether the entire available spectrum in each of the frequency ranges (a) 37-37.5 GHz, (b) 37.5-40 GHz, and (c) 42.5-43.5 GHz, should be put to auction for IMT? If no, please specify the quantum of spectrum in each frequency range to be put to auction. Kindly justify your response.

Q2. In case you are of the opinion that any of the frequency ranges viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz should be put to auction at a later date, what should be the timelines for auctioning of such frequency bands for IMT? Kindly justify your response.

Q3. Do you agree that TDD-based duplexing configuration should be adopted in the country for the frequency ranges under consideration viz. (a) 37 - 37.5 GHz, (b) 37.5 - 40 GHz, and (c) 42.5 - 43.5 GHz, for IMT? If yes, considering that there is an overlap of frequencies in the band plans n260

[9] https://gsacom.com/paper/mmwave-bands-global-licensing-and-usage-for-5g-2/

(37-40 GHz) and n259 (39.5-43.5 GHz), how should the band plan(s) along with its frequency range be adopted? Kindly justify your response.

Comments of stakeholders on Q1 and Q2

2.9 In response to Q1 and Q2, many stakeholders were of the view that the entire available frequency spectrum in each of the frequency ranges 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz should be put to auction for IMT. On the other hand, many other stakeholders were in favour of putting the frequency spectrum bands in auction at a later date.

2.10 A broad summary of the comments of stakeholders, who are in favour of putting entire available frequency spectrum in each of the frequency ranges in forthcoming auction for IMT, is given below:

(a) The availability of these new frequency ranges, in addition to the 26 GHz band, will enable the further expansion of 5G/ FWA services in the country and will also be instrumental in the deployment of enterprise use cases.

(b) These bands have already been identified as the IMT bands, and hence their increased usability for telecom service providers (TSPs) will only help accelerate the ecosystem development.

(c) A few of these stakeholders also submitted that availability of clean spectrum is crucial before auctioning. Hence, adequate information and necessary data regarding present/ planned locations of SRS/ satellite hub stations should be made available to TSPs, and a co-existence study between IMT and satellite operations should be carried out prior to auctions.

(d) One of the stakeholders submitted that there are 7-8 Radio Astronomy centers and proper radio isolation should be kept to ensure that interference effects between the systems is kept minimal.

2.11 A broad summary of the comments of stakeholders, who were not in favour of putting entire available frequency spectrum in each of the frequency ranges in forthcoming auction for IMT, is given below:

(a) There is a huge challenge of device ecosystem for 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz. Device ecosystem is in nascent stage in (37-40 GHz) and is largely limited to US territories. In the 39.5-43.5 GHz, the device ecosystem is not readily available, both globally, as well as in India.

(b) Without adequate device ecosystem there is no point in putting the entire range of spectrum for auctions as it will avail no benefit to the industry as such.

(c) The auction of spectrum for these bands should be deferred by a few years (2-3 years), so that the device ecosystem develops in more global markets, providing more certainty of the device ecosystem in India, which can enable TSPs to project a viable business plan. One of the stakeholders also submitted that in case the Authority decides to put the proposed spectrum for auctions, then only range 37-40 GHz with adequate protection for satellite services should be considered in the next round. The spectrum range 42.5-43.5 GHz may be considered later after a gap of 3-4 years.

2.12 In addition, a couple of stakeholders suggested that from the frequency ranges under consideration, at least 250 MHz spectrum (FDD, paired) in the 37.5-40.0 GHz and 42.5-43.5 GHz bands should be kept reserved specifically for microwave point-to-point applications such as a backhaul spectrum and its allocation should be done administratively on point-to-point basis. All licensed operators should be eligible to obtain, including access service providers.

Comments of stakeholders on Q3

2.13 In response to the Q3, all stakeholders were unanimously in favour of adoption of TDD-based duplexing scheme for 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz frequency ranges.

2.14 A broad summary of the comments of stakeholders, in favour of TDD-based duplexing for 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz frequency ranges, is given below:

(a) The TDD-based configuration has been globally adopted for mmWave band spectrum. Since the device ecosystem is developed at a global level, it is appropriate to follow international standards in this regard.

(b) TDD can be more spectrum-efficient in certain deployment scenarios, particularly where traffic demands are less predictable. It offers the advantage of dynamically adjusting the ratio of uplink and downlink capacity based on traffic patterns, useful in scenarios where usage may be asymmetric. TDD may reduce infrastructure costs as a single frequency band can be used for both uplink and downlink.

2.15 There is an overlap of frequencies in the band plans n260 (37-40 GHz) and n259 (39.5-43.5 GHz). The comments of stakeholders about the adoption of band plans in the frequency ranges from 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz frequency range, may be summarized as below:

(a) Most of the stakeholders were of the view that the operators should be permitted to choose any band plan as per 3GPP, depending on the availability of the device ecosystem. However, a few stakeholders submitted that n260 band may be used for 37-40 GHz and n259 for 42.5-43.5 GHz frequency range.

(b) One of the stakeholders mentioned that each independent block of spectrum should be constrained completely within either band n259 or band n260 respectively.

Analysis of the issues raised through the Q1 to Q3

2.16 In response to the Consultation Paper dated 04.04.2024, many stakeholders were of the view that entire available frequency spectrum in each of the frequency ranges viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz be put to auction in the forthcoming auction; however, many other stakeholders were of

the view that due to lack of ecosystem, these frequency ranges should be put to auction after a period of 2-3 years.

2.17 In addition, a couple of stakeholders suggested that from the frequency ranges under consideration, at least 250 MHz spectrum (FDD, paired) in the 37.5-40.0 GHz and 42.5-43.5 GHz bands should be kept reserved specifically for microwave point-to-point applications such as a backhaul spectrum and its allocation should be done administratively on point-to-point basis. In this regard, it is noted that the Government has already identified these frequency ranges for IMT. Further, other frequency bands are already available for backhaul purpose.

2.18 It is noteworthy that mmWave spectrum (26 GHz band) was put up for auction in India for the first time in the auction of frequency spectrum held in July-August 2022. In the auction, out of the total 3250 MHz spectrum available in each of the 22 LSAs, 400 MHz was reserved for a public sector undertaking (PSU) operator in each of the 22 LSAs and the remaining spectrum was put to auction. Out of the overall 62,700 MHz (2,850 MHz in 22 LSAs) of spectrum put to auction, 45,350 MHz was sold and 17,350 MHz spectrum across 22 LSAs remained unsold in mmWave (26 GHz) band.

2.19 Subsequently, additional 400 MHz in each LSA except Kerala, and 250 MHz in Kerala LSA was reserved for the PSU operator. Rest of the unsold spectrum i.e. 8700 MHz of spectrum across 22 LSAs[10] was put to auction in the spectrum auction held in 2024; however, no bid was received. The table given below shows the LSA-wise spectrum availability in 26 GHz band:

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

Table 2.2: LSA-wise spectrum availability in 26 GHz band

LSA	**Total spectrum (in MHz)**	**Reserved for PSU operator (in MHz)**	**Spectrum sold in Auction (in MHz)**	**Spectrum availability (in MHz)**
Andhra Pradesh	3,250	800	2,050	400
Assam	3,250	800	1,800	650
Bihar	3,250	800	1,800	650
Delhi	3,250	800	2,000	450
Gujarat	3,250	800	2,350	100
Haryana	3,250	800	2,200	250
Himachal Pradesh	3,250	800	1,800	650
Jammu & Kashmir	3,250	800	1,800	650
Karnataka	3,250	800	2,050	400
Kerala	3,250	650	2,600	-
Kolkata	3,250	800	2,000	450
Madhya Pradesh	3,250	800	2,200	250
Maharashtra	3,250	800	2,200	250
Mumbai	3,250	800	2,100	350
North East	3,250	800	1,800	650
Odisha	3,250	800	1,800	650
Punjab	3,250	800	2,100	350
Rajasthan	3,250	800	2,150	300
Tamil Nadu	3,250	800	2,150	300
Uttar Pradesh (E)	3,250	800	2,050	400
Uttar Pradesh (W)	3,250	800	2,150	300
West Bengal	3,250	800	2,200	250
Total	**71,500**	**17,450**	**45,350**	**8,700**

2.20 As can be seen from the above table, while overall 8,700 MHz spectrum across 22 LSAs is available in mmWave (26 GHz) band; LSA-wise spectrum availability is not much and in one of the LSAs (Kerala LSA), no spectrum is available in 26 GHz for auction. Thus, to meet any future demand, there is a need for making available additional spectrum in other mmWave bands as referred by DoT through the instance reference dated 02.08.2023.

2.21 Based on the information available on the frequency check website[11], 263 devices of 11 brands supported the n260 band as of January 2025. Further, the charts depicting the number of operators investing in key 5G spectrum bands (end of October 2024) and the number of devices announced/ available at the end of October 2024, as published in the GSA report on 5G Market Snapshot (November 2024)[12], are given below:

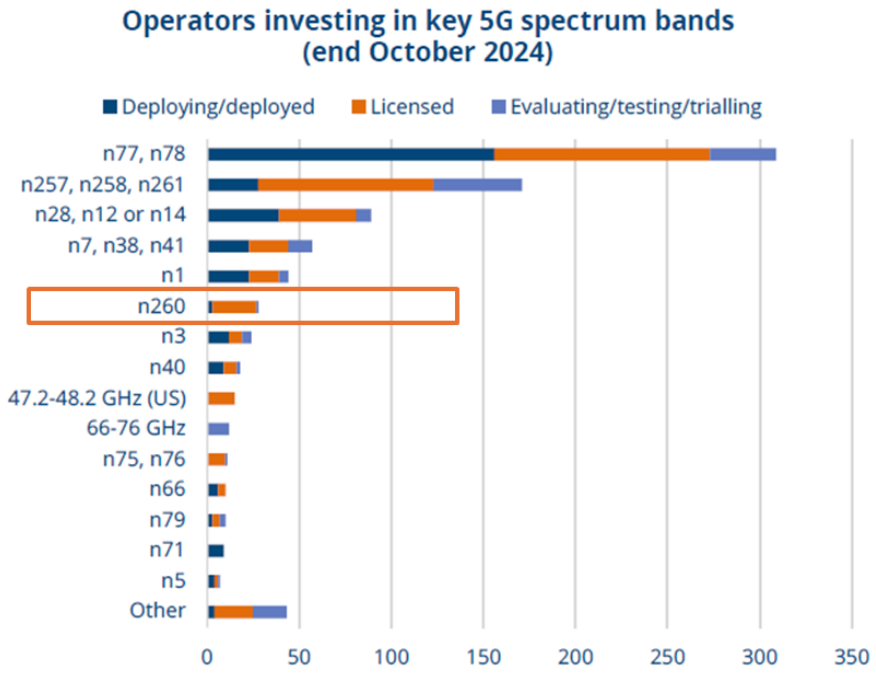

Figure 2.1: Operators investing in key 5G spectrum bands (end of October-2024), Source: GSA[13]

[11] FrequencyCheck - Mobile Network Compatibility Search for Unlocked Phones and Devices
[12] 5G Market Snapshot March 2024 released by GSA
[13] GSA Report on 5G Market Snapshot, November 2024 (https://gsacom.com/paper/5g-market-snapshot-november-2024-2/)

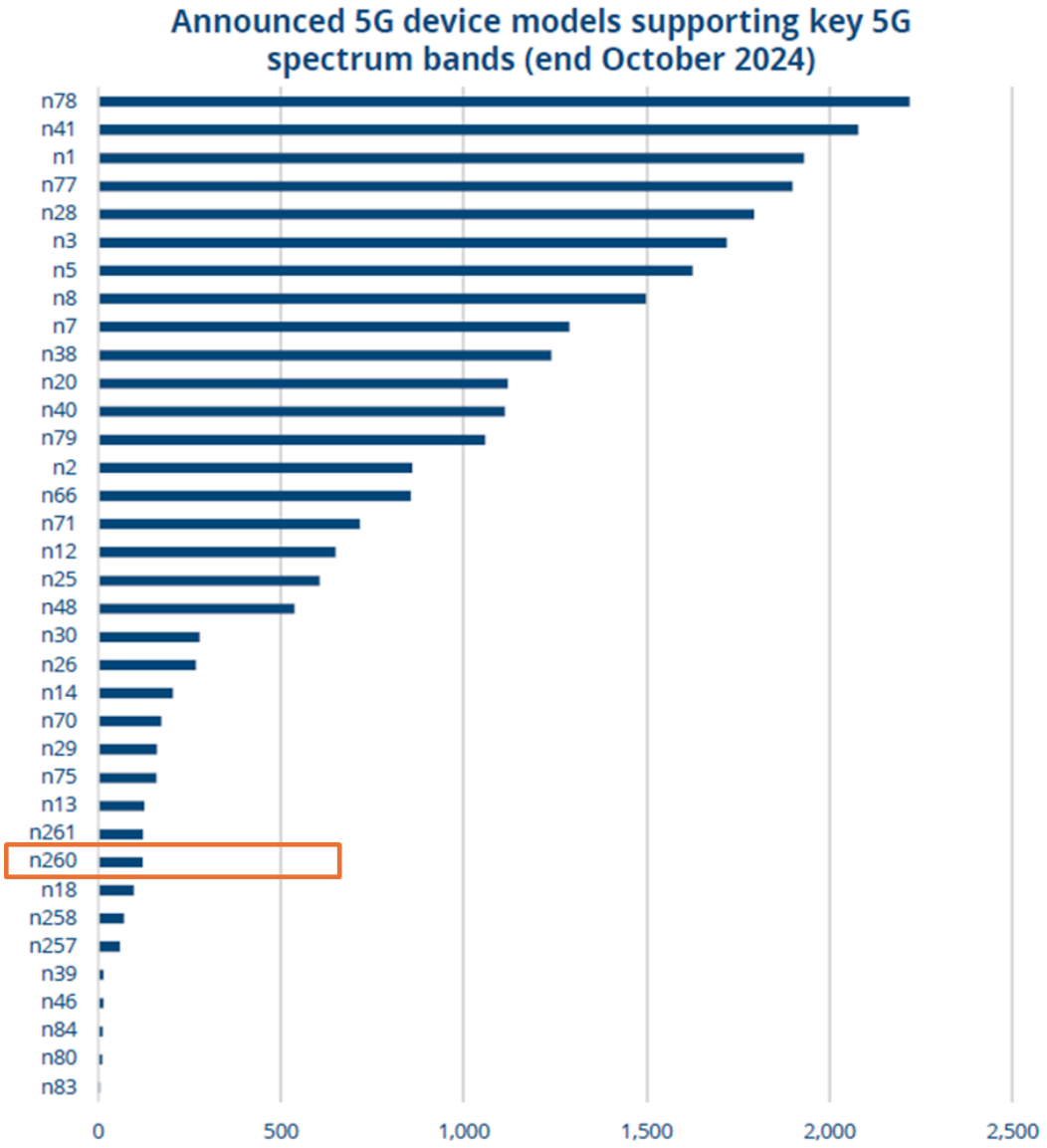

Figure 2.2: Announced 5G device models supporting key 5G spectrum bands (end of October-2024), Source: GSA[23]

2.22 As can be seen from the above figure, device ecosystem is available in frequency band n260; however, for frequency band n259, the device ecosystem is yet to be developed. It is also noted that the device ecosystem in the n260 (37-40 GHz) band is better than that is available in the n258 (26 GHz) band. Therefore, the Authority is of the view that the frequency spectrum range 37-37.5 GHz and 37.5-40 GHz should be put to auction in the forthcoming spectrum auction.

2.23 As regards 42.5-43.5 GHz, it is noted that lately, fully integrated, extended range mmWave antenna modules designed for 5G fixed wireless access customer premise equipment (CPE) are being launched by original equipment manufacturers (OEMs), which also includes 37-40 GHz[14] and 39.5-43.5 GHz[15] frequency range. It is also noted that Ofcom, UK is enabling mmWave spectrum (26 GHz and 40 GHz bands) for new services, including 5G[16]. Ofcom has stated that they plan to auction licences to use spectrum in the 25.1-27.5 GHz and 40.5-43.5 GHz bands in certain parts of the country in 2025[17]. With such developments, the device ecosystem in n259 band, which includes 42.5-43.5 GHz frequency range may begin to develop. However, it cannot be predicted with certainty about the time, by when the device ecosystem will be sufficiently available for the TSPs to derive economic value from the frequency spectrum in 42.5-43.5 GHz. Further, putting this frequency range in the forthcoming auction along with band n260 with a combined spectrum cap, will increase the denominator and thereby the spectrum that can be acquired by a single bidder. This may create a situation where some of the bidders may monopolize the band n260, where device ecosystem is readily available.

2.24 In view of the foregoing discussion, the Authority is of the view that owing to non-availability of the device ecosystem in 42.5-43.5 GHz frequency range, it will be prudent that the frequency range 42.5-43.5 GHz is not put to auction in the forthcoming spectrum auction. DoT may send a separate reference for seeking the Authority's recommendations for 42.5-43.5 GHz frequency range for IMT at an appropriate time.

2.25 It is noted that the higher frequency bands are generally used for enhancing capacity and lowering latency. TDD based configuration gives the flexibility to decide the ratio between uplink and downlink based on the use case, the

[14] https://www.qualcomm.com/products/technology/modems/rf/qtm527
[15] https://www.qualcomm.com/products/technology/modems/rf/qtm545
[16] Source: https://www.ofcom.org.uk/spectrum/frequencies/mmwave-spectrum-for-new-uses/
[17] https://www.telecomrevieweurope.com/articles/telecom-operators/ofcom-to-auction-mmwave-spectrum-in-2025/

spectrum is being deployed. Further, 3GPP has defined this band only for TDD configuration-based band plans in mmWave spectrum bands. The stakeholders are also of the unanimous view that TDD-based configuration should be adopted for the frequency ranges referred to by DoT, viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz. Therefore, the Authority is of the view that TDD based configuration should be adopted for the frequency ranges 37-37.5 GHz and 37.5-40 GHz.

2.26 As mentioned above, the Authority is of the view that only 37-40 GHz frequency range should be put to auction in the forthcoming auction. Further, the device ecosystem is readily available in 37-40 GHz, for which, 3GPP identified band plan n260 is available. Therefore, the Authority is of the view that for 37-40 GHz frequency range, band plan n260 band should be adopted.

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

(a) The frequency spectrum in 37-37.5 GHz and 37.5-40 GHz frequency ranges should be put to auction in the forthcoming spectrum auction.

(b) Band pan n260 with TDD-based duplexing configuration should be adopted for 37-40 GHz frequency range.

(c) Owing to the non-availability of the device ecosystem in 42.5-43.5 GHz frequency range, it will be prudent that the frequency range 42.5-43.5 GHz is not put to auction in the forthcoming spectrum auction. DoT may send a separate reference for seeking the Authority's recommendations for 42.5-43.5 GHz frequency range for IMT at an appropriate time.

C. Validity Period and the License Service Area

2.28 As per the existing licensing and regulatory framework in India, access spectrum is assigned to access service licensees with a validity period of 20 years.

2.29 Considering that the new spectrum bands identified for IMT, particularly the higher spectrum bands, where ecosystem is not fully developed and such frequency bands are yet to find adequate use cases, there could be difficulty in assessing the true value of spectrum in such frequency bands. From the study of international scenario, it is observed that in some countries such as in USA, UK, and South Korea validity period of spectrum has been shortened for mmWave bands.

2.30 Further, considering mmWave spectrum is typically used for meeting the very high-capacity and ultra-low latency requirements, deployment of mmWave spectrum for IMT is not likely to be ubiquitous. From the international scenario, it is observed that some countries such as USA, UK, and Canada have considered a smaller licensed service area for mmWave bands.

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

Q4. Whether the spectrum in the frequency ranges under consideration viz. (a) 37-37.5 GHz, (b) 37.5-40 GHz, and (c) 42.5-43.5 GHz should be assigned for a validity period of 20 years, as prevalent in the existing frequency bands, or for a shorter validity period? In case you are of the opinion that a shorter validity period should be adopted, please suggest the validity period? Kindly provide your response with detailed justifications.

Q5. Whether the spectrum in (a) 37-37.5 GHz, (b) 37.5-40 GHz, and (c) 42.5-43.5 GHz frequency ranges should be assigned for the existing licensed service areas (LSAs) for Access Service (i.e. Telecom Circles/ Metros), or it should be assigned for smaller service areas? In case you are of the opinion that the spectrum in these bands should be assigned for smaller service areas, please suggest the criteria for defining such service areas? Kindly provide your response with detailed justifications.

Comments of stakeholders on Q4

2.32 In response to Q4, most stakeholders were of the view that the spectrum in the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz for IMT should be assigned for a validity of 20 years, as prevalent in the existing frequency bands, while one of the stakeholders was in favour of shorter validity period.

2.33 A broad summary of the comments of stakeholders who were in favour of validity period of 20 years for assignment of spectrum in the frequency ranges under consideration, is given below:

(a) For consistency with other spectrum licenses and clarity for telecom operators to roll-out services, a similar validity period should be followed.

(b) The spectrum validity should provide adequate time for ecosystem penetration, network planning and deployments, and substantial period for providing commercial services thus, enabling adequate certainty to a TSP's business plans.

(c) Longer validity periods have enabled technological development, with the same band being used for different technologies. Shorter validity periods would discourage such innovation and evolution due to the lack of certainty on recovery of investments.

(d) Telecom is a capital intensive sector. Shorter validity periods may not provide sufficient time for TSPs to recoup their investments, and this would risk destabilising the long-term investments of the sector. It may

also attract fly-by-night operators, which may not be in the interests of either the consumers or the exchequer.

(e) A few stakeholders opined that spectrum in these frequency ranges is unlikely to have eco-system fully developed from the beginning of allocation, therefore, these should be assigned for a period not less than 10-15 years or for 20 years.

2.34 A broad summary of the comments of stakeholders, who were in favour of shorter validity period than 20 years for assignment of spectrum in the frequency ranges under consideration, is given below:

(a) These frequency bands are being considered for auction for the first time, and for these higher spectrum bands ecosystem is not fully developed and are yet to find adequate use cases; therefore, assessing the true value of spectrum and their use-cases is not clear.

(b) In the changing technological scenarios, and with the niche usage of mmWave spectrum the validity period of 10 or 15 years should suffice.

Analysis of the issues raised through the Q4

2.35 As mentioned above, as per the extant licensing and regulatory framework, access spectrum is assigned to access service licensees with a validity period of 20 years. Further, based on the TRAI's Recommendations dated 11.04.2022, the Government auctioned the spectrum in the mmWave band, that is, in the 26 GHz band for a period of 20 years. As already mentioned, the ecosystem in the frequency ranges under consideration has started developing, and internationally FCC has auctioned spectrum, and Ofcom, ISED, among others are planning to auction it, the ecosystem is expected to develop further.

2.36 The Authority examined the comments of the stakeholders. Most stakeholders were of the view that spectrum in the frequency ranges under consideration should be assigned for a validity of 20 years. The stakeholders in support mentioned 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. The Authority concurs with the view of stakeholders. Therefore, the Authority is of the view that the frequency spectrum in the 37-40 GHz frequency range should be auctioned with a validity period of 20 years.

2.37 In view of the above, **the Authority recommends that the frequency spectrum in the band n260 (37-40 GHz) should be auctioned with a validity period of 20 years.**

Comments of stakeholders on Q5

2.38 In response to the Q5, many stakeholders were in favour that the spectrum in the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz should be assigned for the existing licensed service areas (LSAs) for Access Service, while some stakeholders were in favour of smaller service areas.

2.39 A broad summary of the comments of stakeholders, who were in favour of existing licensed service areas (LSAs) for assignment of spectrum in the frequency ranges under consideration, is given below:

(a) Assignment for smaller service areas may leave the rural and semi-urban areas uncovered, as TSPs would only be interested in getting the spectrum for densely populated urban areas.

(b) Smaller service areas would disrupt the entire network and business planning of TSPs and would create operational and regulatory complexities. It would be challenging for the Wireless Planning and Coordination (WPC) Wing of DoT to ensure interference management and harmonization with smaller service areas.

(c) Larger TSPs may not be able to deploy nation-wide or LSA-wide networks and enjoy economies of scale, due to disjointed spectrum holdings.

(d) This is consistent with the approach followed in the case of the existing frequency bands, including 26 GHz band.

2.40 A broad summary of the comments of stakeholders, who were in favour of smaller service areas for assignment of spectrum under consideration, is given below:

(a) The limited range of mmWave makes them suitable for a service area, much smaller to LSA based allocation prevalent as of now.

(b) Smaller service areas would allow more flexible use of the spectrum and facilitate the shared use of the band between FSS and IMT.

(c) Spectrum in mmWave should be assigned at Secondary Switching Areas/ SDCA or District level so that the effective utilisation of the spectrum is achieved.

Analysis of the issues raised through the Q5

2.41 It is noteworthy that the frequency spectrum is assigned on an existing licensed service area (LSA) basis, and based on the TRAI's Recommendations dated 11.04.2022, the Government auctioned the spectrum in the 26 GHz mmWave band on an existing LSA basis. Considering the validity period of such an assignment as 20 years, it allows reasonable time for the service provider to extend their services based on their business plan and business potential.

2.42 The Authority has examined the comments of the stakeholders. Most of the stakeholders were in favour of the assignment of spectrum for the existing LSAs (Telecom Circle/ Metro), which will be consistent with the approach being followed for other spectrum bands including 26 GHz band. The stakeholders in support mentioned that assignment for smaller service areas may leave rural and semi-urban areas uncovered, as the service providers would be interested in getting spectrum for densely populated urban areas only. However, a few

other stakeholders suggested for smaller service areas such as secondary switching areas (SSA)/ short distance charging area (SDCA) or district level with a view that limited range of mmWave makes them suitable for a service area, much smaller to LSA based allocation prevalent as of now, which would allow more flexible use of the spectrum and facilitate shared use of the band between fixed satellite service (FSS) and IMT. In this regard, it is noted that the DoT has already earmarked the frequency ranges under consideration for IMT while permitting the establishment of satellite earth station gateways with suitable protection, which is deliberated in a subsequent section of this recommendation.

2.43 It is noteworthy that mmWave spectrum is likely to be used for the provision of use cases requiring very high data rates and ultra-low latency. Therefore, it is possible that the service providers may decide to deploy it selectively in the areas where the demand for such use cases exists. Further, with a longer validity period as recommended in the earlier section, if spectrum is assigned for the entire LSA (Telecom Circle/ Metro), as per the prevailing practice, it will allow the service providers to deploy the network according to the business plan. 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. Therefore, the Authority is of the view that the frequency spectrum in the band n260 (37-40 GHz) should be auctioned on LSA (Telecom Circle/ Metro) basis.

2.44 In view of the above**, the Authority recommends that the frequency spectrum in the band n260 (37-40 GHz) should be auctioned on LSA (Telecom Circle/ Metro) basis.**

D. Block size for the assignment of spectrum

2.45 Block size is the lowest unit of quantum of spectrum, in multiples of which, the spectrum is auctioned/ assigned. The bidders decide the number of blocks to bid in each spectrum band. In some cases, the minimum number of blocks that a bidder is required to bid is also prescribed.

2.46 The spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands will be auctioned for the first time in India. As per the 3GPP[18] standard, for n259 and n260 bands, the supported channel bandwidth is 50 MHz, 100 MHz, 200 MHz, and 400 MHz. From the study of international scenario, it has been observed that minimum block size of 100 MHz or 200 MHz have been adopted or is being considered.

2.47 In this background, the Authority solicits comments of stakeholders on the following question:

Q6. What should be the block size, and the minimum quantity for bidding in (a) 37-37.5 GHz, (b) 37.5-40 GHz, and (c) 42.5-43.5 GHz frequency ranges? Kindly justify your response.

Comments of stakeholders on Q6

2.48 In response to the Q6 for the block size, most stakeholders were in favour of 100 MHz block size while a couple of stakeholders suggested 50 MHz block size in the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz.

[18] ETSI TS 138 101-2 V17.11.0 (2023-10) URL: https://www.etsi.org/deliver/etsi_ts/138100_138199/13810102/17.11.00_60/ts_13810102v171100p.pdf

2.49 The stakeholders who were in favour of 100 MHz block size mentioned that considering the adoption in developed countries and expected use cases, a 100 MHz block size should be optimal. This would meet the capacity requirement, utilisation efficiency, and propagation characteristics. While the stakeholders who were in favour of 50 MHz block size mentioned that a block size of 50 MHz would provide flexibility to telecom service providers to opt for quantum of spectrum required by them, and it will also be in line with the earlier followed practice in the allocation of mmWave band viz. 26 GHz band.

2.50 Regarding minimum quantity of bidding, a broad summary of the comments of stakeholders, is given below:

(a) A few stakeholders were of the view that a minimum 400 MHz of spectrum will be required to provide optimum 5G services.

(b) Some stakeholders were of the view that for the existing operators, who already hold spectrum in any of the mmWave spectrum bands, the minimum quantity of bidding should be 100 MHz. For the new entrant, who are not holding any spectrum in the mmWave band, the minimum quantity for bidding should be 400 MHz.

(c) One stakeholder submitted that a minimum bidding quantity should be 2 blocks of 100 MHz.

(d) A few stakehdolers were of the view that the minimum quantity for bidding in should be one block of 100 MHz. This will provide flexibility to the Government as well as the TSPs.

Analysis of the issues raised through the Q6

2.51 While many of the stakeholders suggested a block size of 100 MHz, a few suggested a block size of 50 MHz.

2.52 From the study of the international scenario, it has been observed that the USA conducted an auction in upper 37, 39 and 47 GHz bands for next generation wireless services and with a minimum block size of 100 MHz. Canada has issued

a consultation paper, wherein it has proposed to auction 38 GHz band with a block size of 100 MHz. Ofcom, UK in its statement and consultation on 'Enabling mmWave spectrum for new uses-Auction design'[19] dated 08.11.2023, has mentioned that it has decided to adopt a lot size of 200 MHz for 40 GHz band.

2.53 It is noteworthy that as per 3GPP, both frequency bands i.e., n259 and n260 bands support a channel bandwidth of 50 MHz, 100 MHz, 200 MHz and 400 MHz. Considering the availability of spectrum in the frequency bands under consideration, the block size could be prescribed as any of the supported channel bandwidths. However, the Authority is of the view that it would be prudent to keep the block size of 100 MHz as it would give flexibility to the TSPs and may also encourage new entrants to participate in the auction. At the same time, considering that n260 frequency band is likely to be used for 5G services, TSPs may like to acquire larger chunk of spectrum in this band; therefore, in case a TSP acquires more than one block, the assignment of spectrum should be done in a contiguous manner.

2.54 In view of the above**, the Authority recommends that the frequency band n260 (37-40 GHz) should be auctioned with a block size of 100 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.**

E. Spectrum Cap for the Assignment of Spectrum

2.55 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

[19] https://www.ofcom.org.uk/__data/assets/pdf_file/0022/271129/consultation-statement-mmwave-auction-design.pdf

prevent large holdings of spectrum by one or a few service providers, which otherwise may create concerns for the competition in the market.

2.56 In the Notice Inviting Applications (NIA), 2024 dated 08.03.2024, the spectrum cap has been 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).

…

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."*

2.57 As mentioned above, for the 26 GHz band spectrum, a band-specific spectrum cap of 40% was prescribed in the NIA 2024. The frequency spectrum in the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands, will be auctioned for the first time in India.

2.58 In this background, the Authority solicited the views of stakeholders on the following question:

Q7. What provisions with respect to the spectrum cap per service provider in a licensed service area (LSA) should be made applicable for the frequency ranges under consideration viz. (i) 37-37.5 GHz, (ii) 37.5-40 GHz, and (iii) 42.5-43.5 GHz for IMT? Specifically, -

(a) Whether there is a case for a combined spectrum cap for 26 GHz band (24.25-27.5 GHz) and the frequency ranges under consideration? If yes, what should be the spectrum cap? Kindly justify your response.

(b) In case your response to (a) above is in the negative, whether spectrum cap should be prescribed separately for each frequency range viz. (i) 37-37.5 GHz, (ii) 37.5-40 GHz, and (iii) 42.5-43.5 GHz, or these frequency ranges should be combined for applicability of spectrum cap? What should be the spectrum cap(s)? Kindly justify your response.

Comments of stakeholders on Q7

2.59 In response to the Q7, a few stakeholders were in favour of a combined spectrum cap of 26 MHz and spectrum under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz, while a few stakeholders were in favour of separate spectrum cap for 26 GHz band and spectrum under consideration. One of the stakeholders was in favour of separate spectrum cap for each frequency range of spectrum under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz.

2.60 The stakeholders who were in favour of combined spectrum cap of 26 MHz and spectrum under consideration stated that the propagation characteristics of mmWave spectrum band is same for these frequency bands. In case, band wise cap needs to be put in place, then it would require revision in application of spectrum cap in sub-GHz bands and 1800/ 2100/ 2300/ 2500 MHz bands as well.

2.61 A broad summary of the comments of stakeholders, who were in favour of separate spectrum cap for 26 GHz band and spectrum under consideration, is given below:

(a) The frequency ranges under consideration are not comparable with 26 GHz band in terms of ecosystem development.

(b) A combined spectrum cap may lead to one TSP monopolizing the more developed 26 GHz band, while others are left with the newer bands which are still in the early stages of ecosystem development.

2.62 A broad summary of the comments of stakeholders, who were in favour of separate spectrum cap for each frequency ranges of spectrum under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz, was that in the combined spectrum cap, there could be a possibility of a service provider monopolizing one of the spectrum bands, particularly in the case of new

spectrum bands. Band-wise capping will ensure healthy competition and fair allocation of the natural resource.

2.63 In regard to the limit on spectrum cap for the frequency ranges under consideration, a broad summary of the comments of stakeholders, is given below:

(a) Most of the stakeholders were in favour spectrum cap of 40%.

(b) One of the stakeholders was of the view that a spectrum cap of 35% is most appropriate as it balances both the objectives of providing bidding activity as well as equitable availability of spectrum for all TSPs.

(c) A few stakeholders were of the view that in case the current three-bidder scenario persists in the upcoming 5G auctions as well then keeping lower caps will lead to quasi-administrative allocation at reserve price. Therefore, no spectrum cap should be imposed, and in case it is deemed necessary, a spectrum cap of 50% for these bands may be prescribed to promote competition.

2.64 In addition, one stakeholder has suggested that since the public sector undertaking (PSU) operator does not participate in the spectrum actions, therefore, 25% of the spectrum to be put for auctions should be reserved for it to enable to meet the objectives as set by the Government.

Analysis of the issues raised through the Q7

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.

2.66 Most of the stakeholders were in favour of a spectrum cap of 40% of the total spectrum put to auction. In case a spectrum cap of 35% is prescribed (as suggested by one of the stakeholders) and only the existing TSPs take part in the spectrum Auction, it may not result in a market clearing price for the spectrum. On the other hand, a spectrum cap of 50% (as suggested by a few stakeholders) may result in lessening of effective number of players in the market and competition post auction. Therefore, the Authority is of the view that spectrum cap for the frequency band n260 (37-40 GHz) should be kept as 40% of the total spectrum put to auction.

2.67 In view of the above, **the Authority recommends that spectrum cap for the frequency band n260 (37-40 GHz) should be kept as 40% of the total spectrum put to auction and it should not be clubbed with 26 GHz band for the purpose of spectrum cap.**

F. Rollout obligations for the Assigned Spectrum

2.68 Roll-out obligations are mandated for the spectrum assigned to the service providers to ensure that spectrum is used effectively and efficiently in a timely manner.

2.69 In the Recommendations dated 11.04.2022, the Authority had noted that 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 the creation of hotspots and provision of fixed wireless access (FWA) services. Therefore, prescribing band-specific coverage-based rollout obligations may not be appropriate. However, nominal network deployment-based rollout obligations may be specified to ensure that the spectrum purchased is put to an efficient use, in a timely manner.

2.70 In the NIA 2024[20] for the auction of spectrum, the following rollout obligations were defined for 26 GHz (24.25 - 27.5 GHz) frequency band:

"8.3.2 For 26 GHz bands

(a) In LSAs other than Metro LSAs

The following rollout obligations for non-metro LSAs have to be fulfilled by the bidders acquiring spectrum through this auction:

Time Period	*Roll Out Obligations (per LSA)*	*Minimum number of towns to be covered using targeted sites (per LSA)*
Phase-1: *By the end of 1st year*	*Commercial launch of services anywhere in the LSA*	*1*
Phase-2: *By the end of 3rd Year*	*Cumulative number of sites to be deployed:* *Category A LSAs: 240* *Category B LSAs: 150* *Category C LSAs: 80*	*In Category A LSAs: 2* *In Category B LSAs: 1* *In Category C LSAs: 1*
Phase-3: *By the end of 5th Year*	*Cumulative number of sites to be deployed:* *Category A LSAs: 660* *Category B LSAs: 460* *Category C LSAs: 300*	*In Category A LSAs: 7* *In Category B LSAs: 5* *In Category C LSAs: 3*

(b) Metro LSAs

The following rollout obligations for metro LSAs have to be fulfilled by the bidders acquiring spectrum through this auction:

Time Period	*Roll Out Obligations (per LSA)*
Phase-1:	*Commercial launch of services anywhere in the*

[20] NIA 2024: (https://dot.gov.in/sites/default/files/Notice%20Inviting%20Applications%202023-24.pdf)

By the end of 1st year	*LSA*
Phase-2: *By the end of 3rd Year*	*Cumulative number of sites to be deployed in each LSA: 90*
Phase-3: *By the end of 5th Year*	*Cumulative number of sites to be deployed in each LSA: 300*

2.71 As the spectrum in 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz frequency ranges are suitable for very high data rate and ultra-low latency applications, therefore, successful bidders are likely to deploy spectrum in these frequency ranges in the geographies having demand for such applications.

2.72 In this context, the Authority solicited the views of stakeholders on the following question:

Q8. What should be the roll-out obligations for the assignment of spectrum in (a) 37-37.5 GHz, (b) 37.5-40 GHz, and (c) 42.5-43.5 GHz frequency bands for IMT? Kindly justify your response.

Comments of stakeholders on Q8

2.73 In response to the Q8, most of the stakeholders were of the view that there should be no separate roll-out obligations in respect of mentioned frequency ranges for such licensees who have already fulfilled roll-out obligations in 26 GHz band. However, one of the stakeholders opined that nominal network deployment-based rollout obligations may be advised to ensure that the spectrum is put to efficient use, in a timely manner.

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

(a) There should be no separate roll-out obligations for such licensees who have already fulfilled roll-out obligations in the 26 GHz band, as the new bands would be utilized only to build additional capacity over and above the network coverage already deployed using 26 GHz band.

(b) If an existing licensee has already met these obligations once using any technology in any band, the present approach of prescribing no rollout obligations should be continued.

(c) Some stakeholders further submitted that for new entrants with no prior spectrum holding in any of the mmWave spectrum bands, rollout obligations should be similar to the roll-out obligations for 26 GHz spectrum in NIA 2022/ 2024 as the mmWave spectrum band (26 GHz band) are similar to spectrum bands under discussion.

(d) One of the stakeholders suggested that considering the evolving device eco-system in the bands, the Authority may consider giving some additional time to meet minimum roll-out obligations (MRO) to new TSPs proposing to have stand-alone networks in this band. Another stakeholder submitted that if the Authority decides to specify any rollout obligation specific for these bands, like in the case of 24.25-28.5 GHz, the time-period of the first phase should start once enough device ecosystem is achieved, say only after 5 years.

Analysis of the issues raised through the Q8

2.75 The Authority has examined the comments of stakeholders. Most stakeholders were of the view that there should be no separate roll-out obligations for such licensees who have already fulfilled roll-out obligations in 26 GHz band. However, one of the stakeholders opined that nominal network deployment-based rollout obligations may be advised to ensure that the spectrum is put to efficient use in a timely manner.

2.76 Based on the examination of the international scenario, the rollout obligations specified by USA, Canada and UK are given below:

(a) USA

2.77 In 2020, FCC concluded auction (Auction 103), which offered 14,144 Upper Microwave Flexible Use Service licenses in the Upper 37 GHz (37.6-38.6 GHz),

39 GHz (38.6-40 GHz), and 47 GHz (47.2-48.2 GHz) bands, and the licenses were based on Partial Economic Areas (PEAs). In this auction, construction requirements[21] were prescribed as follows:

Upper Microwave Flexible Use Service (UMFUS) licensees must make a buildout showing as part of their renewal applications. Licensees relying on mobile or point-to-multipoint service must show that they are providing reliable signal coverage and service to at least 40% of the population within the service area of the licensee, and that they are using facilities to provide service in that area either to customers or for internal use. Licensees relying on point-to-point service must demonstrate that they have four links operating and providing service, either to customers or for internal use, if the population within the license area is equal to or less than 268,000. If the population within the license area is greater than 268,000, a licensee relying on point-to-point service must demonstrate that it has at least one link in operation and is providing service for each 67,000 population within the license area. In order to be eligible to be counted under the point-to-point buildout standard, a point-to-point link must operate with a transmit power greater than +43 dBm.

In the alternative, a licensee may make its buildout showing on the basis of geographic area coverage. To satisfy the requirements of using this metric, licensees relying on mobile or point-to-multipoint service must show that they are providing reliable signal coverage and service to at least 25% of the geographic area of the license. The geographic area of the license shall be determined by the total land area of the county or counties covered by the license. Licensees relying on fixed point-to-point links or other, low-power point-to-point connections must show that they have deployed at least one transmitter or receiver in at least 25% of the census tracts within the license area. All equipment relied upon in the showing, whatever type of service or connection it provides, must be operational and providing service, either to customers or for internal use, as of the date of the filing.

[21] Source:https://www.fcc.gov/auction/103

If a licensee in this service is also a Fixed-Satellite Service licensee and uses the spectrum covered under its UMFUS license in connection with a satellite earth station, it can demonstrate compliance with the requirements of this section by demonstrating that the earth station in question is in service, operational, and using the spectrum associated with the license. This provision can only be used to demonstrate compliance for the county in which the earth station is located.

Licensees may fulfill their performance requirement by showing that they meet their choice of any one of the above standards, or a combination thereof, but they may not combine population-based showings with geographic area-based showings. Showings that rely on a combination of multiple types of service will be evaluated on a case-by-case basis. Licensees must make their showing by the end of their initial license terms in these bands – there is no interim benchmark.

Failure to meet this requirement will result in automatic cancellation of the license. In bands licensed on a Partial Economic Area basis, licensees will have the option of partitioning a license on a county basis in order to reduce the population within the license area to a level where the licensee's buildout would meet one of the applicable performance metrics.

(b) Canada

2.78 ISED, Canada[22] in their consultation on a Policy and Licensing Framework for Spectrum in the 26, 28 and 38 GHz Bands, mentioned that the licensee would be required to demonstrate the spectrum use to actively offer service with number of stations in each Tier 5 service area as specified in annexure D[23], at

[22] Consultation on a Policy and Licensing Framework for Spectrum in the 26, 28 and 38 GHz Bands (https://ised-isde.canada.ca/site/spectrum-management-telecommunications/en/learn-more/key-documents/consultations/consultation-policy-and-licensing-framework-spectrum-26-28-and-38-ghz-bands)

[23] Annex D: Proposed deployment requirements per Tier 5 service area

(https://ised-isde.canada.ca/site/spectrum-management-telecommunications/en/learn-more/key-documents/consultations/consultation-policy-and-licensing-framework-spectrum-26-28-and-38-ghz-bands-annexes#tD1)

5 and 9.5 years following the initial licence issuance date. ISED sought comments on its two proposed options for deployment requirements for all Tier 5 areas shown in annex D. Option 1 had deployment requirements with a lower number of stations to take into account the uncertainty of the business models for the mmWave bands. Option 2 had higher deployment requirements between three to five times the number of stations of Option 1 to encourage greater use of the spectrum. The sample requirement as per Annexure D of the ISED consultation is as follows:

Proposed deployment requirements per Tier 5 service area				
Service area	Option #1		Option 2	
	No. of stations / 100 MHz block at year 5	No. of stations / 100 MHz block at year 9.5	No. of stations / 100 MHz block at year 5	No. of stations / 100 MHz block at year 9.5
Remote (Hottah Lake)	1	2	5	10
Rural (Harbour Grace)	2	4	10	20
Urban (St. John's)	3	11	15	51
Metro (Vancouver)	80	101	400	505

Table 2.3: Proposed (sample) deployment requirements, ISED, Canada

(c) Ofcom, UK

2.79 In March 2023, Ofcom, UK, through 'Statement and further consultation: Enabling mmWave spectrum for new uses'[24] proposed that the roll-out obligations and/ or a 'use it or lose it' condition would require licensees to make use of the relevant spectrum within a specified time period, or risk revocation of the licenses if these obligations are not met (i.e. 'use-it-or-lose-it'). Ofcom

[24] https://www.ofcom.org.uk/__data/assets/pdf_file/0015/255030/03-23-statement-and-consultation-mmwave.pdf

viewed that spectrum hoarding, and other spectrum allocation inefficiencies, can be resolved without the need for 'use it or lose it' conditions. After stakeholders' consultation, Ofcom, in its statement of September 2023 on 'Enabling mmWave spectrum for new uses'[25], decided not to include any roll-out obligations in the award licences. Ofcom stated that *"spectrum hoarding, and other spectrum allocation inefficiencies, can be resolved without the need for 'use it or lose it' conditions. These include that:*

a) it will be possible to trade award licences to a third party;

b) if spectrum remains unused and there are no immediate plans to use it in certain areas, if there is demand, we are able to issue licences under our Local Access licensing framework; and

c) as set out in Section 6, we have decided to award fixed term licences with a 15 year."

2.80 From the above, it may be seen that FCC in the USA has prescribed coverage-based rollout requirements for the spectrum license in Upper 37 GHz Band (37.6-38.6 GHz) and 39 GHz Band (38.6-40 GHz), and ISED in the Canada has proposed network deployment requirements in terms of minimum number of stations to be deployed in each service area in the 38 GHz band. On the other hand, Ofcom in the UK has decided not to include any roll-out obligations in the award license for spectrum in 40 GHz band.

2.81 It is noted that the mmWave spectrum is typically used for meeting the high-capacity and ultra-low latency requirement, and its deployment is not likely to be ubiquitous; therefore, coverage-based roll out obligations may not be appropriate. However, the Authority is of the opinion that there should be some network deployment-based rollout obligations to ensure that spectrum assigned to an entity is put to use at the earliest.

[25] https://www.ofcom.org.uk/__data/assets/pdf_file/0033/268656/Statement-Enabling-mmWave-spectrum-for-new-uses.pdf

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.

2.83 With respect to enhancing the timeline for the fulfilment of minimum roll out obligations, as suggested by a few stakeholders, the Authority is of the view that the stakeholders decide to acquire spectrum in a frequency band only after considering several factors including the availability of ecosystem. Further, enhancement of time period for fulfilment of minimum roll out obligations to 5 years or so may increase the likelihood of hoarding of spectrum.

2.84 In view of the above, in order to ensure that the spectrum is put to use at the earliest and to prevent hoarding, it would be prudent to have some network deployment-based minimum rollout obligations, irrespective of whether the entity is holding spectrum in the other mmWave band such as 26 GHz band. Therefore, the Authority is of the view that minimum rollout obligations for n260 (37-40 GHz) band should be similar to that prescribed for 26 GHz band in the NIA 2024.

2.85 In view of the above**, the Authority recommends that**

(a) The minimum roll-out obligations for band n260 (37-40 GHz) should be similar to that prescribed for 26 GHz band in the NIA, 2024.

(b) The minimum roll-out obligations should be equally applicable for all the TSPs i.e., existing as well as the new TSPs.

G. Eligibility Conditions and Associated Conditions for Participation in the Auction

2.86 Eligibility conditions for the participation in the auction are specified in the relevant NIA. The eligibility conditions prescribed in the NIA 2024[26], are reproduced below:

"3.1 Eligibility criteria to participate in the Auction

(i) Any licensee that holds a UASL/ UL with authorization for Access Services for that LSA; or

(ii) Any licensee that fulfils the eligibility criteria for obtaining a Unified License with authorization for Access Services, and gives an undertaking to obtain a Unified License with authorization for Access Services and an undertaking regarding compliance to FDI guidelines; or

(iii) Any entity that gives an undertaking to obtain a Unified License with authorization for Access Services through a New Entrant Nominee as per the DoT guidelines/ license conditions, and an undertaking regarding compliance to FDI guidelines, can bid for the Spectrum in 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, and 26 GHz Bands subject to other provisions of the Notice.

A Unified License can only be awarded to an Indian Company. Hence, any foreign applicants will need to form or acquire an Indian company, to obtain a Unified License. However, they are allowed to participate in the auctions directly

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

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. …"

2.87 The associated eligibility conditions prescribed in the NIA 2024 stipulate 'Net Worth' requirements on bidders. The key requirement is reproduced below:
"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)."

2.88 In this context, the Authority solicited views of stakeholders on the following question:

Q9. Whether the eligibility conditions and associated eligibility conditions for participation in the auction for 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz should be kept analogous to the eligibility conditions and associated eligibility conditions for participation in the auction for spectrum for IMT, as defined in NIA 2024? In case your response is in the negative, suggestions may kindly be made with detailed justification.

Comments of stakeholders on Q9

2.89 In response to the Q9, most stakeholders were in favour of no change in current eligibility conditions and associated eligibility conditions for the spectrum under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz, while a few

stakeholders were in favour of certain changes in current eligibility conditions and associated eligibility conditions for the spectrum under consideration.

2.90 The stakeholders who were in favour of no change in current eligibility conditions and associated eligibility conditions for the spectrum under consideration, submitted that the eligibility conditions and associated eligibility conditions for participation in these bands should be kept analogous to NIA 2024.

2.91 The stakeholders who were in favour of a change in current eligibility conditions and associated eligibility conditions for the spectrum under consideration, submitted that the eligibility criteria for the allocation of these bands should include TSPs other than Access Service providers including ISPs. It can serve the purpose of provision of high-capacity point-to-point links for Enterprise customers. The revision will promote the usage/ adoption of these frequency ranges and boost the development of enterprise-based use cases.

Analysis of the issues raised through the Q9

2.92 Most of the stakeholders were of the view that the current eligibility conditions and associated eligibility conditions for auction of access spectrum should be made applicable for the frequency bands under consideration, while a few stakeholders were of the view that the eligibility criteria for the assignment of these bands should include TSPs other than Access Service Providers including Internet Service Providers (ISPs).

2.93 The issue of allowing ISPs to participate in the spectrum auction was examined by the Authority in the Recommendations on 'Auction of Spectrum in frequency bands identified for IMT/5G' dated 11.04.2022 and viewed that ISPs should not be allowed to participate in the access spectrum auction, which was accepted by the Government. In the said recommendations dated 11.04.2022, the Authority noted, *inter-alia*, as below:

"2.210 … in the year 2010, for the spectrum in 2300 MHz band was auctioned first time and ISP Category A licensees were permitted to bid and use it under ISP license. The spectrum was designated as Broadband Wireless Access (BWA) spectrum. For all other access spectrum bands, ISPs were not eligible to take part in spectrum auction under ISP license.

2.211 After 2010, spectrum in 2300 MHz band came up for auction in 2016. On the basis of TRAI's recommendations, during this auction UASL/ CMTS/ UL(AS)/ UL with authorization for Access Services were eligible to participate and ISP licensees were not made part of it. While giving its recommendations in 2016, the following rationale was given for not making ISPs eligible for bidding for spectrum:

> *"Uniform eligibility criteria should be made applicable for all the access spectrum bands. Earlier, it was envisaged that the spectrum in the 2300 MHz bands would be used for wireless broadband services. Over a period of time, the technology and the device ecosystem has evolved and now same technology which is used in other bands can also be used in 2300 MHz band and 2500 MHz band. Therefore, as far as eligibility conditions to participate in an auction is concerned, there is no justification for separate treatment to 2300 MHz and 2500 MHz bands vis-à-vis other access spectrum bands."*

2.212 It may be mentioned that none of the ISPs who acquired 2300 MHz spectrum in the auction held in the year 2010, used such spectrum as an ISP – most of them were acquired by Access service providers and one of them acquired access service authorization to offer LTE services.

2.213 In case an entity (including ISP) is willing to offer 5G based broadband services to enterprise customers or otherwise, it can take Access Service Authorization. In case ISPs are permitted to bid for access spectrum, the spectrum can be utilized only for the services permitted under ISP authorization; therefore, it will lead to inefficient utilization of spectrum.

Further, the cost of Access service authorization does not appear to be a hindrance as it may be miniscule in comparison to the cost of deployment of network and cost of spectrum. After the telecom reforms announced in September 2021 by the Government, relaxation has been granted in respect of bank guarantees for the operator, Adjusted Gross Revenue (AGR) has been rationalized by permitting exclusion of non-telecom revenue, KYC reforms have been made. So, it is easier for an ISP to migrate to/or acquire Access Services authorisation to provide all array of services to the customers.

2.214 TRAI in its recommendations on 'Enabling Unbundling of Different Layers Through Differential Licensing' of August 2021, had recommended to create a new category of license for Access Network Provider under UL. It was also recommended that like Unified Licensee with access service authorization, the Access Network provider 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. If DoT accepts TRAI recommendations on Unbundling of Licensing layers, ISPs will also have an option to take 'Network Service Provider' authorisation or become VNO of a Network provider for delivery of services."

2.94 The above-mentioned TRAI recommendation on 'Enabling Unbundling of Different Layers Through Differential Licensing' of August 2021 was not accepted by the Government.

2.95 It is also noted that the Authority has recently given recommendations on the 'Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023' dated 18.09.2024[27] to the Government on the terms and conditions, including fees or charges, under the provisions of the Telecommunications Act, 2023. The recommendations have further enhanced,

[27] https://www.trai.gov.in/sites/default/files/2024-11/Recommendation_18092024.pdf

inter-alia, the scope of the 'Access Service Authorisation' and 'Internet Service Authorisation' and with reduced entry barriers.

2.96 According to the ITU[28] about the IMT, *"[t]he term International Mobile Telecommunications (IMT) is the generic term used by the ITU community to designate broadband mobile systems. It encompasses IMT-2000, IMT-Advanced, IMT- 2020 and IMT-2030 collectively, respectively called 3G, 4G, 5G and 6G by the market".* The term IMT is defined in Resolution ITU-R 56[29], and the term "IMT-2000" encompasses also its enhancements and future developments.

2.97 It is also noted that in the ITU Recommendation[30] (ITU-R M.687-2), IMT-2000 aim to achieve, inter-alia, the following primary general objectives:

"1.1.1 to make available to users who are on the move or whose location may change (mobile users), irrespective of their location (i.e. national and international roaming), a wide range of telecommunication services (voice and non-voice), allowing communication between mobile users and other mobile users, users of the fixed public networks (PSTN, PDNs and ISDN) or other telecommunication networks as appropriate;

1.1.5 to provide for the continuing flexible extension of service provision, subject to the constraints of radio transmission, spectrum efficiency and system economics;

1.1.7 to permit the use of the IMT-2000 for the purpose of providing its services to fixed users, under conditions approved by the appropriate national or regional authority, either permanently or temporarily, either in rural or urban areas;

…

IMT-2000 aim to achieve the following primary technical objectives:

[28] https://www.itu.int/en/itu-r/documents/itu-r-faq-imt.pdf
[29] https://www.itu.int/dms_pub/itu-r/opb/res/R-RES-R.56-3-2023-PDF-E.pdf
[30] https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.687-2-199702-I!!PDF-E.pdf

1.2.4 to provide service flexibility which permits the optional integration of services such as mobile telephone, dispatch, paging and data communication, or any combination thereof;

1.2.5 to support terminal equipment interfaces (and procedures) defined for the fixed public networks which allow the alternative use of terminal equipment in the fixed public networks;"

(emphasis applied)

2.98 As given in figure 2.3 below, the ITU Resolution 56[31] illustrates the capabilities of IMT-2000 and systems beyond IMT-2000.

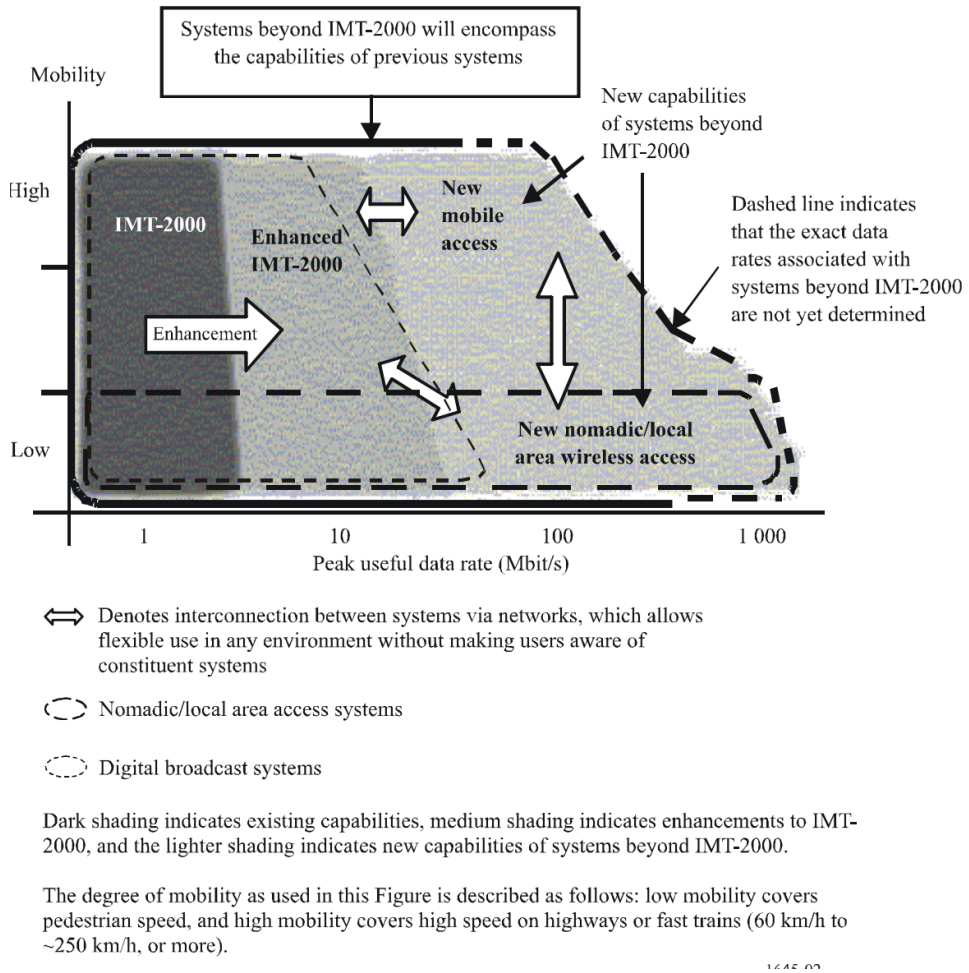

Figure 2.3: Capabilities of IMT-2000 and systems beyond IMT-2000

[31] https://www.itu.int/dms_pub/itu-r/opb/res/R-RES-R.56-2007-PDF-E.pdf

2.99 As can be seen from the figure 2.3 above, IMT systems include new nomadic/ local wireless access. The ITU Recommendation (ITU-R M.1645[32]) mentions that the *"[t]he enhanced IMT-2000 and the new mobile access of systems beyond IMT-2000 will be part of the cellular layer and hot spot layer. Nomadic/ local wireless access of systems beyond IMT-2000 will be part of the hot spot layer".*

2.100 The ITU Recommendation[33] (ITU-R F.1399), defines 'fixed wireless access (FWA)' as *"[w]ireless access application in which the location of the end-user termination and the network access point to be connected to the end-user are fixed."* and 'nomadic wireless access (NMA)' as *"[w]ireless access application in which the location of the end-user termination may be in different places but it must be stationary while in use".*

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

[32] ITU-R M.687-2: Framework and overall objectives of the future development of IMT-2000 and systems beyond IMT-2000
(Source: https://www.itu.int/dms_pubrec/itu-r/rec/m/r-rec-m.1645-0-200306-i!!pdf-e.pdf)
[33] ITU-R F.1399: Vocabulary of terms for wireless access
(Source: https://www.itu.int/dms_pubrec/itu-r/rec/f/R-REC-F.1399-1-200105-I!!PDF-E.pdf)

2.102 Therefore, the Authority is of the view that along with the telecom service providers holding the access service authorisation, internet service authorisation holders should also be permitted to participate in the auction of frequency spectrum for band n260 (37-40 GHz). Considering that the spectrum is auctioned on LSA (Telecom Circle/ Metro areas) basis, internet service authorisation holders of category 'A' and category 'B' should be permitted to participate in the auction of frequency spectrum for band n260 (37-40 GHz).

2.103 Further, the Authority in its earlier recommendations on "Spectrum, Roaming and QoS related requirements in Machine-to-Machine (M2M) Communications" dated 05.09.2017[34], recommended, *inter-alia*, that –

"Connectivity provider using LPWAN technologies operating in unlicensed spectrum should be covered under licensing through a new authorization under UL namely UL (M2M). Such licensees should be allowed to bid for licensed spectrum to provide exclusively M2M services, if they desire to provide M2M services in the licensed band."

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

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

2.105 In the recently given recommendations by the Authority on the 'Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023' dated 18.09.2024[35] to the Government on the terms and conditions, including fees or charges, under the provisions of the Telecommunications Act, 2023, the

[34] https://trai.gov.in/sites/default/files/2024-09/Recommendations_M2M_05092017_0.pdf
[35] https://www.trai.gov.in/sites/default/files/2024-11/Recommendation_18092024.pdf

service authorisation has been named as "M2M WAN Service Authorisation" under the main service authorisations category. The terms and conditions recommended for the service authorisation include as given below:

"4. Assignment and use of spectrum:
The Authorisation does not confer any right to assignment and use of spectrum, for which separate specific frequency assignment shall be required from the Central Government under Section 4 of the Telecommunications Act, 2023. In case the Authorised Entity obtains spectrum from the Central Government, the terms of conditions of the assignment of spectrum and the provisions of the relevant Notice Inviting Application (NIA) document for the auction of spectrum, if spectrum is obtained through auction, shall also be applicable on the Authorised Entity along with the Service Authorisation."

2.106 In view of the above, as already recommended by the Authority through its earlier recommendations dated 05.09.2017, the entities with authorisation for M2M service category A/ B under the Unified License, or M2M WAN Service Authorisation with service area as national (category-A) or Telecom circle/ Metro Area (Category-B), as recommended by the Authority through Recommendations dated 18.09.2024, should also be allowed to participate in the spectrum auction for frequency band n260 (37-40 GHz).

2.107 While allowing Internet Service authorisation holders and M2M WAN service authorisation holders for category 'A' and category 'B' service area to participate in the spectrum auction for frequency band n260, the relevant obligatory provisions on access service providers holding 'access spectrum' such as presumptive AGR, and restrictions on equity crossholding shall become applicable on the successful bidders with Internet Service Authorisation or M2M WAN Service Authorisation. However, relevant security related provisions etc. will require to be specifically made applicable on the successful bidders with Internet Service Authorisation or M2M WAN Service Authorisation. The Authority is of the view that the relevant security related provisions should be

included in the Internet Service Authorisation and M2M WAN Service Authorisation which should become applicable if such authorisation holders acquire access spectrum.

2.108 With regard to spectrum sharing, trading, and leasing, the provisions that need to be made applicable for ISPs or M2M WAN service providers, require detailed examination and consultation with stakeholders. Therefore, the Authority is of the view that in case DoT agrees with the Authority's recommendation to permit such entities to participate in the spectrum auction for the frequency band n260 (37 - 40 GHz), it may go ahead with the spectrum auction, and if required, it may subsequently send a separate reference to the Authority with respect to sharing, trading and leasing of spectrum among such entities. However, the existing provisions for the surrender of access spectrum should be extended to all successful bidders, including Internet service providers and M2M WAN service providers.

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

(a) In addition to the entities holding the access service authorisation, the following entities should also be permitted to participate in the auction of spectrum for frequency band n260 (37-40 GHz):

(i) The entities holding Internet service authorisation for Category 'A' and Category 'B' service area

(ii) The entities holding authorisation for M2M service category A/ B under the Unified License, or M2M WAN Service Authorisation with service area as national (Category-A) or Telecom circle/ Metro Area (Category-B), as recommended by the Authority through Recommendations dated 18.09.2024.

(b) The successful bidders will be permitted to use the acquired spectrum to offer service as per the scope of their respective service authorisations.

(c) The relevant security related provisions should be included in the Internet Service Authorisation and M2M WAN Service Authorisation which should become applicable if such authorisation holders acquire access spectrum.

(d) The existing provisions for the surrender of access spectrum should be extended to all successful bidders, including Internet Service providers and M2M WAN service Authorisation.

(e) Regarding spectrum sharing, trading, and leasing, the provisions that need to be made applicable for ISPs and M2M WAN service providers, require detailed examination and consultation with stakeholders. Therefore, in case DoT agrees with the Authority's recommendation to permit such entities to participate in the spectrum auction for the frequency band n260 (37-40 GHz), it may go ahead with the spectrum auction, and if required, it may subsequently send a separate reference to the Authority with respect to sharing, trading and leasing of spectrum among such entities.

H. Interference Mitigation in the TDD Duplexing Bands

2.110 The Authority solicited the views of stakeholders on the following question:

Q10. To mitigate inter-operator interference due to TDD-based configuration, whether the approach adopted for 3300-3670 MHz and 26 GHz bands should also be made applicable for the frequency ranges under consideration viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz, or some other provisions need to be created? In case you are of the opinion that some other provisions are required to be created, suggestions may be made with detailed justification.

Comments of stakeholders on Q10

2.111 In response to the Q10, to mitigate inter-operator interference due to TDD-based configuration for the frequency ranges under consideration, the stakeholders were unanimously in favour that the approach adopted for 3300-3670 MHz and 26 GHz bands should also be made applicable.

Analysis of the issues raised through Q10

2.112 When more than one Time Division Multiplexing (TDD) network operates in the same band and in the same geographical area, interference may occur if the networks are uncoordinated i.e., if some base stations (BSs) are transmitting while others are receiving. A synchronized operation of TDD networks prevents simultaneous uplink and downlink.

2.113 In the Recommendations dated 11.04.2022, the Authority examined this issue with respect to 3300-3670 GHz and 26 GHz bands and noted, as below:

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

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

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

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

2.235 In view of the above, the Authority recommends that to mitigate inter-operator interference in TDD configuration bands, the following measures should be taken:

(a) In case a TSP acquires more than one block, the entire spectrum should be assigned to it in contiguous form.

(b) In case a TSP acquires spectrum in more than one LSA, same frequency spots should be assigned to it in all those LSAs, to the extent possible.

(c) Interference mitigation be left to the mutual coordination between the TSPs."

2.114 It is noted that all stakeholders are unanimously in favour that to mitigate inter-operator interference due to TDD-based configuration, an approach adopted for 3300-3670 MHz and 26 GHz bands should also be made applicable for the frequency ranges under consideration. The Authority concurs with the views of stakeholders.

2.115 In view of the above, **the Authority recommends that to mitigate inter-operator interference in 37-40 GHz band with TDD configuration, the following measures should be taken –**

(a) In case a TSP acquires more than one block, the entire spectrum should be assigned to it in a contiguous manner.

(b) In case a TSP acquires spectrum in more than one LSA, same frequency spots should be assigned to it in all those LSAs, to the extent possible.

(c) Interference mitigation should be left to the mutual coordination between the TSPs.

I. Coexistence of IMT and Satellite Earth Station Gateways

2.116 As per the DoT's Reference dated 02.08.2023, 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz bands have been identified for IMT; however, 37.5-40 GHz and 42.5-43.5 GHz frequency bands will also be shared with satellite gateway Earth Stations with suitable protection.

2.117 In terrestrial networks, the deployment of mmWave networks is primarily intended to address the growing demand for capacity across different geographic areas. Due to significant propagation loss, achieving seamless coverage poses a challenge, however, it provides an opportunity for sharing of the same spectrum with the satellite gateway earth stations.

2.118 According to the National Frequency Allocation Plan (NFAP) 2022 issued by DoT, apart from mobile service, the frequency range from 37.5 to 40 GHz has been allocated for FSS (Space to Earth) and frequency range from 42.5 to 43.5 GHz has been allocated for FSS (Earth to Space).

2.119 It may be noted that for the spectrum in 27.5-28.5 GHz frequency range, TRAI in its Recommendations dated 11.04.2022, had recommended, *inter-alia*, as below:

a) As mmWave spectrum is going to be used for capacity requirement, its deployment is not likely to be ubiquitous rather it is more likely to be kind of hotspots or urban micro cells. Therefore, IMT Stations and Satellite Earth Stations Gateway (Earth to Space) can co-exist in 27.5-28.5 GHz frequency

range. The Satellite Earth Station Gateway should be permitted to be established in frequency range 27.5-28.5 GHz at uninhabited or remote locations on case-to-case basis, where there is less likelihood of 5G IMT services to come up.

b) *DoT should prescribe the exclusion zone requirement for co-existence of IMT and satellite earth stations (Earth to space) in 27.5-28.5 GHz frequency range.*

c) *DoT should create a software defined automated process on a portal having database of coordinates of the IMT base stations in mmWave. The geofencing coordinates of the proposed earth station in 27.5-28.5 GHz can provide the feasibility results through the portal for establishing the earth station.*

d) *Spectrum dues for 27.5-28.5 GHz frequency range can be revised on pro-rata basis for the mobile operator holding spectrum in the LSA, in which the permission for establishing earth station is given in the same frequency range, on account of creation of exclusion zone.*

2.120 In this context, the Authority solicited the views of stakeholders on the following question:

Q11. Whether there could be any challenges in sharing of 37.5-40 GHz and 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links? If yes, what challenges do you foresee and what measures could be adopted to mitigate such challenges? Kindly justify your response.

Q12. In case it is decided to share (i) 37.5-40 GHz, and (ii) 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links, -

(i) Whether there is a need to prescribe a protection/ keep-off distance between IMT stations and Satellite Earth Station Gateways? If yes, what should be the protection distance?

(ii) What other parameters should be prescribed for the coexistence of IMT and Satellite Gateway links?

Suggestions may kindly be made with detailed justification.

Comments of stakeholders on Q11 and Q12

2.121 In response to the Q11 and Q12, most stakeholders were of the view that there is no challenge in sharing of 37.5-40 GHz and 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links. However, a few stakeholders mentioned that there are challenges in the coexistence in sharing of 37.5-40 GHz and 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links, and some measures are to be taken for their coexistence.

2.122 A broad summary of the comments of stakeholders, who are of the view that there is no challenge in sharing of 37.5-40 GHz and 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links, is given below:

(a) No challenges in coexistence of sharing of bands between IMT and Satellite as mmWave network deployment is expected to be more focused on meeting capacity demand in selective geographies.

(b) This is a well-researched subject globally proving that co-existence is possible, and there are well established mitigation measures recommended to obviate any such risk.

(c) Sharing is highly feasible considering the small separation distances required to avoid interference, coupled with the relatively limited number and known locations of satellite gateways and the expected use of IMT for providing additional capacity in limited areas.

(d) Sharing studies at ITU show that coexistence between IMT and satellite gateway in these bands are possible.

(e) The spectrum can be efficiently shared between IMT and satellite gateway links. A light-licensing regime to allow the registration of links and coordination with other operators.

2.123 A broad summary of the comments of stakeholders who suggested measures for sharing of 37.5-40 GHz and 42.5-43.5 GHz spectrum frequency ranges between IMT and Satellite Gateway links, is given below:

(a) Satellite Earth Station gateways (SESGs) should be permitted to be established at uninhabited or remote locations. As satellite gateways will be few in numbers and primarily in rural areas, sharing of spectrum between IMT and satellite gateways can be easily ensured through the appropriate exclusion zones.

(b) An appropriate protection/ keep-off distance should be prescribed between IMT stations and SESG for the purposes of co-existence in the frequency ranges. Based on the WRC-19 studies referred to in the Consultation Paper, 4 km would be a safe protection distance. On the other hand, some stakeholders mentioned that they support use of pfd thresholds as opposed to static protection/ keep off distances.

(c) The present as well as planned locations of satellite hub stations must be made available prior to auctions. Post auctions, any new hub station may be allowed to be established only in areas with no existing IMT base station.

(d) A software defined automated process on a portal may be created having database of coordinates of the proposed earth station in the spectrum bands under consultation. The geofencing coordinates of the proposed earth station in these spectrum bands under discussion, can provide the feasibility results through the portal for establishing earth station.

(e) ITU Resolution 243 (WRC-19) and the CEPT Report 82 for 5G mobile networks in the 40.5 – 43.5 GHz band may be applied.

(f) For the 42.5-43.5 GHz band, ITU-R recommendation ITU-R M.216136 - 'Guidelines to assist administrations to mitigate in-band interference from fixed-satellite service earth stations operating in the frequency bands 24.65-25.25 GHz, 27-27.5 GHz, 42.5-43.5 GHz and 47.2-48.2 GHz into IMT stations' should be implemented.

(g) The proposed new IMT deployment in these bands should no way constrain the existing or future deployment satellite gateway earth stations citing alibi of possible interference from satellite uplink stations.

[36] https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2161-0-202312-I!!PDF-E.pdf

Therefore, to implement appropriate interference mitigation measures should lie with IMT stations.

(h) A few stakeholders were of the view that co-existence should be left to the parties sharing these frequencies directly (instead of imposing blanket restrictions on keep-off distance or power levels). SESG should be allowed to operate anywhere, even near or in urban areas, as locating SESG near internet points of presence helps to reduce service latency.

Analysis of the issues raised through the Q11 and Q12

2.124 Most of the stakeholders were of the opinion that there is no challenge in sharing of spectrum in the frequency ranges under consideration between IMT and Satellite gateway links. However, a few stakeholders have mentioned that there could be challenges in the coexistence between IMT and Satellite gateway links.

2.125 A few stakeholders have suggested that the satellite Earth station gateways (SESGs) should be permitted to be established at uninhabited or remote locations, and as satellite gateways will be few in numbers and primarily in rural areas, sharing of spectrum between IMT and satellite gateways can be easily ensured through the appropriate exclusion zones.

2.126 The DoT through its reference dated 02.08.2023 mentioned, *inter-alia*, that 37.5-40 GHz frequency range will also be shared with satellite gateway Earth Stations with suitable protection. Considering that this frequency range, i.e. 37.5-40 GHz is identified for Fixed Satellite Service (FSS) space-to-earth communication, provisions of Article 21 of ITU-RR already exist for sharing of frequency bands amongst terrestrial and space services.

2.127 It is further noted that the WRC-19 Resolution 243 on the subject 'Terrestrial component of International Mobile Telecommunications in the frequency bands 37-43.5 GHz and 47.2-48.2 GHz' resolves as under:

"1. that administrations wishing to implement IMT consider use of the frequency band 37-43.5 GHz, or portions thereof, and the frequency band 47.2-48.2 GHz, identified for IMT in No. 5.550B and No. 5.553B, and the benefits of harmonized utilization of the spectrum for the terrestrial component of IMT taking into account the latest relevant ITU-R Recommendations;

2. that, in order to ensure coexistence between IMT in the frequency bands 37-43.5 GHz and 47.2-48.2 GHz as identified by this conference in Article 5 and other services to which the frequency band is allocated, including the protection of these other services, administrations shall apply the following condition(s):

2.1. in order to protect the Earth exploration satellite service (EESS) (passive) in the frequency band 36-37 GHz, the following unwanted emissions of IMT stations operating in the frequency band 37-40.5 GHz apply as specified in Table 1 below:

Table 1

Frequency band for the EESS (passive)	***Frequency band for IMT stations***	***Unwanted emission mean power for IMT stations[1]***	***Recommended limits for IMT stations[1]***
36-37 GHz	*37-40.5 GHz*	*−43 dB(W/MHz) and −23 dB(W/GHz) within the frequency band 36-37 GHz*	*−30 dB(W/GHz)*

[1] The unwanted emission power level is considered in terms of total radiated power (TRP). The TRP is to be understood here as the integral of the power transmitted from all antenna elements in different directions over the entire radiation sphere.

2.2. protection of space research service (SRS) earth stations in the frequency band 37-38 GHz and RAS stations in the frequency band 42.5-43.5 GHz from IMT stations should be facilitated through bilateral agreements for cross-border coordination as necessary;

2.3. protection of and coexistence with fixed-satellite service (FSS) earth stations within the frequency ranges 37.5-43.5 GHz and 47.2-48.2 GHz should be facilitated through bilateral agreements for cross-border coordination as necessary;

2.4. take practical measures to ensure the transmitting antennas of outdoor base stations are normally pointing below the horizon, when deploying IMT base stations within the frequency bands 42.5-43.5 GHz and 47.2-48.2 GHz; the mechanical pointing needs to be at or below the horizon;

2.5. as far as practicable, sites for IMT base stations in the frequency bands 42.5-43.5 GHz and 47.2-48.2 GHz employing values of equivalent isotropically radiated power (e.i.r.p.) per beam exceeding 30 dB(W/200 MHz) should be selected so that the direction of maximum radiation of any antenna will be separated from the geostationary-satellite orbit, within line-of-sight of the IMT base station, by ±7.5 degrees;

3. that IMT stations within the frequency ranges 37-43.5 GHz and 47.2-48.2 GHz are used for applications of the land mobile service."

2.128 In view of the above, the Authority is of the view that provisions for coexistence of IMT and satellite earth station gateways in ITU-RR and ITU recommendations including the provisions of WRC-19 Resolution 243 should be made applicable. The Authority is also of the view that in case challenges in coexistence of IMT and satellite earth station gateways are observed in the future, the DoT with the help of the Telecommunication Engineering Center (TEC), may come out with necessary instructions/ guidelines, which will be binding on the relevant spectrum assignees.

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

(a) The provisions of Article 21 of ITU-RR for terrestrial and space services sharing frequency bands above 1 GHz should be made applicable.

(b) For the coexistence of satellite systems and IMT, ITU-RR provisions and ITU recommendations, including WRC-19 Resolution 243, should be made applicable.

(c) Spectrum dues for 37.5-40 GHz frequency range should be revised on pro-rata basis for the authorised entities holding auction-acquired spectrum in the LSA, in which the permission for establishing satellite earth station gateway is given in the same frequency range, on account of the establishment of the satellite earth station gateways including the exclusion zone, if any.

(d) In case certain challenges are encountered in the future in the coexistence of IMT and satellite earth station gateways, DoT with the help of the Telecommunication Engineering Center (TEC), may come out with necessary instructions/ guidelines, which will be binding on the relevant spectrum assignees.

2.130 The following chapter analyses the issues related to valuation and reserve price of 37-40 GHz band.

Chapter III: Valuation and Reserve Price

A. Introduction

3.1 Millimeter Wave (mmWave) boosted networks are taking off globally, delivering multi-gigabit speeds, capacity and exceptional mobile broadband speeds.[37] There are various advantages/potential benefits of mmWave bands such as it enables higher data rates compared with lower frequencies when used in telecommunications, such as those used for Wi-Fi and cellular networks. It offers increased data capacities, meaning that mmWave networks can handle more traffic compared with other frequencies. mmWave bands are considered suitable bands for small internet of things or IoT devices.[38]

3.2 Thus, considering the above, it becomes imperative to ensure optimal valuation and reserve price fixation of the mmWave i.e. 37–37.5 GHz and 37.5–40 GHz spectrum bands in order to ensure efficient utilization of these bands.

B. Valuation of spectrum

3.3 As already recommended in para 2.27 of these recommendations, the frequency spectrum in 37-37.5 GHz and 37.5-40 GHz frequency ranges should be put to auction in the forthcoming spectrum auction and owing to non-availability of the device ecosystem in 42.5-43.5 GHz frequency range, it will be prudent that the frequency range 42.5-43.5 GHz is not put to auction in the forthcoming spectrum auction.

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[37] The unique capabilities of 5G mmWave : Ericson paper https://www.ericsson.com/en/reports-and-papers/further-insights/leveraging-the-potential-of-5g-millimeter-wave

[38] https://www.techtarget.com/searchnetworking/definition/millimeter-wave-MM-wave#:~:text=Advantages%20of%20millimeter%20wave&text=It%20enables%20higher%20data%20rates,its%20higher%20speeds%20and%20bandwidth.

3.4 Accordingly, the present chapter deals with the valuation and setting reserve price of 37–37.5 GHz and 37.5–40 GHz frequency ranges.

3.5 As already discussed in the Consultation Paper (CP) dated 04.04.2024, 37–37.5 GHz and 37.5–40 GHz bands identified for IMT are being contemplated for auction in India for the first time. There is no historical auction data available to conduct comparative analysis involving auction determined prices in India, for these frequency ranges. Hence, all the valuation methodologies used for IMT|5G spectrum valuation exercise cannot be used for valuation of 37–37.5 GHz and 37.5–40 GHz frequency bands. Accordingly, questions related to technical/ spectral efficiency approach and international benchmarking were asked.

i. Technical efficiency approach: Use of indexed ADP of 26 GHz

3.6 One of the potential approaches for valuation of 37–37.5 GHz and 37.5–40 GHz spectrum bands could be based on comparative values that can be achieved by using relative spectral efficiency approach where characteristics like capacity of a particular spectrum band can be compared with the same characteristics of another spectrum band. In this context, the following question was raised in the CP:

Q13. Whether the value of spectrum in 37–37.5 GHz, 37.5–40 GHz and 42.5–43.5 GHz spectrum bands be derived by relating it to the auction determined price/value of spectrum in any other band by using spectral efficiency factor? If yes, with which spectrum band, should these bands be related and what efficiency factor or formula should be used? Please justify your suggestions.

Comments of stakeholders

3.7 Some of the stakeholders have stated that recently discovered auction price as well as the indexed valuation of 26 GHz band in mmWave should be a key component in final valuation in the present exercise.

3.8 One stakeholder has further stated that deployment of 26 GHz has not been done in a comprehensive way, and this may create a subdued demand for 37-42 GHz. Accordingly, the reserve price/block of 37-42 GHz can be estimated to be 50% of that of the reserve price/block of 26 GHz spectrum auction in the 2022 auction.

3.9 Some stakeholders stated that spectrum efficiency factor is a subjective parameter dependent on many unknown variables in the industry and each band should be valued based on its economic value and business case, using a marginal revenue approach. Further stating that if market value of 26 GHz is considered for valuation of 37–37.5 GHz, 37.5–40 GHz and 42.5–43.5 GHz spectrum bands, this value should be reduced based on the comparative efficiency and propagation loss of these bands compared to the 26 GHz band.

3.10 On the other hand , another stakeholder stated that currently there is no clarity on the value which may be derived by the operators out of the spectrum in 26 GHz band. Hence, the winning prices in the last auction or the reserve prices for the 2024 auction cannot be considered as fair value of the spectrum in the 26 GHz band and should not be used as benchmark for determining the value of spectrum in 37–37.5 GHz, 37.5–40 GHz, and 42.5–43.5 GHz frequency bands.

Analysis

3.11 The details of the 2022 and 2024 auctions for the 26 GHz band are summarized in the table below:

Table 3.1: Bidding activity in previous auctions

Year of Auction	Reserve Price per MHz (Rs. in crore)	Quantum of spectrum put to auction (in MHz)	Auction price per MHz (Rs. in crore)	Quantum of spectrum sold (in MHz)	% Quantum of spectrum sold
2022	6.99	62700 (22 LSAs)	6.99	45350 (22 LSAs)	72%
2024	7.61	8700 (21 LSAs)	-	-	-

3.12 As given in the Table above, the Auction determined price (ADP) of July/August 2022 IMT auction of mmWave band (26 GHz) is available in all 22 LSAs. Around 72% of the spectrum put to auction was acquired by the service providers.

3.13 The above band was again put to auction in 2024, at an indexed reserve price of 7.61 crore for 21 LSAs. However, no bids were received during the 2024 auction. Consequently, no Auction Determined Price for the 26 GHz band was derived from the 2024 auction process. As a result, the Auction Determined Price for the 26 GHz band is available only from the 2022 auction.

3.14 Further, it has been noted by the Authority in the past that Economic theory suggests that pricing of a public resource should reflect, as far as possible, its current economic value, so as to encourage its most efficient, optimal and equitable use.

3.15 The economic value of a particular item, or good, is measured by the maximum amount of other things that a person is willing to give to have that good. This is also termed as Willingness to Pay. The amount or the price paid by the consumer for a good in a market economy is a universally accepted measure of economic value. Thus, the market determined price is considered as the best indicator of economic value of a good.

3.16 mmWave bands possess unique characteristics, including high capacity, faster speeds, low latency, and limited propagation and coverage[39]. Therefore, the Authority is of the view that considering the similar characteristics of mmWave bands, the auction-discovered prices of the 26 GHz band can serve as a reference point for determining the economic value of the 37–37.5 GHz and 37.5–40 GHz spectrum bands.

3.17 Further, the Authority in 2018 and in 2022 has used the 'Marginal Cost of Funds based Lending Rates (MCLR) system' for indexing the last auction determined prices. Accordingly, the Authority is of the view that auction determined prices revealed in the auction held in the year 2022, duly indexed with MCLR, be taken as one of the possible valuations in the present spectrum valuation exercise.

3.18 The authority at para 3.40 of its Recommendations on Auction of Spectrum in frequency bands identified for IMT/5G dated 11.04.2022, recommended that:

(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.

[39] https://www.techtarget.com/searchnetworking/Enterprise-5G-Guide-to-planning-architecture-and-benefits

3.19 As outlined in paragraph 3.18 above, the Authority vide its Recommendation dated 11.04.2022 recommended that spectrum valuation be conducted every three years, with interim auctions relying on auction-determined prices (ADP) from previous auctions, duly indexed where applicable.

3.20 In line with this recommendation, the ADP of the 26 GHz spectrum band from the 2022 auction, which is available for 22 LSAs, falls within the prescribed three-year timeframe. Given that no bids were received for this band in the 2024 auction, the 2022 ADP, indexed using the applicable MCLR, should be considered as one of the possible valuation benchmarks in the present spectrum valuation exercise, as per the approach outlined in paragraph 3.18.

3.21 Therefore, **the Authority is of the view that the auction determined prices of 26 GHz spectrum band auctioned in 2022, duly indexed with MCLR, should be taken as one of the possible values in present spectrum valuation exercise.**

3.22 Using this approach, the valuations arrived at for 37–37.5 GHz and 37.5–40 GHz spectrum bands are tabulated at Annexure 3.1.

ii. USE OF INTERNATIONAL SPECTRUM PRICES:

3.23 Another alternative approach for valuation of 37–37.5 GHz and 37.5–40 GHz bands could be based on international benchmarking. Accordingly, the following questions were raised in the CP:

Q14. Should international spectrum prices i.e. the auction determined price/ reserve price of other countries in 37–37.5 GHz, 37.5–40 GHz and 42.5–43.5 GHz spectrum bands serve as a basis for the purpose of valuation of these bands? If yes, what methodology can be followed in this regard? Please provide detailed information.

Q15. Apart from the approaches highlighted above which other valuation approaches should be adopted for the valuation of 37–37.5 GHz, 37.5–40 GHz and 42.5–43.5 GHz spectrum bands? Please support your suggestions with detailed methodology, related assumptions and other relevant factors, etc.

Comments of stakeholders

3.24 One stakeholder stated that in the absence of any empirical data, international benchmarking will be a key measure for valuation of these capacity bands and it should be used to avoid over-valuation.

3.25 Another stakeholder stated that internationally, the auction determined price (ADP) of mmWave spectrum bands comes to less than 1% of the ADP of mid band spectrum. However, in India, the ADP and consequently the subsequent reserve price of 26 GHz spectrum band is over 2% of the 3300 MHz band pricing. Therefore, the valuation for 40 GHz spectrum needs to be rationalized/reduced as compared to the ADP/current reserve price of 26 GHz band keeping in mind the relevant contingent factors like international benchmarking, the higher cost of building terrestrial networks in higher frequency bands, revenue potential etc.

3.26 One stakeholder stated that internationally only a few countries have successfully done auction-based allocation of the spectrum in 37–37.5 GHz, 37.5–40 GHz, and 42.5–43.5 GHz frequency bands. India as a country presents a different set of opportunities and challenges. Hence, International benchmarking method may not be an appropriate method in the current scenario.

3.27 Some stakeholders stated that international benchmarking may not be used as there are differences in the levels of maturity of the respective network as well as the social and economic parameters of India when compared with the referred international countries. Further, spectrum valuation approach must

emerge from the industry's incremental/aggregate RoCE and incremental/marginal revenue generation ability in the spectrum bands being valued. However, in the absence of other reference points this approach could be considered after being normalised to adjust for the Indian telecom sector indices, i.e., ARPU, RoCE, rollout obligations and investment.

Analysis

3.28 The Authority in its Recommendations on Auction of Spectrum in frequency bands identified for IMT/5G dated 11th April 2022 used international auction price ratio for valuation of mmWave band (26 GHz). The average auction price ratio was derived by considering the country wise ratio of auction prices per MHz per pop[40] per year for mmWave bands vis-à-vis mid-band.

3.29 The Authority was of the view that since the ratio is between auction prices of the two bands in the same country, it avoids the problem of cross-country divergences, and thereby no further normalization would be required.

3.30 In the present scenario, only one country, i.e. USA has conducted the auction of the mmWave spectrum bands. While other two countries, namely UK and Canada, have decided to auction the mmwave bands. Thus, the auction determined price ratio is available for only one country, whereas the relative reserve price ratios between the above-mentioned bands are available for two countries i.e. UK and Canada.

3.31 As mentioned earlier, auction-determined price (ADP) ratios are available for one country (USA), while reserve price (RP) ratios are available for two countries (UK and Canada). However, unlike ADP, reserve prices are not determined by the market dynamics of demand and supply. Therefore, RP

[40] pop refers to population

ratios have not been considered for spectrum valuation, as they may not provide an accurate or reliable measure of the market value of spectrum bands.

3.32 In this context, the Authority has consistently relied on auction-determined prices in its previous valuation exercises, as these prices more accurately reflect the value the market places on spectrum bands. Nevertheless, to provide additional information and insights, details regarding the reserve prices for the USA, the UK, and Canada are included in Annexure 3.2.

3.33 Internationally, only USA has conducted auction for 24.25–25.25 GHz spectrum band and also for 37 and 39 GHz spectrum bands. The ratio of auction prices per MHz per pop per year of 37 GHz band vis-à-vis 24 GHz is as tabulated below: -

Table 3.2: International Auction price ratios (USA)

S.No	Particulars	24.25-24.45 and 24.75-25.25 GHz (A)	37.6-40 GHz (B)
1	Auction determined price per MHz per pop per year (US$) (License duration =10 year)	0.000878797	0.000914998
2	**Ratio (B/A)**	**1.04**	

3.34 The Authority is of the view that the international auction price ratio of two bands reflects the relative values placed by the market internationally on the respective bands. This ratio will be independent of cross-country divergences.

3.35 Since 37–37.5 GHz and 37.5–40 GHz bands are decided to be put to auction for the first time in India, there is lack of dataset for the valuation of these bands. Hence, the Authority is of the view that it may be beneficial to consider the international prices as well to enhance the valuation efficiency of these bands.

3.36 Therefore**, the Authority is of the view that the international auction determined price ratios should be taken as one of the possible values in present spectrum valuation exercise.**

3.37 Using this approach, the valuations arrived at for the 37–37.5 GHz and 37.5–40 GHz spectrum bands are given at Annexure 3.1.

C. Average Valuation and Reserve Price Fixation

3.38 It has been the Authority's position over the years that the various approaches used in the valuation of different spectrum bands have their respective merits and constraints. Rather than relying on one valuation approach, it is prudent and rational to rely on a number of approaches to arrive at the final valuation. It is not possible to claim deterministically that any one of these models/ approaches is absolutely the right approach to arrive at the valuation, since no single approach can completely and exactly capture every variable that influences the valuation of spectrum. It is well-nigh impossible to calculate the complete range of possible valuations. Therefore, the Authority has been consistently maintaining that rather than following a deterministic approach, it is best to work with a probabilistic average valuation (through simple mean) that captures the range of possible valuations

3.39 During previous valuation exercise, the Authority estimated the value of spectrum using various valuation models and taking a mean of value derived from all approaches and the reserve price was set at 70% of the average valuation. A reserve price refers to the lower bound on the bid below which the item up for sale cannot be acquired through an auction.

3.40 Accordingly, the following questions were raised in this regard in the CP for seeking the comments of the stakeholders:

Q16. Whether the value arrived at by using any single valuation approach for a particular spectrum band should be taken as the appropriate value of that band? If yes, please suggest which single approach/method should be used. Please support your answer with detailed justification.

Q.17 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 a particular spectrum band, or some other approach like taking weighted mean etc. should be followed? Please support your answer with detailed justification.

Q18. What ratio should be adopted between the reserve price for the auction and the valuation of the spectrum in these spectrum bands and why? Please support your answer with detailed justification.

Comments of stakeholders

3.41 No specific comments have been received from stakeholders on the issues raised in Q.16 and Q.17. However in response to the issue of reserve price fixation, raised in Q.18, majority of stakeholders have stated that reserve price should be kept at 50% of the valuation of the spectrum. They are of the opinion that 50% is an optimum ratio to determine true valuation, promote new investments, reduce entry barriers, and promote competition, encourage wider participation of the TSPs in acquisition of spectrum etc.

Analysis

3.42 The Authority has carefully considered the comments of the stakeholders. Since September 2013, the Authority has been conducting spectrum valuation by taking the simple mean of the valuations obtained from the various valuation approaches, on the assumption of equal probability of occurrence of each valuation approach.

3.43 This approach is justified since the attempt is to arrive at the 'Expected Value' of the valuation of spectrum from the set of available valuations, and the simple mean serves this purpose as a measure of central location. Accordingly, the Authority has decided to use different spectrum valuation approaches, whichever feasible, and take the simple mean of the valuations obtained through the different approaches used for valuation of the spectrum band, to arrive at the average valuation.

3.44 Thus, the average valuation of 37–37.5 GHz and 37.5–40 GHz bands for each LSA is tabulated below. The valuations arrived at using different approaches for 37–37.5 GHz and 37.5–40 GHz bands are given at Annexure 3.1.

Table 3.3

Average Value per MHz

in 37–37.5 GHz and 37.5–40 GHz bands

(Rs. in crore)

LSA	Category	Average Value
Andhra Pradesh	A	**0.70**
Assam	C	**0.12**
Bihar	C	**0.33**
Delhi	Metro	**1.09**
Gujarat	A	**0.61**
Haryana	B	**0.16**
Himachal Pradesh	C	**0.06**
J&K	C	**0.04**
Karnataka	A	**0.49**
Kerala	B	**0.23**
Kolkata	Metro	**0.39**
Madhya Pradesh	B	**0.36**
Maharasthra	A	**0.77**
Mumbai	Metro	**0.96**
North East	C	**0.04**
Odisha	C	**0.15**
Punjab	B	**0.24**

Rajasthan	B	**0.31**
Tamilnadu	A	**0.56**
U. P. (East)	B	**0.37**
U.P. (West)	B	**0.36**
West Bengal	B	**0.23**

3.45 The Authority vide its Recommendations on Auction of Spectrum in frequency bands identified for IMT|5G dated 11.04.2022 recommended that reserve price should be set at 70% of the average valuation of the spectrum.

3.46 The Authority had taken the view 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.

3.47 It is worth mentioning that the reserve price should be set at an optimal level to ensure efficiency of the auction process. The Authority is of the view that in order to ensure competitive bidding and price discovery, the reserve price may continue to be set at 70% of average valuation.

3.48 Accordingly, **the Authority recommends that the reserve price for 37–37.5 GHz and 37.5–40 GHz bands should be set at 70% of the average valuation arrived at.**

3.49 Thus, **the recommended reserve price of 37–37.5 GHz and 37.5–40 GHz bands for each LSA is tabulated below: -**

Table-3.4

Recommended Reserve Price (per MHz)

in 37–37.5 GHz and 37.5–40 GHz bands

(Rs. in crore)

LSA	Category	Recommended Reserve price
Andhra Pradesh	**A**	**0.49**
Assam	**C**	**0.09**
Bihar	**C**	**0.23**

Delhi	**Metro**	**0.76**
Gujarat	**A**	**0.43**
Haryana	**B**	**0.11**
Himachal Pradesh	**C**	**0.04**
J&K	**C**	**0.03**
Karnataka	**A**	**0.34**
Kerala	**B**	**0.16**
Kolkata	**Metro**	**0.27**
Madhya Pradesh	**B**	**0.25**
Maharashtra	**A**	**0.54**
Mumbai	**Metro**	**0.67**
North East	**C**	**0.03**
Odisha	**C**	**0.10**
Punjab	**B**	**0.17**
Rajasthan	**B**	**0.21**
Tamil Nadu	**A**	**0.39**
U. P. (East)	**B**	**0.26**
U.P. (West)	**B**	**0.25**
West Bengal	**B**	**0.16**

D. Payment terms

Q19. What should the payment terms and associated conditions for the assignment of 37–37.5 GHz, 37.5–40 GHz and 42.5–43.5 GHz spectrum bands relating to:

i. Upfront payment

ii. Moratorium period

iii. Total number of installments to recover deferred payments

iv. Rate of discount in respect of deferred payment and prepayment

Please support your answer with detailed justification.

Comments of stakeholders

3.50 Some stakeholders have favoured the following payment terms, along with the existing two options as per NIA dated 8th March, 2024 stating that there should

be no requirement of upfront payment. At least a 6-year moratorium period should be allowed, in order for TSPs to be able to start realizing revenues from the spectrum before they have to make the payments for the same. A total of 14 annual instalments, after the 6 years moratorium period, should be fixed – with no upfront payment requirement. This will enable TSPs to invest in network rollout. Huge interest on deferred spectrum payments defeats the purpose of allowing a moratorium. Therefore, no interest should be levied on deferred payments. And in case interest has to be levied, it should be at the repo rate, and not the SBI PLR/MCLR, as repo rate is adequate to protect the time value of money. SBI PLR/MCLR imposes unwarranted financial burden on TSPs.

3.51 Other stakeholders have stated that the payment terms should be relaxed. The upfront payment should be kept only at 10% of the bid amount and thereafter minimum 5-year moratorium without any interest cost should be provided. They further added that the deferred payment for auction discovered spectrum price, should be spread over the remaining 15 years by way of annual payments. These annual payments should be charged with the reasonable interest rates of 6.5% as specified by RBI Repo rate, in place of current prohibitive interest rates.

Analysis

3.52 The Notice Inviting Applications 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 prescribes the following payment terms:

"*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 calendar days from the issuance of Demand Note by DoT. 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 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 calendar days from the issuance of Demand Note by DoT. The balance 19 instalments shall become due and payable on the Effective Date anniversary of each following year.*"

3.53 The Authority is of the view that similar payment terms shall be adopted for assignment of 37–37.5 GHz and 37.5–40 GHz spectrum bands.

3.54 Accordingly, **the Authority recommends that the following options for payment terms should be allowed for assignment of 37–37.5 GHz and 37.5–40 GHz spectrum bands:**

(a) <u>Option 1:</u> 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.

(b) <u>Option 2:</u> 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.

3.55 The following chapter provides a summary of recommendations.

Chapter IV: Summary of Recommendations

4.1 The Authority recommends that –

(a) The frequency spectrum in 37-37.5 GHz and 37.5-40 GHz frequency ranges should be put to auction in the forthcoming spectrum auction.

(b) Band pan n260 with TDD-based duplexing configuration should be adopted for 37-40 GHz frequency range.

(c) Owing to the non-availability of the device ecosystem in 42.5-43.5 GHz frequency range, it will be prudent that the frequency range 42.5-43.5 GHz is not put to auction in the forthcoming spectrum auction. The DoT may send a separate reference for seeking the Authority's recommendations for 42.5-43.5 GHz frequency range for IMT at an appropriate time.

[Para 2.27]

4.2 The Authority recommends that the frequency spectrum in the band n260 (37-40 GHz) should be auctioned with a validity period of 20 years.

[Para 2.37]

4.3 The Authority recommends that the frequency spectrum in the band n260 (37-40 GHz) should be auctioned on LSA (Telecom Circle/ Metro) basis.

[Para 2.44]

4.4 The Authority recommends that the frequency band n260 (37-40 GHz) should be auctioned with a block size of 100 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.

[Para 2.54]

4.5 The Authority recommends that spectrum cap for the frequency band n260 (37-40 GHz) should be kept as 40% of the total spectrum put to auction and it should not be clubbed with 26 GHz band for the purpose of spectrum cap.

[Para 2.67]

4.6 The Authority recommends that

(a) The minimum roll-out obligations for band n260 (37-40 GHz) should be similar to that prescribed for 26 GHz band in the NIA, 2024.

(b) The minimum roll-out obligations should be equally applicable for all the TSPs i.e., existing as well as the new TSPs.

[Para 2.85]

4.7 The Authority recommends that -

(a) In addition to the entities holding the access service authorisation, the following entities should also be permitted to participate in the auction of spectrum for frequency band n260 (37-40 GHz):

(i) The entities holding Internet service authorisation holders for category 'A' and category 'B' service area

(ii) The entities holding authorisation for M2M service category A/ B under the Unified License, or M2M WAN Service Authorisation with service area as national (category-A) or Telecom circle/ Metro Area (Category-B), as recommended by the Authority through Recommendations dated 18.09.2024.

(b) The successful bidders will be permitted to use the acquired spectrum to offer service as per the scope of their respective service authorisations.

(c) The relevant security related provisions should be included in the Internet Service Authorisation and M2M WAN Service Authorisation which should become applicable if such authorisation holders acquire access spectrum.

(d) The existing provisions for the surrender of access spectrum should be extended to all successful bidders, including Internet Service providers and M2M WAN service Authorisation.

(e) Regarding spectrum sharing, trading, and leasing, the provisions that need to be made applicable for ISPs and M2M WAN service providers, require detailed examination and consultation with stakeholders. Therefore, in case DoT agrees with the Authority's recommendation to permit such entities to participate in the spectrum auction for the frequency band n260 (37-40 GHz), it may go ahead with the spectrum auction, and if required, it may subsequently send a separate reference to the Authority with respect to sharing, trading and leasing of spectrum among such entities.

[Para 2.109]

4.8 The Authority recommends that to mitigate inter-operator interference in 37-40 GHz band with TDD configuration, the following measures should be taken –

(a) In case a TSP acquires more than one block, the entire spectrum should be assigned to it in a contiguous manner.

(b) In case a TSP acquires spectrum in more than one LSA, same frequency spots should be assigned to it in all those LSAs, to the extent possible.

(c) Interference mitigation should be left to the mutual coordination between the TSPs.

[Para 2.115]

4.9 The Authority recommends that-

(a) The provisions of Article 21 of ITU-RR for terrestrial and space services sharing frequency bands above 1 GHz should be made applicable.

(b) For the coexistence of satellite systems and IMT, ITU-RR provisions and ITU recommendations, including WRC-19 Resolution 243, should be made applicable.

(c) Spectrum dues for 37.5-40 GHz frequency range should be revised on pro-rata basis for the authorised entities holding auction-acquired spectrum in the LSA, in which the permission for establishing satellite earth station gateway is given in the same frequency range, on account of the establishment of the satellite earth station gateways including the exclusion zone, if any.

(d) In case certain challenges are encountered in the future in the coexistence of IMT and satellite earth station gateways, DoT with the help of the Telecommunication Engineering Center (TEC), may come out with necessary instructions/ guidelines, which will be binding on the relevant spectrum assignees.

[Para 2.129]

4.10 The Authority recommends that the reserve price for 37–37.5 GHz and 37.5–40 GHz bands should be set at 70% of the average valuation arrived at.

[Para 3.48]

4.11 The recommended reserve price of 37–37.5 GHz and 37.5–40 GHz bands for each LSA is tabulated below: -

Table-3.4

Recommended Reserve Price (per MHz)

in 37–37.5 GHz and 37.5–40 GHz bands

(Rs. in crore)

LSA	Category	Recommended Reserve price
Andhra Pradesh	A	0.49
Assam	C	0.09
Bihar	C	0.23
Delhi	Metro	0.76
Gujarat	A	0.43
Haryana	B	0.11
Himachal Pradesh	C	0.04
J&K	C	0.03
Karnataka	A	0.34
Kerala	B	0.16
Kolkata	Metro	0.27
Madhya Pradesh	B	0.25
Maharashtra	A	0.54
Mumbai	Metro	0.67
North East	C	0.03
Odisha	C	0.10
Punjab	B	0.17
Rajasthan	B	0.21
Tamil Nadu	A	0.39
U. P. (East)	B	0.26
U.P. (West)	B	0.25
West Bengal	B	0.16

[Para 3.49]

4.12 The Authority recommends that the following options for payment terms should be allowed for assignment of 37–37.5 GHz and 37.5–40 GHz spectrum bands:

(a) <u>Option 1:</u> 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.

(b) <u>Option 2:</u> 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 3.54]

ANNEXURES

Annexure - 1.1: DoT letter No. L-14006/01/2023-IMT dated 02.08.2023

(Without Annexures)

Government of India
Ministry of Communications
Department of Telecommunications
Wireless Planning & Coordination (WPC) Wing

6th floor, Sanchar Bhawan,
20, Ashoka Road, New Delhi – 110001.

No.: L-14006/01/2023-IMT Date: 02.08.2023

To,

The Secretary
Telecom Regulatory Authority of India
Mahanagar Doorsanchar Bhawan
Jawahar Lal Nehru Marg (Old Minto Road)
New Delhi-110002.

Subject: Seeking TRAI recommendations for the auction of spectrum in the frequency bands identified for International Mobile Telecommunications (IMT).

Sir,

In response to DoT's reference dated 13.09.2021, TRAI had provided its recommendations dated 11.04.2022 on various issues involved in the auction of spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands. Based on the TRAI recommendations dated 11.04.2022 and its subsequent response dated 09.05.2022 on DoT's back-reference, Government conducted auction of spectrum in the above frequency bands during July-August, 2022.

(i) A total of 72097.85 MHz spectrum in different band-LSA combinations worth Rs. 4,31,605 crores (at Reserve Price) were made available for bidding. A quantum of 51236.2 MHz worth Rs. 150173.3 crores were sold in the auction. However, no bids were received in the 600 MHz and 2300 MHz bands during the auction. As per the TRAI recommendations, a comprehensive report (***Annexure – I***) analysing the outcomes of the above auction was also communicated on 14.12.2022 to the TRAI.

2. Further, the following developments took place after the completion of the spectrum auctions held during July-August 2022:

(i) Indian Railways surrendered 1.6 MHz of paired spectrum in the 900 MHz band in the Jammu & Kashmir LSA, which can be included in the next auction.

(ii) Based on the recommendations of TRAI on Spectrum Requirements of National Capital Region Transport Corporation (NCRTC) for Train Control System for RRTS Corridors dated 28.12.2022, 5 MHz of paired spectrum has been assigned to NCRTC on provisional basis in the 700 MHz band. The same will be regularised after the final decision is taken on the above TRAI Recommendations.

1

(iii) Recently, as per the decision taken by the Union Cabinet in its meeting held on 07.06.2023, the Department has reserved for BSNL's 5G purpose, 10 MHz (paired) spectrum in the 700 MHz band in all 22 LSAs in lieu of the 10 MHz (paired) spectrum previously reserved in the 600 MHz band, additional 30 MHz spectrum to the already reserved 40 MHz in the 3300 MHz band in all 22 LSAs, additional 400 MHz to the already reserved 400 MHz in the 26 GHz band in all but Kerala LSA. In Kerala LSA, 250 MHz in addition to already reserved 400 MHz in 26 GHz band is being kept reserved for 5G services of BSNL.

(iv) Further, the Cabinet in its above meeting, has also decided to allot additional 20 MHz of spectrum in the Andhra Pradesh, Karnataka, Kolkata, Tamil Nadu, Delhi and Mumbai LSAs and 10 MHz of spectrum in Gujarat and Maharashtra LSAs to BSNL in the 2500 MHz band for the roll out of 4G services, in addition to already reserved spectrum in various bands for them for 4G services through the Cabinet decision of 2019.

These additional spectrum provisions for BSNL need to be kept out of the next auction.

2.1 In addition to above, Department of Telecommunications (DoT) has decided to make available the following new frequency bands as detailed below for IMT, which can be made available for bidding in the next auction.

Sl No	Applications/Services	Frequency bands
1.	IMT	37-37.5 GHz
2.	IMT (to share with Satellite Gateway Earth Stations with suitable protection)	37.5 – 40 GHz, 42.5-43.5 GHz

2.2 The LSA-wise quantum available with the Government in the existing bands after the auction, taking into consideration the facts mentioned in the paras 2 (i) to (iv) and 2.1 above is given in **Annexure-II**

2.3 Moreover, part of the administratively assigned spectrum to various TSPs, including that of BSNL, will be expiring during the year 2024; the same may also be included in the next auction. The LSA-wise details of such spectrum (2024 expiring) is placed at **Annexure-III.**

2.4 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.

3. Considering the above, the competent authority has decided that the spectrum mentioned at Para 2.2 and 2.3 above (**Annexure-II** and **Annexure-III** respectively) may be made available for bidding in the next auction for IMT. 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.

4. 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 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.

(b) 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.

This issues with the approval of the competent authority.

(Gulab Chand)
Joint Wireless Adviser

Enclosures:

i) ***Annexure I***: A comprehensive report analysing the outcomes of the auction held during July/August 2022.

ii) ***Annexure-II***: LSA-wise quantum available with the Government in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz, 26 GHz after July-August, 2022 auction and new 40 GHz bands (37-43.5 GHz range); taking into account the spectrum surrendered by Indian Railway, taking out the spectrum reserved/ proposed to be assigned to BSNL/MTNL and Railways/ NCRTC.

iii) ***Annexure-III***: LSA-wise quantum of the administratively assigned spectrum which is due for expiry during 2024.

Annexure - 1.2: TRAI letter No. C-15/2/(2)/2023-NSL-II dated 01.09.2023

(Without Annexures)

भारतीय दूरसंचार विनियामक प्राधिकरण
TELECOM REGULATORY AUTHORITY OF INDIA
भारत सरकार / Government of India

No. C-15/2/(2)/2023-NSL-II
Date: 01.09.2023

To,

The Secretary,
Department of Telecommunications,
Sanchar Bhawan, 20 Ashoka Road, New Delhi - 110 001.

Subject: DoT's letter dated 02.08.2023 seeking TRAI's Recommendations for the auction of spectrum in the frequency bands identified for International Mobile Telecommunications (IMT) - reg.

Kindly refer to the DoT's letter No. L-14006/01/2023-IMT dated 02.08.2023, on the subject - 'seeking recommendations for the auction of spectrum in the frequency bands identified for International Mobile Telecommunications (IMT)'. A copy of the said letter is enclosed.

2. As mentioned in the above-referred letter, in response to the DoT's reference dated 13.09.2021, TRAI had provided its recommendations dated 11.04.2022 on various issues involved in the auction of spectrum in the 600 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300 MHz and 26 GHz bands; based on the TRAI's recommendations dated 11.04.2022 and its subsequent response dated 09.05.2022 on DoT's backreference, the Government conducted auction of spectrum in the above frequency bands during July-August 2022.

3. Through the said letter dated 02.08.2023, DoT has mentioned the developments that took place after the completion of spectrum auctions held during July-August 2022. It has also been mentioned that DoT has decided to make available the new frequency bands viz. 37-37.5 GHz, 37.5-40 GHz, and 42.5-43.5 GHz for IMT, which can be made available for bidding in the next auction. DoT has also provided the LSA-wise quantum of spectrum available with the Government for auction of spectrum and details of the administratively assigned spectrum which will be expiring in the year 2024, which may also be included in the next auction.

Cont'd

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"Effective Regulation - Ease of Communication"

4. With this background, under the terms of clause 11 (1)(a) of TRAI Act, 1997, (as amended), DoT has requested TRAI to -

a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 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.

b) 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.

5. It may be noted that, TRAI through the recommendations dated 11.04.2022 on 'Auction of spectrum in the frequency bands identified for IMT/5G', provided, *inter-alia*, recommendations in the matter of regular conduct of spectrum auctions on annual basis (or at shorter intervals). The recommendations made at Para 6.42 of the TRAI's recommendations dated 11.04.2022 are reproduced below:

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

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

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

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

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

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

6. Subsequently, DoT, through its letter dated 29.04.2022, referred back some of the recommendations made through the TRAI's recommendations dated 11.04.2022 on 'Auction of spectrum in the frequency bands identified for IMT/5G'. With respect to the recommendation made at para 6.42 (as mentioned in the para above), through the back-reference dated 29.04.2022, DoT mentioned that:

> *"DoT is of the view that given the fast-changing techno-commercial ecosystem, spectrum valuation at shorter intervals may be desirable. For instance, in LSAs/bands where spectrum remains unsold, there could be a case for reduction in reserve prices. Alternatively, there could be a spectrum band which may become more valuable due to a technological break-through.*
>
> *Hence, it is proposed that recommendations of TRAI on spectrum pricing would be sought before conduct of every auction."*

7. TRAI in its response dated 09.05.2022 to the DoT's back-reference dated 29.04.2022, concluded that:

> *"..the Authority does not agree with DoT's proposal to seek the Authority's recommendations before conduct of every (annual/ shorter interval) auction, as this would not be necessary unless DoT comes to a conclusion that the changes in the techno-commercial ecosystem and other factors warrants a fresh valuation. The Authority reiterates its recommendation given at paragraph 6.42 of the Recommendations dated 11.04.2022. As recommended at sub-paragraph (IV) thereof, in case DoT would like to seek the Authority's recommendations for existing spectrum bands in the interim period between periodic valuation exercises conducted once every three years, it may do so with a full and reasoned justification for the same. For new spectrum bands to be put to auction for the first time, the recommendation at sub-paragraph (III) of paragraph 6.42 would be applicable."*

8. In view of the above, and in the absence of full and reasoned justification by DoT for seeking fresh reserve prices from the Authority for the existing bands, recommendations at para 6.42 (II) of the TRAI's recommendations dated 11.04.2022 are applicable for all bands and for all LSAs referred through Annexure-II and Annexure III of the DoT's letter dated 02.08.2023 except for the new referred bands viz. 37-37.5 GHz, 37.5-40 GHz and 42.5-43.5 GHz. Therefore, for 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, auction may be conducted as per the recommendations at para 6.42 (II) of the TRAI's Recommendations dated 11.04.2022.

9. With regard to band plan, block size, and associated conditions for auction of 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 bands for IMT, it may be noted that the previous recommendations for auction of spectrum in these bands were made on 11.04.2022, based on which the auction was conducted during July-August 2022. The Authority is of the view that in such a short span of time since the previous recommendations, no technological developments or market changes have occurred that warrant any change in the band plan, block size, and associated conditions for auction of spectrum in the existing bands. The Authority also notes the changes made by the Government in the roll-out obligations in the Auctions of 2022. As regards the quantum of spectrum to be auctioned, the Authority maintains its position that all available spectrum should be put to auction.

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

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

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

This is issued with the approval of the Competent Authority.

Enclosure: As above

V. Raghunandan

(V. Raghunandan)
Secretary, TRAI
Tel: 23237448
Email: secretary@trai.gov.in

Annexure 3.1

Valuation (per MHz)

of 37–37.5 GHz and 37.5–40 GHz bands

(Rs. in crore)

LSA	Category	Auction Price of 26 GHz (per MHz) duly indexed	Using International ADP ratio	Average (mean) Value
Andhra Pradesh	A	0.68	0.71	**0.70**
Assam	C	0.12	0.12	**0.12**
Bihar	C	0.32	0.34	**0.33**
Delhi	Metro	1.07	1.11	**1.09**
Gujarat	A	0.60	0.62	**0.61**
Haryana	B	0.16	0.16	**0.16**
Himachal Pradesh	C	0.06	0.06	**0.06**
J&K	C	0.04	0.04	**0.04**
Karnataka	A	0.48	0.50	**0.49**
Kerala	B	0.23	0.24	**0.23**
Kolkata	Metro	0.38	0.40	**0.39**
Madhya Pradesh	B	0.35	0.36	**0.36**
Maharasthra	A	0.76	0.79	**0.77**
Mumbai	Metro	0.94	0.97	**0.96**
North East	C	0.04	0.04	**0.04**
Odisha	C	0.14	0.15	**0.15**
Punjab	B	0.24	0.25	**0.24**
Rajasthan	B	0.30	0.31	**0.31**
Tamilnadu	A	0.55	0.57	**0.56**
U. P. (East)	B	0.36	0.37	**0.37**
U.P. (West)	B	0.35	0.36	**0.36**
West Bengal	B	0.23	0.24	**0.23**

Annexure 3.2

International Reserve Prices

1. **UK** [41]

- Ofcom has plans for the auction of licences for spectrum in the 26 GHz and 40 GHz bands. Ofcom has decided to offer the frequencies in 200 MHz lots.

- There are total of 15 lots in the 40 GHz (40.5-43.5 GHz) spectrum band. Each lot will comprise of a block of 200 MHz.

- Reserve prices are as follows:
  - £2m for each lot of 26 GHz,
  - and £1m for each lot of 40 GHz.

- It was noted that the lower reserve price for 40 GHz lots reflects the less developed ecosystem compared to 26 GHz.

- The reserve price of 26 GHz was set using international benchmarking, considering ADP of other European countries.

2. **Canada**[42]

Spectrum Bands- 26 GHz and 38 GHz

- The proposed opening bid amounts in terms of $/MHz/pop for the mmWave bands auction are the following:

[41] https://www.ofcom.org.uk/spectrum/innovative-use-of-spectrum/paving-the-way-for-improved-5g-and-innovative-new-wireless-services/
https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-1-10-weeks/237135-enabling-mmwave-spectrum-for-new-uses/november-2023-documents/consultation-statement-mmwave-auction-design.pdf
[42] https://ised-isde.canada.ca/site/spectrum-management-telecommunications/sites/default/files/attachments/2022/SPB-001-22-ENvJUL7.pdf

- Metro Tier 5 service areas: $0.002/MHz/pop
- Urban Tier 5 service areas: $0.001/MHz/pop
- Rural Tier 5 service areas: $0.0002/MHz/pop
- Remote Tier 5 service areas: $0.0001/MHz/pop

- For each service area, the proposed opening bids were determined by multiplying the proposed prices in $/MHz/pop as outlined above by the population of the service area and 100 MHz. This was based on the USA approach.

LIST OF ACRONYMS

3GPP	3rd Generation Partnership Project
4G	Fourth Generation
5G	Fifth Generation
AGR	Adjusted Gross Revenue
BHQ	Block Headquarters
BS	Base Station
BSNL	Bharat Sanchar Nigam Limited
BWA	Broadband Wireless Access
CEPT	European Conference of Postal and Telecommunications Administrations
CMTS	Cellular Mobile Telephone Services
CPE	Customer Premise Equipment
DHQ	District Headquarters
DoT	Department of Telecommunications
EESS	Earth Exploration Satellite Service
EIRP	Equivalent Isotropic Radiated Power
ETSI	European Telecommunication Standards Institute
FCC	Federal Communications Commission
FCFS	First Come First Serve
FDD	Frequency Division Duplexing
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GHz	Giga Hertz
GSA	Global mobile Suppliers Association
IMT	International Mobile Telecommunications
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ISED	Innovation, Science and Economic Development
ITU	International Telecommunication Union

ITU-R	International Telecommunication Union Radiocommunication
KYC	Know Your Customer
LPWAN	Low Power Wide Area Network
LSA	Licensed Service Area
LTE	Long Term Evolution
M2M	Machine-to-Machine
MCLR	Marginal Cost of Landing Rate
MHz	Mega Hertz
mmWave	millimeter Wave
MRO	Minimum Roll-out Obligations
NCRTC	National Capital Region Transport Corporation
NFAP	National Frequency Allocation Plan
NIA	Notice Inviting Applications
NMA	Nomadic Wireless Access
NTIA	National Telecommunications and Information Administration
NR	New Radio
OEM	Original Equipment Manufacturer
Ofcom	Office of Communications
OHD	Open House Discussion
PEA	Partial Economic Areas
PDN	Public Data Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RR	Radio Regulation
SDCA	Short-Distance Charging Area
SESG	Satellite Earth Station Gateway
SRS	Space Research Service
SSA	Secondary Switching Area
TDD	Time Division Duplexing
TEC	Telecommunication Engineering Center

TRAI	Telecom Regulatory Authority of India
TRP	Total Radiated Power
TSP	Telecom Service Provider
UASL	Unified Access Service License
UL	Unified License
UK	United Kingdom
UMFUS	Upper Microwave Flexible Use Service
USA	United States of America
WAN	Wide Area Network
WBB ECS	Wireless Broadband Electronic Communications Services
WRC	World Radiocommunication Conference