



भारतीय दूरसंचार विनियामक प्राधिकरण
Telecom Regulatory Authority of India



Consultation Paper on
Terms and Conditions for the Assignment of Spectrum
for Certain Satellite-Based Commercial Communication Services

New Delhi, India
27th September 2024

Written Comments on the Consultation Paper are invited from stakeholders by 18th October 2024 and counter-comments by 25th October 2024. The comments and counter-comments may be sent, preferably in electronic form, to Shri Akhilesh Kumar Trivedi, Advisor (Networks, Spectrum and Licensing), TRAI on the email ID advmn@traigov.in. Comments and counter-comments received from stakeholders will be posted on the TRAI's website (www.traigov.in).

For any clarification/ information, Shri Akhilesh Kumar Trivedi, Advisor (Networks, Spectrum and Licensing), TRAI, may be contacted at Telephone No. +91-11-20907758.

CONTENTS

Chapter I: Introduction and Background	1
Chapter II: Aspects of Satellite Communication Services.....	8
Chapter III: Issues Related to the Assignment of Spectrum for Certain Satellite-based Commercial Communication Services	25
Chapter IV: Spectrum Charging Mechanism for Satellite-Based Commercial Communication Services	48
Chapter V: Issues for Consultation	61
Annexures.....	67

Chapter I: Introduction and Background

A. Background

- 1.1 Through the letter No. L-14006/01/2021-NTG dated 13.09.2021 (**Annexure 1.1**), the Department of Telecommunications (DoT), Ministry of Communications, Government of India sent a reference on the subject- "Seeking TRAI recommendations for the auction of spectrum in the frequency bands identified for International Mobile Telecommunications (IMT)/ 5G" to Telecom Regulatory Authority of India (hereinafter, also referred to as "TRAI", or "the Authority"). Through the reference letter dated 13.09.2021, TRAI was requested to provide recommendations, *inter-alia*, on the auction of spectrum for space-based communication services. The relevant extract of the reference letter dated 13.09.2021 is reproduced below:

"6. The Department of Space had invited comments on Draft Spacecom Policy liberalizing space segment for private sector participation to provide commercial communication services in India. This includes the Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) satellite constellations operational over India. In case of satellite communication, the subscriber is accessed from the satellite through "Access Spectrum" similar to "Access Spectrum" in terrestrial network and the demand for such spectrum will potentially increase in the future.

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

...

7(c) provide recommendations on appropriate frequency bands, band plan, block size, applicable reserve price, quantum of spectrum to be auctioned and associated conditions for auction of spectrum for space-based communication services, in view of para 6 above."

- 1.2 In this regard, TRAI, through the letters dated 27.09.2021 and 23.11.2021, sought, *inter-alia*, the following information/ clarifications in respect of space-based communication services from DoT:
- (a) Details of the frequency bands and quantum of spectrum available in each band required to be put to auction and associated information in respect of space-based communication.
 - (b) Whether spectrum for space-based communication is being envisaged to be assigned on exclusive basis or it would be shared among multiple service licensees?
 - (c) Details of spectrum assignment mechanism and methodology of charging currently being followed by DoT for space-based communication services.
- 1.3 In response, DoT through the letter dated 27.11.2021 informed, *inter-alia*, that the information in respect of space-based communication services sought by TRAI will take some time; therefore, to avoid delay in 5G roll-out, TRAI may go ahead with consultations/ recommendations on issues excluding space-based communication services referred to in DoT's reference dated 13.09.2021 and 23.09.2021. Through the said letter, DoT also mentioned that the issues related to space-based communication services may be taken up separately on the receipt of information from DoT.
- 1.4 Thereafter, through the letter No. J-19022/01/2022-SAT dated 16.08.2022 **(Annexure 1.2)**, DoT provided information with respect to space-based communication services as sought by TRAI through the letters dated 27.09.2021 and 23.11.2021. While providing the said information, DoT requested TRAI to provide recommendations on certain additional issues. The relevant extracts of the DoT's letter dated 16.08.2022 are given below:
- (a) TRAI, through consultations, may assess the demand for space-based communication services and accordingly provide recommendations on the quantum of spectrum in each band required to be put to auction.

- (b) It is envisaged to auction the space spectrum on an exclusive basis. TRAI may explore feasibility and procedure of sharing auctioned spectrum among multiple service licensees. TRAI may provide recommendations on the sharing of auctioned frequency bands between satellite networks and terrestrial networks also, the criteria for sharing and appropriate interference mitigation techniques for sharing and coexistence.
- (c) In frequency bands 27.5-28.5 GHz (identified for IMT) and 28.5-29.5 GHz (being studied for Captive Non-Public Networks), TRAI may recommend a mechanism for sharing of auctioned frequency bands in which both IMT/ CNPN and satellite-based services (both user terminal and Gateways) can be provided in a flexible manner.
- (d) Since the service providers may require spectrum both in user link as well as in feeder link, TRAI may take inputs from the stakeholders and recommend the appropriate auction methodology so that the successful bidder gets spectrum for user link (shared with IMT in flexible) as well as feeder link.
- (e) In addition, TRAI may provide any other recommendations as 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 ITU-R Radio Regulations.

1.5 Through the afore-mentioned letter dated 16.08.2022, DoT provided a list of frequency bands to be considered by TRAI for providing recommendations with respect to space-based communication services, as given below:

S. No.	Frequency Band	Link	Remarks
1	10.7 – 12.75 GHz	Space to Earth	
2	12.75 – 13.25 GHz	Earth to Space	
3	13.75 – 14.5 GHz	Earth to Space	
4	17.7 – 18.6 GHz	Space to Earth	17.7 – 18.4 GHz is used for Earth to Space also.
5	18.8 – 19.3 GHz	Space to Earth	
6	19.3 – 19.7 GHz	Space to Earth	
7	19.7 – 21.2 GHz	Space to Earth	

8	27.5 – 29.5 GHz	Earth to Space	27.5 – 28.5 GHz has been identified for implementation of IMT in India.
9	29.5 – 31 GHz	Earth to Space	

1.6 While providing the above list of frequency bands, DoT also mentioned that *"TRAI can however provide recommendations for other frequency bands also"*.

1.7 Thereafter, through a letter dated 19.10.2022, TRAI requested DoT to, *inter-alia*, clarify that for which kind of licensed services, spectrum for space-based communication has been envisaged to be granted through auction. DoT was requested to provide information as per the following table:

S. No.	Type of service	Whether spectrum is envisaged to be assigned through auction (Yes/ No)?	Reasons, if any
1	Access		
2	Internet		
3	NLD		
4	ILD		
5	GMPCS		
6	VSAT CUG (Commercial)		
7	Captive VSAT CUG		
8	Machine to Machine (M2M)		
9	DTH		
10	Teleport		
11	DSNG		
12	HITS		
13	Any other relevant service (please specify)		

1.8 In response, DoT, through the letter dated 16.12.2022, conveyed that TRAI may provide suitable recommendations for each of the space-based communication services after detailed examination.

1.9 In this regard, TRAI released a consultation paper on 'Assignment of Spectrum for Space-based Communication Services' dated 06.04.2023 for soliciting comments of stakeholders on the issues related to assignment of spectrum for space-based communication services. As part of the consultation process, an Open House Discussion (OHD) was conducted on 14.07.2023 through online mode.

1.10 In the meanwhile, in December 2023, the Parliament enacted a new statute namely, 'the Telecommunication Act, 2023'¹. The Act amends and consolidates the law relating to development, expansion and operation of telecommunication services and telecommunication networks, assignment of spectrum, and for matters connected therewith or incidental thereto. The section 4 (4) of the Telecommunications Act, 2023 is reproduced below:

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

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

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

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

1.11 The First Schedule of the Telecommunications Act, 2023 lists 19 items for 'assignment of spectrum through administrative process'. The relevant items of the First Schedule are reproduced below:

"14. In-flight and maritime connectivity.

15. Space research and application, launch vehicle operations and ground station for satellite control.

16. Certain satellite-based services such as: Teleports, Television channels, Direct To Home, Headend In The Sky, Digital Satellite News Gathering, Very Small Aperture Terminal, Global Mobile Personal Communication by Satellites,

¹ <https://egazette.gov.in/WriteReadData/2023/250880.pdf>

National Long Distance, International Long Distance, Mobile Satellite Service in L and S bands."

- 1.12 In view of the above, TRAI, through a letter dated 08.02.2024, conveyed DoT that *"the DoT's Reference requesting TRAI to provide its recommendations for auction of spectrum for space-based communication services, may require a review by DoT. Therefore, DoT is requested to provide the specific issues on which TRAI's recommendations are required on the subject."*

B. The DoT's Instant Reference Dated 11.07.2024

- 1.13 Through a letter dated 11.07.2024 (**Annexure-1.3**), DoT has sent a fresh reference to the Authority under Section 11(1)(a) of the TRAI Act, 1997 on the subject – 'Seeking TRAI recommendations on terms and conditions of spectrum assignment including spectrum pricing for certain satellite-based commercial communication services'. The DoT's reference dated 11.07.2024 is reproduced below:

"TRAI in its letter No. C-15/2/(2)/2022-NSL-II dated 08 February 2024 requested DoT to review its earlier reference No. L-14006/01/2021-NTG dated 13/09/2021 to TRAI seeking their recommendations for auction of spectrum for space-based communication services in view of the provisions of the Section 4 & First Schedule of the Telecommunications Act 2023.

2. It is to inform that a reference dated 21/06/2024 has already been sent to TRAI for seeking recommendations on terms and conditions, including fees or charges, for authorization to provide telecommunication services (including satellite-based communication services) as per the provisions of the Telecommunications Act, 2023.

3. Since the last reference dated 13/09/2021 to TRAI on spectrum for space-based communication services, a few Unified Licenses with VSAT CUG, Global Mobile Personal Communication by Satellite (GMPCS), NLD and ISP Category 'A' authorizations have been issued by DoT for providing satellite-based communication services through Non-Geostationary Orbit (NGSO)

satellites. For assignment of spectrum to such licensees, terms and conditions of spectrum assignment including spectrum pricing need to be finalized.

4. Keeping in view the provisions of Section 4 and the First Schedule of the Telecommunications Act-2023, in terms of Section 11(1)(a) of TRAI Act 1997, TRAI is requested to provide its recommendations on terms and conditions of spectrum assignment including spectrum pricing while accounting for level playing field with terrestrial access services for the following satellite-based communication services:

- i. NGSO based Fixed Satellite Services providing data communication and Internet services. In its recommendations, TRAI may take into account services provided by GSO-based satellite communication service providers.*
- ii. GSO/ NGSO based Mobile Satellite Services providing voice, text, data, and internet services.”*

C. The Present Consultation Paper

1.14 In this background, this consultation paper has been prepared to solicit comments of stakeholders on specific issues related to the terms and conditions for assignment of spectrum for certain satellite-based commercial communication services. This Chapter provides the background information. Chapter II provides a brief description of the aspects of satellite communication systems. Chapter III examines the issues related to terms and conditions for assignment of spectrum for certain satellite-based commercial communication services. Chapter IV examines the issues related to spectrum charging mechanism for satellite-based commercial communication services. Chapter V summarizes the issues for consultation.

Chapter II: Aspects of Satellite Communication Services

A. Evolution of Wireless Telegraphy

- 2.1 In 1864, James Clerk Maxwell published a paper titled 'A Dynamical Theory of the Electromagnetic Field' which predicted the existence of electromagnetic waves capable of transmitting signals through space². In 1887, Heinrich Hertz experimentally confirmed Maxwell's theories by generating and detecting electromagnetic waves and demonstrated that electromagnetic waves could be transmitted and received³.
- 2.2 Guglielmo Marconi in 1895, after a few preliminary experiments with Hertzian waves, became convinced that *if these waves or similar waves could be reliably transmitted and received over considerable distances a new system of communication would become available possessing enormous advantages over flashlights and optical methods, which are so much dependent for their success on the clearness of the atmosphere*⁴. In December 1901, Marconi succeeded in receiving a message – a series of three "bips" Morse code for the letter "s" – at St. John's, Newfoundland, across the Atlantic Ocean from Cornwall, England⁵.

B. Evolution of Satellite Communication Services

- 2.3 The Second World War stimulated the expansion of two very distinct technologies – Radar and microwaves. The expertise eventually gained in the combined use of these two techniques opened the era of satellite communications.

² Source: The Royal Society [<https://royalsocietypublishing.org/doi/epdf/10.1098/rstl.1865.0008>]

³ Source: Electric Waves: Being Researches on the Propagation of Electric Action with Finite Velocity through Space by Heinrich Hertz [[https://babel.hathitrust.org/cgi/pt?id=uc1.\\$b104628](https://babel.hathitrust.org/cgi/pt?id=uc1.$b104628)]

⁴ Source: <https://www.nobelprize.org/uploads/2018/06/marconi-lecture.pdf>

⁵ Source: ibid

- 2.4 In 1945, Arthur C. Clarke proposed the first practical satellite communication concept in his paper⁶ titled '*Extra-Terrestrial Relays: Can Rocket Stations Give World-wide Radio Coverage?*'. He proposed that placing satellites at an altitude of 35,786 km would be ideal for satellite communications, since an antenna on the ground can be pointed to a satellite without tracking its position. He calculated that three such satellites spaced equidistantly would be able to provide near-global radio coverage⁷.
- 2.5 In October 1957, the Soviet Union launched the first artificial satellite – 'Sputnik 1'. In December 1958, the United States of America launched the first satellite to relay voice signals. In July 1962, AT&T Bell Telephone Laboratories (now Nokia Bell Labs) and NASA launched Telstar 1, the first communications satellite⁸. Telstar 1 was the first active communication satellite, transmitting live TV images between Europe and North America. It also transmitted the first phone call via satellite from the ground station in Andover, Maine to Washington DC. In April 1965, Intelsat 1 satellite was launched to provide regular telecom and broadcasting services between North America and Europe⁹.

C. Evolution of Satellite Communication in India

- 2.6 India launched its first satellite, Aryabhata in 1975. In 1980, it launched Rohini satellite (RS-1) making it the seventh country to perform orbital launches. In 1988, India launched its first IRS (remote-sensing satellite). The launch of INSAT-1A satellite in 1982 marked the beginning of a new era of satellite communications. Over the years, the INSAT series brought advanced capabilities in telecommunication, broadcasting, and meteorological services. In 2001, India launched GSAT-1 satellite, which further expanded India's communication satellite capabilities. The introduction of the CMS series with

⁶ Source: Progress in Astronautics and Rocketry, Communication Satellite Systems Technology Volume 19, [doi:10.1016/b978-1-4832-2716-0.50006-2]

⁷ Source: <https://www.britannica.com/technology/satellite-communication>

Source: ⁸ <https://www.bell-labs.com/about/history/innovation-stories/telstar-1/>

⁹ Source: <https://www.britannica.com/technology/satellite-communication/Development-of-satellite-communication>

CMS-01 launch in December 2020 continued to enhance communication services.

D. Satellite Communication Services

- 2.7 Satellite communication refers to any communication link that involves the use of an artificial satellite in its propagation path. A communications satellite relays and amplifies radio telecommunication signals via a transponder. There are many transponders on a typical satellite, each capable of supporting one or more communication channels.¹⁰
- 2.8 Satellite-based communication systems can provide coverage to the remotest and most inaccessible areas of a geographically widespread country like India. At present, many sparsely populated areas do not have mobile terrestrial coverage and other forms of connectivity. Communication satellites have a potential to bridge this gap by providing telecommunication and broadcasting services to even the remotest areas.
- 2.9 A typical satellite communication system includes a space segment with satellites, a control segment for managing satellite operations, and a ground segment with traffic earth stations, which include user stations, interface stations (gateways), and service stations for distributing information. The following figure shows three key elements of a typical satellite communication system viz. satellite, satellite earth station gateway and user station. The satellite earth station gateway (hereinafter also referred to as 'gateway'), acts as a bridge (or gateway) between space-based communication network and terrestrial communication network.

¹⁰ The term "satellite transponder" refers collectively to a transmitter-receiver subsystem on board the satellite that processes, amplifies, and retransmits a range of frequencies (the transponder bandwidth) to another location/ terminal/ antenna on the earth.

[<https://www.gartner.com/en/information-technology/glossary/transponder>]

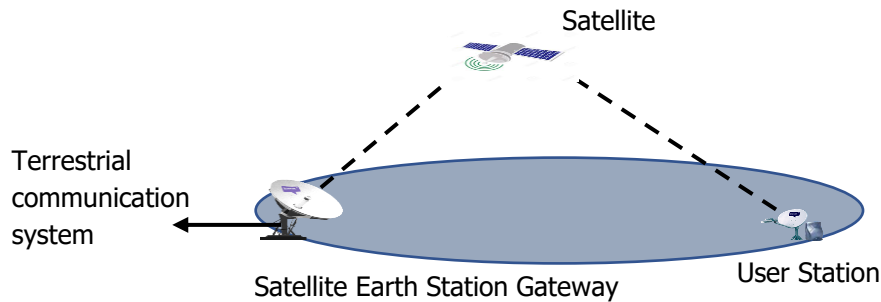


Figure 2.1: Key Elements of Satellite Communication Systems

- 2.10 The trajectory of a satellite around Earth is known as orbit. The most common orbits followed by communication satellites are Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and Geostationary Satellite Orbit (GSO). MEO and LEO satellites collectively are also called Non-Geo Stationary orbit (NGSO) satellites¹¹. The satellite orbit is selected based on the requirements of the application.
- 2.11 GSO satellites are at about 36,000 kilometers above the Earth, a place where they appear fixed in the sky when observed from the ground. They are commonly used for communication, weather monitoring, Direct-To-Home (DTH) television broadcasting, and internet provisioning. NGSO satellites at MEO altitudes are between 8,000 and 20,000 kilometers above the Earth and LEO altitudes are between 400 to 2,000 kilometers above the Earth. Since NGSO satellites move across the sky during their orbit around the Earth, NGSO operators deploy a fleet of satellites, generally called 'constellations', to provide continuous service from these altitudes. NGSO constellations intend to cover the globe providing high-bandwidth connectivity and processing high volumes of data with minimal delay. The following figure depicts the orbital altitudes and coverage areas of GSO and NGSO systems.

¹¹ Non-geostationary orbit (NGSO) satellites occupy a range of orbital positions, and do not maintain a stationary position, but instead move in relation to the Earth's surface. During the last decade, the most prominent NGSO constellations planned are of Amazon Kuiper, Boeing, LeoSat, OneWeb, O3b, SpaceX Starlink, Telesat, and Viasat, among others.

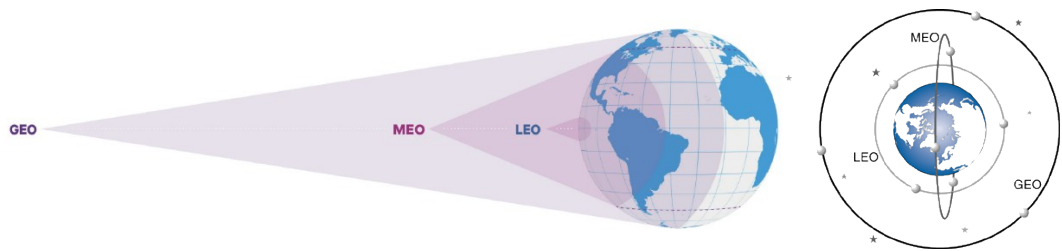


Figure 2.2: Schematic diagram of orbital altitudes and coverage areas of LEO/ MEO/ GEO satellites¹²

2.12 The International Telecommunication Union (ITU) publication titled 'The Last-mile Internet Connectivity Solutions Guide Sustainable connectivity options for unconnected sites 2020', provides a comparison of GEO, MEO and LEO characteristics as given in the following table:

Table 2.1: Characteristics of GEO, MEO and LEO Satellite¹³

Satellite category	Altitude	Orbital period	Latency (round-trip) [#]	Number of satellites to span globe	Cost per satellite [§]	Effective lifetime of satellite (years)
GEO	35,786 km	24 hours	477 ms	3*	100 to 400	15 to 20
MEO	8,000 to 20,000 km	127 minutes to 24 hours	27 to 477 ms	5 to 30	80 to 100	10 to 15
LEO	400 to 2,000 km	88 minutes to 127 minutes	2 to 27 ms	100s or 1000s	0.5 to 45	5 to 10

[#] Round-trip (ms), approximate

[§] In million USD, approximate

* This excludes high-latitude areas, that is, above the polar circles

2.13 At present, many satellite communication systems make use of high-throughput satellites (HTSs). HTS provides significantly more throughput than a conventional satellite for the same amount of radio frequency spectrum. While a conventional satellite utilizes a broad single beam (usually in the order of thousands of kilometers) to cover wide regions or even entire continents, HTS employs - (a) frequency re-use, and (b) spot beam technology which enables

¹² Source: satellitetoday.com

¹³ Source: https://www.itu.int/dms_pub/itu-d/opb/tnd/D-TND-01-2020-PDF-E.pdf

frequency re-use across multiple narrowly focused spot beams (usually in the order of hundreds of kilometers), as in cellular networks. Together, these features help HTSs provide significantly higher throughputs as compared to conventional satellites.

2.14 Initially, HTS systems used GSO satellites. However, the propagation delay for a round-trip transmission for a GSO satellite can exceed 500 milli-second, which is detrimental to many digital connectivity applications. As a result, the focus for HTS systems is increasingly shifting to the MEO and LEO.

2.15 A variety of frequency bands can be used for providing satellite communication services. The popular frequency bands used for providing satellite communication services are outlined below:

- a) L-band: It ranges from 1 GHz to 2 GHz and is used for mobile satellite services (MSS) and global positioning system (GPS) navigation signals.
- b) S-band: It ranges from 2 GHz to 4 GHz and is used for MSS, as well as weather and air traffic control applications.
- c) C-band: It ranges from 4 GHz to 8 GHz and is commonly used for fixed satellite services (FSS) such as television and radio broadcasting, telephony, and data transmission.
- d) Ku-band: It ranges from 10 GHz to 15 GHz and is used for both FSS and MSS. It is commonly used for direct-to-home (DTH) television broadcasting and satellite internet services.
- e) Ka-band: It ranges from 17 GHz to 31 GHz and is used for FSS and MSS applications. It is commonly used for high-speed broadband.
- f) Q/V-band: It ranges from 37.5-51.4 GHz and is used for both FSS and MSS. It is commonly used for High-speed broadband services and in-flight connectivity¹⁴.

¹⁴ Source: Cadence - [Satellite Frequency Allocation and the Band Spectrum](#)

- 2.16 According to European Space Agency¹⁵, because of satellites' increased use, number and size, congestion has become a serious issue in the lower frequency bands. New technologies are being investigated so that higher bands can be used. The higher frequency bands typically give access to wider bandwidths.
- 2.17 By using the principle of orthogonal polarisation, the frequency can be reused and is illustrated in Figure given below. The system uses this bandwidth B centred on the frequency f_U for the uplink and on the frequency f_D for the downlink and the bandwidth B is used twice using the concept of orthogonal polarization.

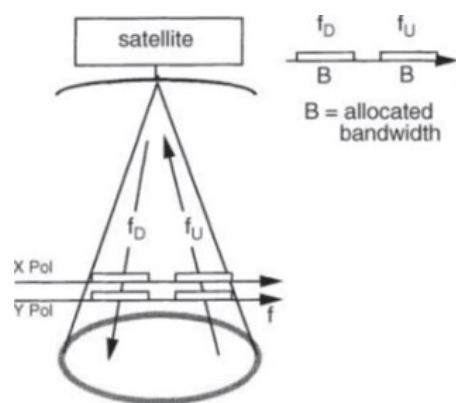


Figure 2.3: Frequency reuse with two beams by orthogonal polarization¹⁶

- 2.18 Similarly, the use of Left- or Right-Hand Circular Polarization (LHCP or RHCP) allows frequency reuse to the same satellite, since a LHCP and RHCP antenna reject each other's signals. So, for a single frequency allocation, two simultaneous RF links may be used with two different rotational sense antennas.
- 2.19 As per the existing practice, the frequency spectrum is assigned to service providers with a specific polarization to be used with a specified GSO satellite system. It has been observed that NGSO systems, generally, use both polarizations to enhance their capacity.

¹⁵ Source: The European Space Agency - [Satellite frequency bands](#)

¹⁶ Source: Satellite Communications Systems, Techniques and Technology, John Wiley & Sons Ltd.

E. Regulatory Framework for Satellite Communication Services

2.20 International coordination of satellite systems is crucial¹⁷. For the space segment, satellite operators need to obtain international recognition for the frequency and orbital resources they plan to use, by way of 'satellite-filing' in ITU¹⁸. For the earth segment, operators need to obtain licenses from individual countries, unless there is an explicit exemption in place. Licenses provide national recognition for the use of certain frequencies within a country. The following figure depicts the regulatory framework for satellite communication systems.

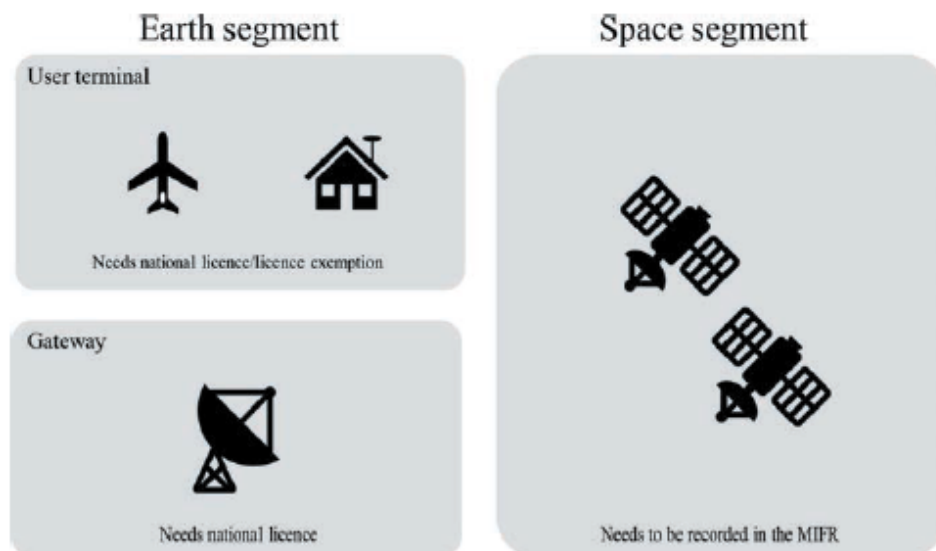


Figure 2.4: Regulatory framework for satellite communication systems

2.21 Satellite communication services do not stop at country borders. Therefore, a global agreement is needed to regulate the use of the radio spectrum. The Radio Regulations (RR), which is an international treaty binding to ITU Member States, fulfils this function. RR have the following objectives:

¹⁷ Source: Publication titled 'Non- Geostationary Satellite Communication Systems' (2021) released by The Institute of Engineering and Technology

¹⁸ ITU manages a cooperative system of international coordination on the radio frequencies used by satellites, aimed at preventing such systems from interfering with each other or with other radio systems. It oversees a satellite frequency registration process. [Source: ITU - [Regulation of satellite systems](#)]

- a) to facilitate equitable access to and rational use of the natural resources of the radio-frequency spectrum and the geostationary-satellite orbit;
- b) to ensure the availability and protection from harmful interference of the frequencies provided for distress and safety purposes;
- c) to assist in the prevention and resolution of cases of harmful interference between the radio services of different administrations;
- d) to facilitate the efficient and effective operation of all radiocommunication services; and
- e) to provide for and, where necessary, regulate new applications of radiocommunication technology.

2.22 The Government of India has drawn up National Frequency Allocation Plan 2022 (NFAP-2022) using the Radio Regulations (Edition of 2020) as the foundational text. The central theme of NFAP-2022 is the allocation of radio-frequency spectrum to different radiocommunication services. NFAP-2022, though governing the use of spectrum in India, does not by itself provide the right to use the spectrum. Any person intending to use spectrum requires an assignment from the Central Government of India unless specifically exempted from the requirement of assignment.

2.23 Amongst space-based communication services, Fixed-Satellite Services (FSS) and Mobile-Satellite Services (MSS) are the most prominent services. The definitions of these services, as provided by ITU's Radio Regulations 2020, are given below:

"1.21 fixed-satellite service: A radiocommunication service between earth stations at given positions, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services."

*"1.25 mobile-satellite service: A radiocommunication service:
– between mobile earth stations and one or more space stations, or between space stations used by this service; or*

*– between mobile earth stations by means of one or more space stations.
This service may also include feeder links necessary for its operation.”*

- 2.24 In simple words, Fixed Satellite Service (FSS) supports communications from one fixed-point to another fixed-point, such as VSAT, Teleports, DSNG, etc. FSS can also be used for connectivity with mobile platforms such as aircraft and ships. Such applications, however, are regulated by appropriate technical, operational, and regulatory conditions. Mobile Satellite Service (MSS) supports communications between mobile devices, such as handsets. Satellite phones are important examples of MSS.
- 2.25 As indicated above, at the global level, ITU is responsible for management of the radio-frequency spectrum and satellite orbit resources to ensure interference free operation of space-based communication services. A key component of international frequency management is the ITU Radio Regulations (ITU-RR), which is an international treaty that governs the use of the radio-frequency spectrum and the geostationary satellite orbits and non-geostationary satellite orbits under the aegis of ITU. The ITU-RR determines how the radio frequency spectrum is shared among different services, including space services.
- 2.26 ITU-RR has a defined frequency coordination process. The aim of frequency coordination is for developing new orbit-spectrum assets and protecting the rights to use such resources. It is a technical and regulatory process by which radio-frequency interference between different radio systems that use the same frequency is removed or mitigated and trouble-free service to users is ensured.
- 2.27 ITU’s coordination process includes¹⁹ the following activities:
- (a) Maintaining the Master International Frequency Register (MIFR) which records, *inter-alia*, the international rights and obligations of satellites and

¹⁹ <https://www.itu.int/en/plenipotentiary/2014/newsroom/Documents/backgrounders/pp14-backgrounder-sharing-the-sky.pdf>

associated earth stations to use this resource, including international recognition and protection of that use.

- (b) Coordinating the planning of new satellite networks to ensure that new satellite systems are compatible with those previously recorded in the MIFR.
- (c) Ensuring that satellite systems operate in conformity with the provisions of the RR.

2.28 ITU assesses every new planned satellite system in relation to its compatibility with all the systems and stations already included in the MIFR and that could be affected by it. Beyond the initial phase, coordination needs to be an on-going effort as long as the use of the radio frequency is required by the satellite system, as an essential part in maintaining the quality and reliability of the service it provides.

2.29 In addition, ITU-R study develops recommendations and reports with regard to the efficient orbit/ spectrum utilization, and ensure compatibility among these systems, as well as with the terrestrial systems sharing the same frequency bands. For example, previously six degrees of spatial separation between geostationary satellites using the same frequencies over the same geographic area was considered a minimum to ensure their harmonious coexistence. But due to technical advances and by coordination within the framework of the ITU-RR, the orbital separation between satellite systems is routinely two degrees.²⁰

2.30 Protection to GSO from NGSO²¹: The Article 22 of ITU-RR for 'space services', provides provisions for control of interference to geostationary-satellite systems as below:

²⁰ <https://www.itu.int/en/plenipotentiary/2014/newsroom/Documents/backgrounders/pp14-backgrounder-sharing-the-sky.pdf>

²¹ <https://www.itu.int/en/ITU-R/space/WRS20space/27%20Non-geostationary%20satellite%20systems%20and%20networks.pdf>

"2.2 Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations."

- 2.31 The two regulatory mechanisms adopted include - Equivalent Power Flux Density (EPFD) hard-limits, and coordination. The technical solution for NGSO is to avoid pointing antennas to GSO orbit or avoid operating satellite when there is insufficient separation angle between the NGSO satellite and GSO satellite when viewed from NGSO earth station.
- 2.32 EPFD considers the aggregate of the emissions from all NGSO satellites in the direction of any GSO earth station, taking into account the GSO antenna directivity. EPFD considers pointing at a victim receiving antenna with respect to any source of interference.
- 2.33 Hard EPFD limits enable NGSO FSS systems to share frequencies with and protect GSO systems without requiring individual coordination with all the systems worldwide. NGSO FSS satellite systems shall comply with the EPFD limits contained in different tables of Article 22 of ITU's RR. Besides, for coordination between NGSO and GSO system, and coordination between NGSO systems, the provisions contained in the Appendices of ITU's RR apply. The main provisions of the Appendices of ITU's RR are given below:
- "9.11A for a station for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision, the provisions of Nos. 9.12 to 9.16 are applicable;*
- 9.12 for a station in a satellite network using a non-geostationary-satellite orbit, for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision or to No. 9.11A, in respect of any other satellite network using a non-geostationary-satellite orbit,*

with the exception of coordination between earth stations operating in the opposite direction of transmission;

9.12A for a station in a satellite network using a non-geostationary-satellite orbit, for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision or to No. 9.11A, in respect of any other satellite network using the geostationary-satellite orbit, with the exception of coordination between earth stations operating in the opposite direction of transmission; (WRC-2000)

9.13 for a station in a satellite network using the geostationary-satellite orbit, for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision or to No. 9.11A, in respect of any other satellite network using a non-geostationary-satellite orbit, with the exception of coordination between earth stations operating in the opposite direction of transmission;

9.14 for a transmitting space station of a satellite network for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision or to No. 9.11A in respect of receiving stations of terrestrial services where the threshold value is exceeded;

9.15 for either a specific earth station or typical earth station of a non-geostationary satellite network for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to No. 9.11A, in respect of terrestrial stations in frequency bands allocated with equal rights to space and terrestrial services and where the coordination area of the earth station includes the territory of another country;

9.16 for a transmitting station of a terrestrial service for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to No. 9.11A and which is located within the coordination area of an earth station in a non-geostationary-satellite network;”

2.34 A summary of FSS frequency bands and coordination provisions provided in ITU-RR are summarized in the following table.

Table 2.2: FSS frequency bands and coordination provisions (Source: ITU)²²

FSS frequency bands		No hard-limits for protection of GSO	Coordination between Non-GSO	Coordination between Non-GSO and GSO	Article 22 EPFD hard limits are applicable
Earth-space	space-Earth				
	3400-4200 MHz	22.2			Yes (3700-4200)
5725-6700 MHz		22.2			Yes (5925-6700)
6700-7075 MHz		22.2	9.12		Yes (6700-6725)
7250-7750 MHz		22.2			
7900-8400 MHz		22.2			
	10.7-12.95 GHz	22.2	9.12		Yes
	11.2-11.45 GHz	22.2	9.12		Yes
	11.7-12.75 GHz	22.2	9.12		Yes
12.75-13.25 GHz		22.2	9.12		Yes
13.75-14.0 GHz		22.2	9.12		Yes
	17.8-18.6 GHz	22.2	9.12		Yes
	18.6-18.8 GHz	22.2			
	18.8-19.3 GHz		9.12	9.12A	
	19.3-19.7 GHz (MSS FL)		9.12	9.12A	
	19.3-19.7 GHz	22.2			
	19.7-20.2 GHz	22.2	9.12		Yes
	20.2-21.2 GHz	22.2			
27.5-28.6 GHz		22.2	9.12		Yes
28.6-29.1 GHz			9.12	9.12A	
29.5-30.0 GHz		22.2	9.12		Yes
V-band FSS	V-band FSS	22.2	9.12		Yes Single/Aggregate

²² <https://www.itu.int/en/ITU-R/space/WRS20space/27%20Non-geostationary%20satellite%20systems%20and%20networks.pdf>

F. MSS and FSS in India

2.35 L-band and S-band are used to provide MSS on a commercial basis. Worldwide, a few global operators such as Inmarsat (GSO), Thuraya (GSO) and Iridium (NGSO) provide MSS services. In India, L-band is used by a public sector undertaking (PSU) for providing Inmarsat service. The spectrum in S-Band has not been assigned for commercial purposes in India. Frequency reuse is not possible in the L-band and S-band over the same geographical area. Hence, each satellite needs to have its exclusive assignment to provide service over a specific area and it cannot share the same frequency with another satellite operator for providing service in the same area.

2.36 The C-band, Ku-band and Ka-band are the most popular bands for FSS in India. In these bands, FSS requires highly directive antennas producing narrow beams which must always accurately point a specific satellite or satellite system. This is to avoid causing interference to other adjacent satellites. The antennas on aircrafts and vessels as well as those on land mobile platforms must ensure that they always point in the specific direction in the sky to the associated satellite and stop operations within milli-seconds of a misalignment. The highly directive antennas make it possible that any frequency can be reused in the same service area by different users each one using a different satellite or satellite system. Coexistence between different satellite networks, adequately separated in the GSO arc complying with the provisions of ITU-RR, is possible in a given geographical area without causing interference to one another.

G. The Extant Licensing Regime for Satellite-based Commercial Communication Services in India

2.37 Under the extant regime of Unified License, there are two separate authorizations for provisioning of satellite-based commercial communication services, namely-

- (a) Global Mobile Personal Communication by Satellite (GMPCS) service authorization; and
- (b) Commercial VSAT CUG service authorization.

2.38 The VSAT CUG service authorisation permits the authorized entity to provide, *inter-alia*, satellite-based data connectivity between various sites of a user within the territorial boundary of India and backhaul connectivity to Access Service providers. The scope also provides that the authorized entity after obtaining Internet Service Provider (ISP) license may use the same Hub station and VSAT (remote station) to provide Internet service to subscribers.

2.39 The GMPCS service authorization permits the authorized entity to provide all types of mobile services, including voice and non-voice messages, data services and satellite-based data connectivity to the IoT devices/ Aggregator devices.

2.40 Recently, through the recommendations on the Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023 dated 18.09.2024, the Authority recommended, *inter-alia*, as below:

"The scope of the extant GMPCS service authorization and Commercial VSAT CUG Service authorization should be merged into a single authorisation namely Satellite-based Telecommunication Service authorisation under the Telecommunications Act, 2023.

The scope of the Satellite-based Telecommunication Service authorisation should include both GMPCS and VSAT based FSS. The Authorised Entity may choose to provide any or all the services permitted under the scope of Satellite-based Telecommunication Service authorisation."

H. The Indian Space Policy, 2023

2.41 The Indian Space Policy, 2023 by the Department of Space has opened the doors for enhanced participation of Non-Government Entities (NGEs) in carrying out end-to-end activities in the space domain and with an aim to provide them

a level playing field. The Indian Space Policy 2023 has a vision, *inter-alia*, to enable, encourage, and develop a flourishing commercial presence in space, and use space as a driver of technology development and derived benefits in allied areas for the nation's socio-economic development.

- 2.42 The new policy and reforms are aimed to unleash the space sector for larger participation of the space industry and start-ups to achieve greater social, economic, and technological progress for the country and humanity.
- 2.43 In May 2024, the Government released Norms, Guidelines, and Procedures (NGP) for the implementation of Indian Space Policy-2023 in respect of the Authorization of Space activities. The released NGP includes a list of Space Activities which need Authorization from IN-SPACe, criteria for granting the Authorization and necessary conditions/ guidelines to be adhered to by an Applicant.
- 2.44 The following chapter explores the issues relating to the assignment of spectrum for certain satellite-based commercial communication services, as referred to by DoT in the reference dated 11.07.2024.

Chapter III: Issues Related to the Assignment of Spectrum for Certain Satellite-based Commercial Communication Services

- 3.1 Through the reference dated 11.07.2024, DoT has requested TRAI to provide recommendations on terms and conditions of spectrum assignment including spectrum pricing while accounting for level playing field with terrestrial access services for the following satellite-based communication services:
- (i) NGSO based Fixed Satellite Services providing data communication and Internet services. In its recommendations, TRAI may take into account services provided by GSO-based satellite communication service providers.
 - (ii) GSO/ NGSO based Mobile Satellite Services providing voice, text, data, and internet services.
- 3.2 It is noteworthy that section 4 of the newly enacted Telecommunications Act, 2023 states, *inter-alia*, that -
- "(2) Any person intending to use spectrum shall require an assignment from the Central Government.*
- (3) The Central Government may prescribe such terms and conditions as may be applicable, for such assignment of spectrum, including the frequency range, methodology for pricing, price, fees and charges, payment mechanism, duration and procedure for the same."*

A. Frequency Bands for Satellite-based Communication Services

- 3.3 Satellite-based communication service involves two links - a user link and gateway link. The user link is a link between the satellite and user terminals, and it involves frequency spectrum for establishing user link (uplink) and user link (downlink). While the gateway link is a link between satellite and satellite earth station gateway, and it involves frequency spectrum for establishing gateway link (uplink) and gateway link (downlink). Thus, satellite-based communication services involve frequency spectrum for establishing four types

of links viz. user link (uplink and downlink), and gateway link (uplink and downlink).

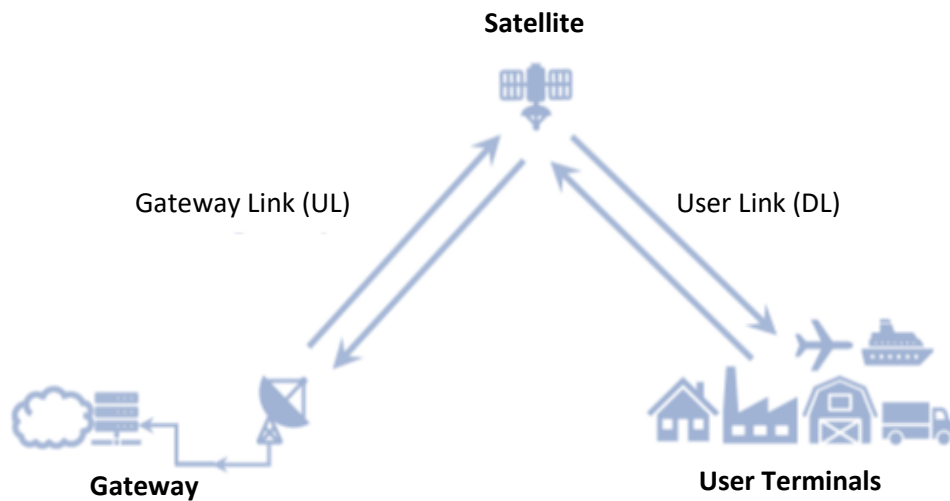


Figure 3.1: Diagram of Communication links depicting forward link and return link, and user link and gateway link

- 3.4 As discussed earlier, while a variety of frequency bands can be used for providing satellite communication services, the popular frequency bands used for providing satellite communication services are L-band (1-2 GHz), S-band (2-4 GHz), C-band (4-8 GHz), Ku-band (10-15 GHz) and Ka-band (17-31 GHz).
- 3.5 The DoT through its letter dated 16.08.2022 had enclosed an annexure providing details of the existing/ planned deployments by various satellite operators in NGSO (enclosed as **Annexure 3.1**). From the information, it can be seen that the user links of the existing NGSO satellite systems are generally in Ku and Ka band, while the feeder links are predominantly in Ka-band. Further, the new-generation satellite communication systems have plans for deployment in higher bands such as the lower part of V-band (37.5 to 52.4 GHz) for user links as well as gateway links and E-band (71-76 GHz/ 81- 86 GHz) for gateway links.

- 3.6 DoT, in its earlier reference letter dated 16.08.2022, provided a list of frequency bands that may be considered by TRAI for providing recommendations with respect to space-based communication services. The following table enlists the frequency bands referred by DoT in its earlier reference letter dated 16.08.2022:

Table 3.1: List of frequency bands referred by DoT through its earlier reference letter dated 16.08.2022

S. No.	Frequency Band	Link
1.	10.7 – 12.75 GHz	Space to Earth
2.	12.75 – 13.25 GHz	Earth to Space
3.	13.75 – 14.5 GHz	Earth to Space
4.	17.7 – 18.6 GHz	Space to Earth
5.	18.8 – 19.3 GHz	Space to Earth
6.	19.3 – 19.7 GHz	Space to Earth
7.	19.7 – 21.2 GHz	Space to Earth
8.	27.5 – 29.5 GHz	Earth to Space
9.	29.5 – 31 GHz	Earth to Space

- 3.7 These frequency bands are predominantly being used for NGSO-based Fixed Satellite Services (FSS).
- 3.8 As regards Mobile Satellite Service (MSS), the satellite systems generally operate the user links in L-band and S-band, and the feeder links in C-band or other higher frequency bands. Frequency ranges identified for MSS in L and S bands are given below:

Table 3.2: Frequency ranges identified for MSS in L and S bands

S. No.	Frequency range	Link
1	1.525-1.559 GHz	Space to Earth
2	1.610-1.6605 GHz	Earth to Space
3	1.980-2.010 GHz	Earth to Space
4	2.170-2.200 GHz	Space to Earth
5	2.4835-2.520 GHz	Space to Earth
6	2.670-2.690 GHz	Earth to Space

3.9 Besides, there is a long list of frequency ranges which are allocated, *inter-alia*, on primary or secondary basis for FSS and MSS in the National Frequency Allocation Plan (NFAP) 2022 released by the DoT.

3.10 In this background, the Authority solicits views of stakeholders on the following set of questions:

Issues for Consultation:

Q1. Which frequency band(s)/ range(s) should be considered for the assignment to NGSO based Fixed Satellite Services for providing data communication and Internet service? Please provide a detailed response separately for the user link and feeder link.

Q2. Which frequency band(s)/ range(s) should be considered for the assignment to GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet service. Please provide a detailed response separately for the user link and feeder link.

B. Period of Validity of Spectrum Assignment

- 3.11 Generally, the useful life of satellites varies from 15 to 20 years for GSO satellites and 5 to 10 years for LEO satellites. As satellite services are in the evolution phase and many satellite systems are under deployment, an issue arises as to what should be the maximum period for which frequency spectrum should be assigned for the provision of (a) NGSO-based FSS for providing data communication and Internet services, and (b) GSO/ NGSO based MSS for providing voice, text, data and Internet services.
- 3.12 One could argue that the period of validity of spectrum assignment for NGSO-based FSS and GSO/ NGSO based MSS should be 20 years in line with the period of validity of the service authorisation, so that it provides sufficient certainty to service providers for recovery of their capital investments. Another view could be to keep a smaller period of validity of spectrum assignment for such services like five years as satellite-based broadband services are, at present, in a nascent stage of development, and their business potential would emerge after some years of operations; the regulatory environment might require to be reviewed and revised considering the uptake of NGSO-based FSS and GSO/ NGSO based MSS in the country, after a few years.
- 3.13 In the case of GSO satellite systems, frequency spectrum is assigned separately for each satellite. It may be possible that a service provider may provide services utilizing multiple satellite systems, as filed with ITU, especially in the case of the use of a combination of satellite orbits. An issue arises as to whether for the purpose of assignment of the frequency spectrum for NGSO satellite systems, every ITU filing should be treated as a separate satellite system.

- 3.14 In this background, the Authority solicits views of stakeholders on the following set of questions:

Issues for Consultation:

Q3. What should be the maximum period of assignment of spectrum for -

- (a) NGSO based Fixed Satellite Services for providing data communication and Internet services, and**
- (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?**

Please provide a detailed response alongwith international practice in this regard.

Q4. For assigning spectrum for NGSO-based communication services, whether every ITU filing should be treated as a separate satellite system? Please provide a detailed response alongwith international practice in this regard.

C. Interference-related Challenges and Coordination Issues

- 3.15 As per the ITU's framework, NGSO systems are generally required to provide protection to GSO systems. The Article 22.2 of ITU RR provides as below:

"Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. ..."

- 3.16 In the frequency bands, for which Article 22.2 does not apply, NGSO networks are required to coordinate with the existing GSO networks (Article 9.11A of ITU RR). Further, for the coexistence of NGSO networks, as per the ITU's

framework, any upcoming NGSO network is required to coordinate with the existing NGSO networks.

3.17 In the case of GSO satellites, the same frequency spectrum can be used by multiple GSO satellite systems as long as they are sufficiently apart in terms of angular separation. In the case of NGSO satellite constellations, the same frequency spectrum is used by different satellite constellations by adopting coordination techniques. In case of in-line events where a satellite comes in the same line-of-sight path between the earth station and the satellite of another satellite constellation, the satellite operators might need to adopt additional measures to mitigate interference.

3.18 The Authority notes that there are apprehensions about interference-free operations of NGSO satellite systems. Lately, the Federal Communication Commission (FCC), USA and Ofcom, UK have examined the issue of interference between NGSO satellite systems, as mentioned below:

(a) FCC in its order released on 21.04.2023 in the matter of 'Revising Spectrum Sharing Rules for Non-Geostationary Orbit, Fixed-Satellite Service Systems' stated as below:

"5. NGSO FSS System Spectrum Sharing Overview. The Commission has adopted rules for spectrum sharing among NGSO FSS systems. NGSO FSS space station applications granted with a condition to abide by these sharing rules are exempt from frequency band segmentation procedures that otherwise apply to applications for NGSO-like satellite operation. Instead, NGSO FSS operators must coordinate with one another in good faith the use of commonly authorized frequencies. If two or more NGSO FSS satellite systems fail to complete coordination, a default spectrum-splitting procedure applies.

6. Under the default spectrum-splitting procedure, whenever the percentage increase in system noise temperature of an earth station receiver, or a space station receiver for a satellite with onboard processing, of either system, $\Delta T/T$, exceeds 6% due to interference from

emissions originating in the other system in a commonly authorized frequency band, such frequency band will be divided among the affected satellite networks (i.e., individual links) in accordance with the following: (1) Each of n (number of) satellite networks involved must select $1/n$ of the assigned spectrum available in each of these frequency bands; (2) the affected station(s) of the respective satellite systems may operate in only the selected ($1/n$) spectrum associated with its satellite system while the $\Delta T/T$ of 6% threshold is exceeded; and (3) all affected station(s) may resume operations throughout the assigned frequency bands once the $\Delta T/T$ of 6% threshold is no longer exceeded. The spectrum selection order for each satellite network is determined by the date that the first space station in each satellite system is launched and capable of operating in the frequency band under consideration.”

- (b) Ofcom in its non-geostationary satellite systems licensing update of December 2021 noted that “*the more dynamic nature of NGSO systems, the large number of satellites involved, along with the current lack of agreements between operators, all serve to increase the risk of interference between satellite systems. These factors have prompted our consideration of the NGSO licensing process and license conditions.*”. After stakeholders’ consultation, Ofcom concluded that “*[w]e are not adopting spectrum splitting because of the inherent inefficiency in doing so. In addition, it may impact different systems to different degrees, and as a result may be limited in how much it incentivises cooperation between systems. There are other ways of mitigating the possibility of harmful interference without limiting operators’ access to spectrum, given that doing so may impact the quality of service received by users and the ability to support a competitive market.*”

3.19 From the above description, it can be inferred that the FCC provides that NGSO FSS operators must coordinate with one another in good faith the use of commonly authorized frequencies. If two or more NGSO FSS satellite systems

fail to complete coordination, they should follow a default spectrum-splitting procedure. On the other hand, Ofcom has not adopted the spectrum-splitting procedure as it considers that splitting the spectrum may impact the quality of services received by the users.

- 3.20 Further, as the antenna of the satellite earth station gateway (SESG) of a GSO satellite looks at a fixed angle according to the orbital slot, it is possible to establish SESGs of different GSO satellites in nearby locations without any protection zone requirement. On the other hand, NGSO satellite constellation consists of several satellites and several orbital planes. Therefore, the SESG of NGSO satellite constellation consists of an array of tracking antennas so that the satellite earth station gateway gets connected to the next arriving satellite before disconnecting with the so far connected satellite. Considering that the NGSO gateway consists of an array of tracking antennae, there may be a protection zone requirement for interference-free operation of the SESGs of different NGSO constellations using the same frequency spectrum.
- 3.21 In many frequency bands, spectrum is shared between satellite-based networks and terrestrial networks such as Fixed Service (backhaul) and IMT. For instance, in 13 GHz band (12.75-13.25 GHz) and 18 GHz band (17.7-19.7 GHz), the frequency spectrum is assigned for microwave access (MWA) service for cellular backhaul. Thus, MWA coexists with FSS in these frequency bands.
- 3.22 To control interference, ITU provides an elaborate framework including the following²³:
- (a) Allocation: Frequency separation of stations of different services (Article 5)
 - (b) Coordination: between Administrations to ensure interference-free operations conditions (Article 9)
 - (c) Power Limits: (Articles 5, 21 & 22)

²³ Source: <https://www.itu.int/en/ITU-R/space/WRS16space/PFD%20External.pdf>

- (i) Power Flux Density (PFD) to protect terrestrial services
- (ii) Equivalent isotropically radiated power (EIRP) to protect space services
- (iii) Equivalent Power Flux Density (EPFD) to protect GSO from NGSO
- (d) Regulatory Protection: Not to cause harmful interference or claim protection (Article 5 and 22)

3.23 In this regard, it is noteworthy that Article 21 of ITU-RR deals with the aspects of terrestrial and space services sharing frequency bands above 1 GHz. The Section I of Article 21 deals with the choice of sites and frequencies. It provides as below:

"21.1 Sites and frequencies for terrestrial stations and earth stations, operating in frequency bands shared with equal rights between terrestrial radiocommunication and space radiocommunication services, shall be selected having regard to the relevant ITU-R Recommendations with respect to geographical separation between earth stations and terrestrial stations.

21.2 As far as practicable, sites for transmitting stations, in the fixed or mobile service, employing maximum values of equivalent isotropically radiated power (e.i.r.p.) exceeding the values given in Table 21-1 in the frequency bands indicated, should be selected so that the direction of maximum radiation of any antenna will be separated from the geostationary-satellite orbit by at least the angle in degrees shown in the Table, taking into account the effect of atmospheric refraction.

TABLE 21-1

Frequency band (GHz)	e.i.r.p. value (dBW) (see also Nos. 21.2 and 21.4)	Minimum separation angle with respect to geostationary-satellite orbit (degrees)
1-10	+35	2
10-15	+45	1.5
25.25-27.5	+24 (in any 1 MHz band)	1.5
Other bands above 15 GHz	+55	No limit ³

21.2.1 For their own protection receiving stations in the fixed or mobile service operating in frequency bands shared with space radiocommunication services

(space-to-Earth) should also avoid directing their antennas towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant. In particular, in the frequency bands 13.4-13.65 GHz and 21.4-22 GHz, it is recommended to maintain a minimum separation angle of 1.5 degree with respect to the direction of the geostationary-satellite orbit."

- 3.24 The Section II of Article 21 of ITU' RR deals with power limits for terrestrial stations. It provides, *inter-alia*, as below:

"21.3 The maximum equivalent isotropically radiated power (e.i.r.p.) of a station in the fixed or mobile service shall not exceed +55 dBW."

- 3.25 Section-III of Article 21 of ITU's RR provides power limits for earth stations. Section-IV provides a minimum angle of elevation of earth stations. Section-V provides limits of power flux density from space stations.

- 3.26 In many frequency bands, the frequency spectrum earmarked for satellite earth station gateways may also be shared between satellite earth station gateways and terrestrial services like IMT. For instance, the DoT has decided to make available the frequency ranges (a) 37.5 - 40 GHz, and (b) 42.5 - 43.5 GHz, for IMT and the same will also be shared with satellite earth station gateways with a suitable protection.

- 3.27 In this background, the Authority solicits views of stakeholders on the following set of questions:

Issues for Consultation:

Q5. Whether the provisions of ITU-RR are sufficient to resolve interference related challenges and coordination issues? If not, what additional conditions should be prescribed while assigning frequency spectrum for –

- (a) NGSO based Fixed Satellite Services for providing data communication and Internet services; and**
- (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?**

Please provide a detailed response alongwith international practice in this regard.

Q6. For satellite earth station gateways of different satellite systems operating in the same frequency range, whether there is a need to prescribe a protection distance or any other measures to avoid interference from each other–

- (a) Between the gateways of GSO and NGSO systems; and**
- (b) Between the gateways of NGSO systems?**

If yes, please provide a detailed response alongwith international practice in this regard.

Q7. In case the spectrum assigned for satellite gateway links is also assigned to terrestrial networks such as Fixed Service, IMT etc., what protection distance or criterion should be included in the terms and conditions of the assignment of spectrum for satellite gateway links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.

Q8. In case the spectrum assigned to the satellite user link is also assigned to terrestrial networks such as Fixed Service, what criterion should be included in the terms and conditions of the assignment of spectrum for satellite user links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.

D. Scarcity of Satellite Gateway Sites

- 3.28 At present, many satellite communication systems make use of high-throughput satellites (HTSs). HTS provides significantly more throughput than a conventional satellite for the same amount of radio frequency spectrum. While a conventional satellite utilizes a broad single beam, usually in the order of thousands of kilometers, to cover wide regions or even entire continents, HTS employs - (a) frequency re-use, and (b) spot beam technology which enables frequency re-use across multiple narrowly focused spot beams, usually in the order of hundreds of kilometers, as in cellular networks. Together, these features help HTSs provide significantly higher throughputs as compared to conventional satellites. Initially, HTS systems used GSO satellites. However, with technological development, focus for HTS systems is increasingly shifting to NGSO satellite systems.
- 3.29 The satellite earth station gateway provides the interface between the space-based communication network and terrestrial communication network. In the case of GSO satellite systems, which are geostationary, the SESG requires a fixed antenna and stable communication link to maintain a constant connection with the satellite. In the case of NGSO satellites, which are non-geostationary, the gateways require precise tracking, rapid beamforming, and effective interference management.
- 3.30 The number of gateways required by the satellite system depends on factors such as intended application, geographic coverage, capacity, and quality of service. For conventional GSO satellites, a single gateway can provide adequate coverage for a region. On the other hand, the HTSs and NGSO satellite systems, which operate through much narrower beams, require multiple gateways to control various beams and to meet the throughput requirement.
- 3.31 The satellite gateway of NGSO satellite systems consists of an array of tracking antennas, and the decision of the location of the gateway may involve several

factors such as no obstructions blocking any views to the satellites, cost of land, power supply, fiber availability etc. Such gateway location deciding factors may raise a concern that one or a few service providers may take spectrum usage rights for the key locations for gateway links. A similar concern was considered by Ofcom, UK. It concluded that the risk of scarcity of gateway sites can be reduced by introducing a requirement for gateway licensees to commence and maintain transmissions within 12 months.

3.32 While the condition prescribed by Ofcom, UK could be one of the solutions to mitigate the risk of scarcity of gateway sites, there may be a need to find other ways to address this issue. One such way could be to prescribe a certain minimum distance between two gateway sites of an entity for a given satellite system.

3.33 In this background, the Authority solicits views of stakeholders on the following question:

Issue for Consultation:

Q9. Whether there is a need to prescribe any conditions to mitigate the risk of scarcity of satellite gateway sites? If yes, please provide a detailed response alongwith international practice in this regard.

E. Roll-out Obligations for the Assigned Spectrum

3.34 As per the extant regime, the satellite-based commercial communication services can be provided under the following authorisations under Unified License:

- (a) Commercial VSAT CUG service authorization
- (b) GMPCS service authorization

3.35 The roll-out obligations provided under Commercial VSAT CUG Service authorization are reproduced below:

"5. Roll out Obligation:

5.1 The Licensee shall roll out the network by installing and commissioning a HUB Station for Star Network configuration or at least two VSAT Terminals in case of Mesh Network configuration within 12 months from the date of frequency allotment by WPC. The Licensee shall approach WPC for frequency allotment within 1 month of obtaining transponder bandwidth from Department of Space (DoS) or space segment provider duly authorized by DoS.

5.2 For the purpose of verification of the commissioning of the applicable system, Licensee shall register with the Network Operations Control Centre (NOCC) of DoT, as per the prescribed procedure.

5.3 Date of registration by NOCC is to be treated as date of commissioning in case of successful testing as per test schedule prescribed by NOCC/Licensors. If the testing fails, then the Licensee shall re-register with the NOCC after necessary corrections and in that case, Date of re-registration by NOCC shall be treated as date of meeting the roll-out obligation subject to successful testing.

5.4 The time period for roll out of network as per the rollout obligations mentioned above shall be deemed as the essence of the License Agreement and the network must be rolled out not later than such specified time period(s). No extension in prescribed due date will be granted. If the network is rolled out after the expiry of the due date, such delay in rollout of network will entail recovery of Liquidated Damages (LD) under this Condition. Provided further that if the rollout of the network is effected within 15 calendar days of the expiry of the due date then the Licensors shall accept the rollout of network without levy of LD charges.

5.5 At present, minimum 60 calendar days duration is prescribed for grant of SACFA clearance. While examining the compliance of rollout obligations, the delay in grant of the SACFA clearance beyond the above mentioned prescribed duration shall be excluded from the duration set for rollout. For the purpose of calculating the delay in grant of SACFA clearance of VSAT/Hub Station site, the

date of 'WPC acceptance number' for SACFA clearance application would be treated as the 'start date' and the date on which the SACFA clearance is granted in the online system of WPC would be considered as the 'end date'. The difference between the 'start date' and 'end date' after excluding the above mentioned prescribed period would be considered as the delay in grant of SACFA clearance for VSAT/Hub Station site for the limited purpose of calculating the delay in compliance of rollout obligations. If the SACFA clearance for VSAT/Hub Station site has been granted within prescribed duration, then for that particular site, delay would be considered as 'zero' days.

5.6 In case the Licensee fails to rollout the network, within the period prescribed, the Licensor shall be entitled to recover LD charges @ Rs. 1 Lakh (Rupees One Lakh) per month subject to a maximum amount of Rs. 24 lakh. For delay of more than 24 months, in addition to imposition of maximum amount of LD as mentioned above, the frequency allotment may be withdrawn and the Service authorization may also be terminated. The PBG shall be encashed to the extent of LD amount, if the same is not paid within the time period specified in the notice for recovery of LD. The licensee on such occasions, shall restore the partially encashed guarantee to the full amount. Any failure to do so shall amount to violation of the terms and conditions of the License.

5.7 For the purpose of calculation of delay in compliance of rollout obligations, the month shall mean 1 Calendar month and any extra day shall be counted as full month for the purposes of recovery of liquidated damages."

3.36 The roll-out obligations provided under GMPCS Service authorization are reproduced below:

"5. Roll out Obligation:

5.1 The Land Earth Station Gateway Switch for provision of GMPCS Service must be commissioned within 12 months from the date of frequency allotment by WPC. The Licensee shall approach WPC for frequency allotment within 1 month of date of allocation of transponder bandwidth in the concerned Satellite System.

5.2 For the purpose of verification of the commissioning of the applicable system Licensee shall register with the Network Operations Control Centre (NOCC) of DoT, as per the prescribed procedure and payment of prescribed charges.

5.3 Date of registration by NOCC is to be treated as date of commissioning in case of successful testing as per test schedule prescribed by NOCC/Licensors. If the testing fails then the Licensee shall re-register with the NOCC after necessary corrections and in that case, Date of re-registration by NOCC shall be treated as date of meeting the roll-out obligation subject to successful testing.

5.4 The time period for roll out of network as per the rollout obligations mentioned above shall be deemed as the essence of the License Agreement and the network must be rolled out not later than such specified time period(s). No extension in prescribed due date will be granted. If the network is rolled out after the expiry of the due date, such delay in rollout of network will entail recovery of Liquidated Damages (LD) under this Condition. Provided further that if the rollout of the network is effected within 15 calendar days of the expiry of the due date then the Licensor shall accept the rollout of network without levy of LD charges.

5.5 At present, minimum 60 calendar days duration is prescribed for grant of SACFA clearance. While examining the compliance of rollout obligations, the delay in grant of the SACFA clearance beyond the above mentioned prescribed duration shall be excluded from the duration set for rollout. For the purpose of calculating the delay in grant of SACFA clearance of Land Earth Station Gateway site, the date of 'WPC acceptance number' for SACFA clearance application would be treated as the 'start date' and the date on which the SACFA clearance is granted in the online system of WPC would be considered as the 'end date'. The difference between the 'start date' and 'end date' after excluding the above mentioned prescribed period would be considered as the delay in grant of SACFA clearance for Land Earth Station Gateway site for the limited purpose of calculating the delay in compliance of rollout obligations. If the SACFA clearance

for Land Earth Station Gateway site has been granted within prescribed duration, then for that particular site, delay would be considered as 'zero' days.

5.6 In case the Licensee fails to rollout the network, within the period prescribed, the Licensor shall be entitled to recover LD charges @ Rs. 1 Lakh (Rupees One Lakh) per month subject to a maximum amount of Rs. 24 lakh. For delay of more than 24 months, in addition to imposition of maximum amount of LD as mentioned above, the frequency allotment may be withdrawn and the Service authorization may also be terminated. The PBG shall be encashed to the extent of LD amount, if the same is not paid within the time period specified in the notice for recovery of LD. The licensee on such occasions, shall restore the partially encashed guarantee to the full amount. Any failure to do so shall amount to violation of the terms and conditions of the License.

5.7 For the purpose of calculation of delay in compliance of rollout obligations, the month shall mean 1 Calendar month and any extra day shall be counted as full month for the purposes of recovery of liquidated damages.”

3.37 In short, for the Commercial VSAT CUG service authorization, the service licensee is required to roll out its network by installing and commissioning a Hub station for star network configuration or at least two VSAT terminals in case of mesh network configuration within 12 months from the date of frequency allotment by WPC. For the GMPCS service authorisation, the service licensee is required to commission land earth station gateway switch for the provision of GMPCS service within 12 months from the date of frequency allotment by the WPC.

3.38 It is noteworthy that in its recent recommendation on 'Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023' dated 18.09.2024, the Authority has recommended, *inter-alia*, that the scope of the extant GMPCS service authorization and Commercial VSAT CUG Service authorization should be merged into a single authorisation namely Satellite-based Telecommunication Service authorisation under the Telecommunications

Act, 2023. The Authority has recommended the following roll-out obligations for Satellite-based Telecommunication Service authorisation:

“Roll Out Obligations

(5) For provision of Satellite-based Telecommunication Service, the Authorised Entity shall roll out the network within 12 months from the date of frequency assignment, unless otherwise stipulated in the terms and conditions of the assignment of spectrum.

(6) In case of GMPCS Service, the roll out of the network shall mean installation and commissioning of a Satellite Earth Station Gateway Switch. In case of VSAT-based FSS, the roll out of the network shall mean installation and commissioning of a Hub Station for star network configuration or at least two VSAT terminals in case of mesh network configuration. For this purpose, the Authorised Entity can make use of the Satellite Earth Station Gateway Switch/ Hub Station established by other eligible authorised entities.

(7) For verification of the installation and commissioning of the applicable system, the Authorised Entity shall register with the SATCOM Monitoring Centre (SMC) of the Central Government, as per the procedure prescribed by the Central Government. Date of registration by SMC is to be treated as the date of commissioning in case of successful verification of the rollout of the network. If the verification of the roll out of the network fails, then the Authorised Entity shall re-register with the SMC after necessary corrections and in that case, the date of re-registration by SMC shall be treated as the date of meeting the roll out obligation subject to successful verification. If the network is rolled out after the expiry of the due date, such delay in rollout of network will entail recovery of Liquidated Damages (LD) under this condition:

Provided further that if the rollout of the network is effected within 30 calendar days of the expiry of the due date then the Central Government shall accept the rollout of network without levy of LD charges.

(8) In case the Authorised Entity fails to rollout the network within the period prescribed, the Central Government shall be entitled to recover LD charges @ ₹ 100,000/- (Rupees One lakh only) per month of delay subject to a maximum amount of ₹ 24 lakh. For the delay of more than 24 months, in addition to

imposition of maximum amount of LD, the frequency assignment may be withdrawn. The bank guarantee (BG) shall be encashed to the extent of LD amount, if the same is not paid within the time period specified in the notice for recovery of LD. The Authorised Entity, on such occasions, shall restore the partially encashed bank guarantee to the full amount. Any failure to do so shall amount to violation of the terms and conditions of the Authorisation. For calculation of delay in compliance of roll out obligations, the month shall mean one Calendar month and any extra day shall be counted as full month for the purpose of recovery of liquidated damages.”

3.39 From the above, it can be seen that the roll-out obligations are in respect of the operationalization of satellite earth station gateway i.e. feeder link frequency spectrum. In respect of the spectrum assigned for user links, no separate roll-out obligations have been prescribed. Considering that the new generation satellite systems including NGSO based satellite systems require a large quantum of frequency spectrum, one may contend that there could be a need to include certain additional roll-out obligations to ensure that the spectrum assigned for satellite-based telecommunications services is put to its efficient use.

3.40 In this background, the Authority solicits views of stakeholders on the following question:

Issue for Consultation:

Q10. In addition to the roll-out conditions recommended by TRAI for satellite-based Telecommunication Service Authorisation through its recommendations on the Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023 dated 18.09.2024, whether there is a need to impose certain additional roll-out obligations for the assignment of frequency spectrum for –

(a) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response alongwith international practice in this regard.

F. Surrender of the Assigned Spectrum

3.41 Considering that the entities authorised to provide satellite-based telecommunication service obtain satellite resources from satellite operators, there may be a requirement to shift to another satellite system in case of the end of life of a satellite system or for better commercial arrangements. Accordingly, once a frequency spectrum is assigned for the provision of satellite-based telecommunication services for a defined validity period, there may be instances where an authorised entity/ licensee may like to surrender the assigned spectrum prior to the expiry of the period of validity of such assignment. It needs to be deliberated as to whether there should be a provision for the surrender of spectrum before the completion of the validity period, and if so, what terms and conditions should be made applicable.

3.42 In this background, the Authority solicits views of stakeholders on the following question:

Issue for Consultation:

Q11. Whether there is a need to introduce a provision for surrender of frequency spectrum prior to the expiry of the period of validity of spectrum assigned for -

(a) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

If yes, what should be the process, and associated terms and conditions such as minimum period of spectrum holding, notice period, surrender fee, etc.? Please provide a detailed response with justifications.

G. Timelines for Processing the Applications for the Assignment of Spectrum

3.43 Generally, for the provision of satellite-based telecommunication services, the authorised entities seek the assignment of spectrum from DoT only after the satellite-based network is ready for operation. Considering that the effective life of a satellite system varies from 5 to 10 years for LEO satellites, a delay in the assignment of spectrum may result in non-utilization of satellite resources. Therefore, it is important that the frequency spectrum is assigned to the authorised entities within a reasonable timeframe.

3.44 In this background, the Authority solicits views of stakeholders on the following set of questions:

Issues for Consultation:

Q12. Whether there is a need to prescribe timelines for processing the applications for the assignment of frequency spectrum for-

(a) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response with justifications.

Q13. Whether there are any other suggestions related to assignment of spectrum for-

(a) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response with justifications.

3.45 The following chapter examines the spectrum charging mechanism for satellite-Based commercial communication services.

Chapter IV: Spectrum Charging Mechanism for Satellite-Based Commercial Communication Services

A. Introduction

4.1 In chapter VII, Article 44 of the constitution of the International Telecommunication Union (ITU), dealing with the 'Use of the Radio-Frequency Spectrum and of the Geostationary-Satellite and Other Satellite Orbits', it has been mentioned that radio frequencies and any associated orbits, including the geostationary satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulation²⁴.

4.2 The ICRIER working paper on “ *Universal Coverage, Enhancing Spacecom Sector Growth, And Supporting Democratic Ethos: The Role Of Satellite Spectrum Assignment*” states that :

*"Spectrum management issues related to satellite communications have become more complex as the demand for spectrum from new players, applications and systems is increasing. Spectrum being a limited resource, it is imperative that technological characteristics that enable maximal exploitation and supportive policy and regulation principles are adopted."*²⁵

4.3 Before formulating any pricing policy for satellite-based communication services, it is essential to understand the four different types of goods as defined in economics²⁶. These goods are categorized based on two key characteristics: excludability and rivalry. The classification is illustrated in the figure below:

²⁴ <https://www.itu.int/en/council/Documents/basic-texts/Constitution-E.pdf>

²⁵ https://icrier.org/pdf/Working_Paper_417.pdf

²⁶ The Continua of Excludability and Rivalry by Bryan Caplan

	Excludable	Non-Excludable
Rivalrous	Private Goods Food, clothes, cars and other consumer goods	Common Goods Fish, timber, coal
Non-Rivalrous	Club Goods Cinemas, private parks, satellite TV	Public Goods air, national defence

Figure 4.1: Type of goods in Economics

- 4.4 According to James Buchanan's "Economic Theory of Clubs"²⁷ (1965), club goods are economic goods that are excludable and have limited rivalry. Consequently, if satellite systems are designed to operate on shared spectrum with low or no rivalry in consumption, the spectrum used for satellite-based communications in the C, Ku, and Ka bands would exhibit the characteristics of a "club good."
- 4.5 Accordingly, an optimal spectrum pricing policy must consider the unique characteristics of the spectrum used for space-based communication services. Therefore, the pricing exercise for the C, Ku, and Ka bands should be distinct, taking into account the specific characteristics of spectrum utilization for satellite-based communication services.
- 4.6 Currently, the Indian satellite broadband industry is in its early stages. The growth and business potential of satellite broadband services are expected to become more evident after several years of operation. Therefore, the current pricing exercise should be based on an intertemporal analysis—considering the present state of the satellite industry while also providing predictive insight into its future development.

²⁷ Buchanan Clubs: Page 265-284 (2013), Springer

B. DoT's reference

- 4.7 The DoT vide its letter dated 11th July, 2024 has sought TRAI recommendations on terms and conditions of spectrum assignment including spectrum pricing for certain satellite-based commercial communication services. It states, *inter-alia*, that:

"Keeping in view the provisions of Section 4 and the First Schedule of the Telecommunications Act-2023, in terms of Section 11(1)(a) of TRAI Act 1997, TRAI is requested to provide its recommendations on terms and conditions of spectrum assignment including spectrum pricing while accounting for level playing field with terrestrial access services for the following satellite-based communication services:

- i. NGSO based Fixed Satellite Services providing data communication and Internet services. In its recommendations, TRAI may take into account services provided by GSO-based satellite communication service providers.*
- ii. GSO/NGSO based Mobile Satellite Services providing voice, text, data, and internet services."*

C. Spectrum Charging Mechanism

- 4.8 The spectrum for space-based communications services is presently being assigned through an administrative mechanism with formula-based charging for some services and percentage of AGR-based charging for others.

D. DoT's Annual Royalty Formula for Satellite Based Services

- 4.9 The spectrum charges for assignment of frequencies are being levied as per DoT's administrative orders issued vide letter no. P-11014/34/2009-PP(III) dated 22nd March 2012 (revised vide DoT order dated 11.12.2023) attached at **Annexure 4.1.**

4.10 The Schedule VII of the above order is applicable for Assignment of spectrum to satellite based services including Fixed Satellite Services (FSS), Broadcasting Satellite Services (BSS), Mobile satellite Services (MSS) and Earth Exploration Satellite Services (EESS). The standard annual royalty factor is fixed as Rs. 35,000/- per frequency. The same rates are applicable for all applications under FSS, BSS, MSS and EESS, in combination with the relevant Bandwidth Factor (Bs).

4.11 As per Part -I of the said revised order, the Annual Royalty payable is calculated, as given below:

$$\text{Royalty, R (in Rs.)} = 35000 \times \text{Bs}$$

where (Bs) is the Bandwidth Factor for Satellite Communications

Table 4.1: Bandwidth Factor (Bs)

S. No.	Total Assigned Bandwidth		Bandwidth factor (Bs)			
			For uplink		For downlink	
			Broadcast	Others	Broadcast	Others
i	Up to and including 500 KHz, Bs is either of these three	Up to and including 100 KHz	0.25	0.20	Nil	0.20
ii		More than 100 KHz to up to and including 250 KHz	0.60	0.50	Nil	0.50
iii		More than 250 KHz to and up to and including 500 KHz	1.25	1.00	Nil	1.00
iv	More than 500 KHz [i.e. BW > 500 KHz]		Total Bs			

- 4.12 In addition to the annual royalty, a license fee is also imposed on wireless stations operating under Satellite Services (FSS, BSS, MSS), including standby sets, as specified in Part II of the aforementioned order, as follows:

S. No.	Type of Wireless station License	Annual License Fee (in Rs.)
1	Fixed Earth station DTH/ Teleport/ DSNG/NLD/ILD/DCP/IP-II	1000/- per station
2	Captive VSAT/Inmarsat Earth Station	500/- per station
3	Vehicle Mobile/ Handheld Mobile Station	250/- per station

E. Spectrum Charges for Commercial VSAT service

- 4.13 For commercial VSAT service, the spectrum charges are being levied as a percentage of Adjusted Gross Revenue (AGR), based on data rate range as per DoT's circular no. R-11014/2001-LR dated 16th April 2003 (**Annexure 4.2**).

- 4.14 The WPC spectrum charges as per the above-mentioned order are given below:

Range of Data rate	WPC Spectrum charges
Up to 128 Kbps	3.00% of AGR
Higher than 128 Kbps and up to 512 Kbps	3.50% of AGR
Higher than 512 Kbps and up to 2 Mbps	4.00% of AGR

4.15 The Authority, in its past recommendations has recommended that spectrum usage charges in respect of commercial VSAT services should be kept at 1% of AGR. These recommendations are briefly discussed below:

- In its recommendations of 3rd October 2005 on 'Growth of Telecom services in rural India — The Way Forward', the Authority had recommended that for Commercial VSAT CUG services, there should be a single rate of WPC fee (SUC) and the ceiling of 4% should be lowered to 1% to cover administrative charges only. The Authority was of the view that in the interest of growth of such services, WPC spectrum charges on VSAT should be lowered.
- Further, in its recommendations dated 7th March 2017 on 'Spectrum Usage Charges and Presumptive Adjusted Gross Revenue for Internet Service Providers and Commercial Very Small Aperture Terminal Service Providers', the Authority reiterated its earlier recommendations that SUC should not be more than 1% of AGR irrespective of the data rate.
- In its recommendations dated 28.07.2020 on 'Provision of Cellular Backhaul Connectivity via Satellite through VSAT under Commercial VSAT CUG Service Authorization', the Authority while referring to its earlier recommendations reiterated to make the SUC as 1% of AGR irrespective of the data rate.

4.16 It may be noted that DoT vide its letter no. J- 19045/04/2022-SAT dated 24.07.2024 has mentioned that:

"...TRAI in its earlier recommendations on "Licensing Framework for Satellite-based connectivity for Low Bit Rate Applications" dated 26-08-2021 had recommended for reduction in Spectrum Usage Charges (SUC) from 4% to 1% of AGR and levy of 1% across all data-rates for Commercial VSAT CUG

Service Licensees. It is not yet implemented and DoT continues to levy SUC between 3% to 4% of AGR depending on data rates for Commercial VSAT CUG Service Licensees...”

- 4.17 The DoT has requested to take this also into consideration while providing Recommendations to its present reference on the subject. Further, in its recommendations dated 18.09.2024 on “The Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023”, the Authority has recommended for the merger of the GMPCS and the VSAT authorisation framework, whereby the scope of commercial VSAT (CUG) has been enhanced to include the provision of internet services also.
- 4.18 In light of the foregoing discussion, the question arises whether the issue of the percentage of AGR, previously recommended by the Authority for Commercial VSAT (CUG), which is a GSO based Fixed satellite service (FSS), needs to be re-examined.
- 4.19 Further in this regard ,it can be argued that a spectrum charge tied to Adjusted Gross Revenue (AGR) ensures that the spectrum charges are commensurate with the operator's financial performance. When revenue is high, the operator pays more, and when revenue is low, the spectrum charge decreases. This provides for a flexible financial burden that aligns with the operator’s capacity to pay. Moreover, revenue-based spectrum charges takes into account the level playing field among operators of different sizes as smaller operators with lower revenues pay less and larger operators, who may generate more revenue, contribute more.
- 4.20 It is noted that in its reference dated July 11, 2024, the Department of Telecommunications (DoT) has requested recommendations on the terms and conditions of spectrum assignment, including spectrum pricing, with consideration for ensuring a level playing field with terrestrial access services. In this context, it is essential to examine whether such a level playing field

between service providers of NGSO based Fixed Satellite Services providing data communication and Internet services and GSO/NGSO based Mobile Satellite Services providing voice, text, data, and internet services. and terrestrial access service providers actually exists. Following this examination, if spectrum charges are to be levied as a percentage of AGR, the percentage previously recommended by the Authority may need to be reassessed.

- 4.21 A concern with Adjusted Gross Revenue (AGR) based charging is that as spectrum charges are not tied to the amount of spectrum held, it may encourage some operators to keep spectrum idle rather than utilizing it effectively. One approach to address this issue of hoarding of spectrum could be the imposition of a minimum spectrum charge for amount of spectrum held by a service provider.

F. Spectrum Charges for satellite services under Sui Generis category

- 4.22 The Authority in its recommendations on "Methodology for levy of Spectrum Charges for provision of Satellite based Services using Gateway installed in India under 'sui-generis' category" dated 27th December 2018, recommended that the spectrum charges should be levied at 1% of the AGR of BSNL's satellite-based services under 'sui-generis' category. These recommendations have been accepted by the Government and the spectrum charges for BSNL's satellite-based services under 'sui-generis' category has been prescribed as 1% of the AGR vide DoT's order dated 28.06.2021.

G. International Spectrum Charges

- 4.23 Satellite spectrum is generally assigned through an administrative mechanism internationally. The spectrum charges are levied in the form of an administratively determined fee. Some details of the spectrum charges levied internationally are given below:

Singapore:²⁸

Radio-communication Service	Radio Frequency Bands	Occupied Bandwidth (X)	Fee payable per frequency per annum*
Satellite (GeoStationary Orbit)	Frequency Bands	25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$700
		10 MHz < X ≤ 20 MHz	\$1,000
		X > 20 MHz	\$1,600
Satellite (Non-GeoStationary Orbit)	All Frequency Bands	X ≤ 25 kHz	\$300
		25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$1,500
		10 MHz < X ≤ 20 MHz	\$2,800
		X > 20 MHz	\$4,700

Radio-communication Service	Radio Frequency Bands	Occupied Bandwidth (X)	Fee payable per frequency per annum*
Fixed	Below 10 GHz	X ≤ 25 kHz	\$300
		25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$800
		10 MHz < X ≤ 20 MHz	\$1,800
		X > 20 MHz	\$2,400
	10 GHz – 15.7 GHz	X ≤ 25 kHz	\$300
		25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$500
		10 MHz < X ≤ 20 MHz	\$900
		X > 20 MHz	\$1,200
	15.7 GHz – 21.2 GHz	X ≤ 25 kHz	\$300
		25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$500

²⁸<https://www.imda.gov.sg/-/media/imda/files/regulation-licensing-and-consultations/licensing/licenses/guidesatecomm.pdf>

Radio-communication Service	Radio Frequency Bands	Occupied Bandwidth (X)	Fee payable per frequency per annum*
		10 MHz < X ≤ 20 MHz	\$700
		X > 20 MHz	\$900
	Above 21.2 GHz	X ≤ 25 kHz	\$300
		25 kHz < X ≤ 500 kHz	\$400
		500 kHz < X ≤ 10 MHz	\$500
		10 MHz < X ≤ 20 MHz	\$600
		X > 20 MHz	\$700

Malaysia²⁹

Satellite service type	Fee per station (RM)	Spectrum fee (RM)	Total (RM)
Fixed	120	830	950
Mobile	60	830	890

Canada³⁰

Type of Station	Spectrum fee
Fixed earth stations, transportable earth stations, and earth stations in motion (ESIMs)	\$5.22 per MHz assigned spectrum
Mobile earth stations ≤ 3.0 GHz	\$1,566.00 per MHz assigned spectrum
Mobile earth stations > 3.0 GHz	\$5.22 per MHz assigned spectrum

²⁹ <https://www.mcmc.gov.my/en/commons/viewdetail?docid=31186>

Spectrum fee is constant for spectrum qty >54 MHz for above 3 GHz spectrum bands

³⁰ <https://ised-isde.canada.ca/site/spectrum-management-telecommunications/en/spectrum-and-telecommunications-fees>

South Africa³¹

The Unit Price per MHz paired is Rs. 3,125.00 (Three Thousand One Hundred and Twenty-Five Rand) per year.

- 4.24 It may be noted that the spectrum charges levied in other countries for satellite communications services are generally low on a per MHz basis.
- 4.25 In this background, the Authority solicits comments of stakeholders on the following:

Issues for Consultation:

Q14. Should spectrum charges for NGSO-based FSS providing data communication and Internet services, be levied:

- i. On a per MHz basis,**
- ii. On a percentage of Adjusted Gross Revenue (AGR) basis, or**
- iii. Through some other methodology?**

Please provide a detailed justification for your answer.

Q15. In case it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

- i. The Department of Telecommunications (DoT) order dated December 11, 2023, or**
- ii. An alternative approach (please specify)?**

Please provide a detailed justification to support your answer.

³¹ <https://www.icasa.org.za/pages/fees>

Q16. If it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a percentage of AGR basis:

- i. What should be the appropriate percentage of AGR?**
- ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge?**
- iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization?**

Please provide a detailed justification for your answers.

Q17. Considering the Adjusted Gross Revenue (AGR) based charging methodology currently followed for Commercial VSAT and in view of the enhanced scope of the Satellite service authorisation, what should be the spectrum charge, as a percentage of AGR, that should be levied on GSO-based FSS?

Or,

Should some alternative spectrum charging methodology be used for determining spectrum charges for GSO-based FSS?

Please provide a detailed justification for your answer.

Q18. Should spectrum charges for GSO and NGSO-based MSS that provide voice, text, data, and Internet services be levied:

- i. On a per MHz basis,**
- ii. On a percentage of AGR basis, or**
- iii. Through some other methodology?**

Please provide a detailed justification for your answer.

Q19. If it is determined that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

- i. The Department of Telecommunications (DoT) order dated December 11, 2023, or**
- ii. An alternative approach (please specify)?**

Please provide a detailed justification to support your answer.

Q20. If it is decided that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a percentage of AGR basis:

- i. What should be the appropriate percentage?**
- ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge?**
- iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization?**

Please provide a detailed justification for your answers.

Q21. Whether there are any other issues/suggestions relevant to the spectrum charging for:

- i. NGSO/GSO based FSS providing data communication and Internet services.**
- ii. NGSO/GSO based MSS providing voice, text, data, and Internet services.**

The response may be submitted with proper explanation and justification.

4.26 The following chapter lists the issues for consultation.

Chapter V: Issues for Consultation

Stakeholders are requested to provide their responses to the following questions with detailed justifications:

- Q1. Which frequency band(s)/ range(s) should be considered for the assignment to NGSO based Fixed Satellite Services for providing data communication and Internet service? Please provide a detailed response separately for the user link and feeder link.**
- Q2. Which frequency band(s)/ range(s) should be considered for the assignment to GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet service. Please provide a detailed response separately for the user link and feeder link.**
- Q3. What should be the maximum period of assignment of spectrum for -**
(c) NGSO based Fixed Satellite Services for providing data communication and Internet services, and
(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?
Please provide a detailed response alongwith international practice in this regard.
- Q4. For assigning spectrum for NGSO-based communication services, whether every ITU filing should be treated as a separate satellite system? Please provide a detailed response alongwith international practice in this regard.**
- Q5. Whether the provisions of ITU-RR are sufficient to resolve interference related challenges and coordination issues? If not, what additional conditions should be prescribed while assigning frequency spectrum for –**

(c) NGSO based Fixed Satellite Services for providing data communication and Internet services; and

(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response alongwith international practice in this regard.

Q6. For satellite earth station gateways of different satellite systems operating in the same frequency range, whether there is a need to prescribe a protection distance or any other measures to avoid interference from each other–

(c) Between the gateways of GSO and NGSO systems; and

(d) Between the gateways of NGSO systems?

If yes, please provide a detailed response alongwith international practice in this regard.

Q7. In case the spectrum assigned for satellite gateway links is also assigned to terrestrial networks such as Fixed Service, IMT etc., what protection distance or criterion should be included in the terms and conditions of the assignment of spectrum for satellite gateway links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.

Q8. In case the spectrum assigned to the satellite user link is also assigned to terrestrial networks such as Fixed Service, what criterion should be included in the terms and conditions of the assignment of spectrum for satellite user links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.

Q9. Whether there is a need to prescribe any conditions to mitigate the risk of scarcity of satellite gateway sites? If yes, please provide a detailed response alongwith international practice in this regard.

Q10. In addition to the roll-out conditions recommended by TRAI for satellite-based Telecommunication Service Authorisation through its recommendations on the Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023 dated 18.09.2024, whether there is a need to impose certain additional roll-out obligations for the assignment of frequency spectrum for –

(c) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response alongwith international practice in this regard.

Q11. Whether there is a need to introduce a provision for surrender of frequency spectrum prior to the expiry of the period of validity of spectrum assigned for -

(c) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

If yes, what should be the process, and associated terms and conditions such as minimum period of spectrum holding, notice period, surrender fee, etc.? Please provide a detailed response with justifications.

Q12. Whether there is a need to prescribe timelines for processing the applications for the assignment of frequency spectrum for-

(c) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response with justifications.

Q13. Whether there are any other suggestions related to assignment of spectrum for-

(a) NGSO based Fixed Satellite Services for providing data communication and Internet services;

(b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services?

Please provide a detailed response with justifications.

Q14. Should spectrum charges for NGSO-based FSS providing data communication and Internet services, be levied:

i. On a per MHz basis,

ii. On a percentage of Adjusted Gross Revenue (AGR) basis, or

iii. Through some other methodology?

Please provide a detailed justification for your answer.

Q15. In case it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

i. The Department of Telecommunications (DoT) order dated December 11, 2023, or

ii. An alternative approach (please specify)?

Please provide a detailed justification to support your answer.

Q16. If it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a percentage of AGR basis:

- i. What should be the appropriate percentage of AGR?**
- ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge?**
- iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization?**

Please provide a detailed justification for your answers.

Q17. Considering the Adjusted Gross Revenue (AGR) based charging methodology currently followed for Commercial VSAT and in view of the enhanced scope of the Satellite service authorisation, what should be the spectrum charge, as a percentage of AGR, that should be levied on GSO-based FSS? Or,

Should some alternative spectrum charging methodology be used for determining spectrum charges for GSO-based FSS?

Please provide a detailed justification for your answer.

Q18. Should spectrum charges for GSO and NGSO-based MSS that provide voice, text, data, and Internet services be levied:

- i. On a per MHz basis,**
- ii. On a percentage of AGR basis, or**
- iii. Through some other methodology?**

Please provide a detailed justification for your answer.

Q19. If it is determined that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

- i. The Department of Telecommunications (DoT) order dated December 11, 2023, or**
- ii. An alternative approach (please specify)?**

Please provide a detailed justification to support your answer.

Q20. If it is decided that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a percentage of AGR basis:

- i. What should be the appropriate percentage?**
- ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge?**
- iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization?**

Please provide a detailed justification for your answers.

Q21. Whether there are any other issues/suggestions relevant to the spectrum charging for:

- i. NGSO/GSO based FSS providing data communication and Internet services.**
- ii. NGSO/GSO based MSS providing voice, text, data, and Internet services.**

The response may be submitted with proper explanation and justification.

Annexure-1.1: DoT's reference letter dated 13.09.2021
(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-14006/01/2021-NTG

Date: 13.09.2021

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)/ 5G.

Sir,

In response to DoT's reference dated 17.04.2017, TRAI provided its recommendations dated 01.08.2018 on various issues involved in the auction of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz and 3300-3600 MHz bands. Based on the TRAI recommendations dated 01.08.2018 and response dated 08.07.2019 on DoT's back-reference, Government conducted auction of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands in March 2021. A total of 2308.80 MHz spectrum worth Rs. 400396.20 Crore at Reserve Price in different band-LSA combinations was put to auction, out of which 855.60 MHz quantum was sold in the auction resulting in total winning bids worth Rs. 77820.81 Crore. No bids were received in 700 MHz and 2500 MHz bands. Spectrum unsold in the auction held in March 2021 may be put to auction in the forthcoming auction. LSA-wise quantum available with the Government in these bands after the auction is given in **Annexure-I**.

SPC

2. In the recommendations dated 01.08.2018, spectrum in 3300-3600 MHz band was also included. However, due to certain issues, the Government decided to initiate action to auction spectrum in this band separately after resolution of these issues and, therefore, it was not a part of the auction held in March 2021. Now, as the issues have been resolved as well as the range of available frequencies in this range has slightly gone up, it has been decided by the Government that spectrum in the frequency range 3300-3670 MHz should be made available to the Telecom Service Providers for IMT/ 5G through auction, except in few areas/locations (details of excluded areas/locations in **Annexure-II**).

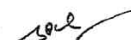
3. In addition to the above, new frequency bands (mentioned below) have also been decided to be used for IMT/5G:

- (i) 526-582 MHz in all the LSAs in coordination with Ministry of Information & Broadcasting. The use will be coordinated with minimum keep out distance from MIB transmitters.
- (ii) 582-617 MHz in all the LSAs. This band will be available for IMT/5G and rural point to point links.
- (iii) 617-698 MHz in all the LSAs; except few areas/locations (details of excluded areas/locations in **Annexure-II**).
- (iv) 24.25 to 28.5 GHz in all the LSAs except at 5 locations (details of locations in **Annexure-II**) with protection distance of 2.7 km.

4. DoT has also received few requests regarding spectrum requirements for captive usage of 5G applications by some industries e.g. Industry 4.0. COAI has also submitted a letter regarding Private Captive Networks, wherein they have *inter alia* requested not to reserve any spectrum which has been identified for IMT, for Private Captive Networks.

5. Parliamentary Standing Committee on Information Technology in its report on "India's preparedness for 5G" has made certain observations on pricing of spectrum. Also, DoT has received request from COAI regarding effective spectrum pricing. Copy of the relevant pages of the Standing Committee report is enclosed as **Annexure-III**.

6. Department of Space (DoS) had invited comments on Draft Spacecom Policy liberalizing space segment for private sector participation to provide commercial communication services in India. This includes the Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) satellite constellations operational over India. In case of satellite communication, the subscriber is accessed from the satellite through "Access spectrum"



similar to "Access spectrum" in terrestrial network and the demand for such spectrum will potentially increase in the future.

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

- (a) provide recommendations on applicable reserve price, band plan, block size, quantum of spectrum to be auctioned and associated conditions for auction of spectrum in 526-698 MHz, 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3670 MHz and 24.25-28.5 GHz bands for IMT/ 5G.
- (b) provide recommendation on quantum of spectrum/bands, if any, to be earmarked for private captive/isolated 5G networks, competitive/transparent method of allocation, and pricing, for meeting the spectrum requirements if captive 5G applications of industries for machine/plant automation purposes/M2M in premises.
- (c) provide recommendation on appropriate frequency bands, band plan, block size, applicable reserve price, quantum of spectrum to be auctioned and associated conditions for auction of spectrum for space-based communication services, in view of para 6 above.
- (d) provide any other recommendations deemed fit for the purpose of spectrum auction in these frequency bands, including the regulatory/ technical requirements as enunciated in the relevant provisions of the latest ITU-R Radio Regulations.

This issues with the approval of the competent authority.


(Sukhpal Singh)
Joint Wireless Adviser

Enclosure:

- i) **Annexure-I** LSA-wise quantum available with the Government in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands after March' 2021 auction and after earmarking of 5 MHz (paired) to Indian Railways in 700 MHz band.
- ii) **Annexure-II** Details of the areas/locations where certain spectrum would not be available for IMT/5G.

- iii) **Annexure-III:** Copy of the relevant pages of Parliamentary Standing Committee Report on "India's Preparedness for 5G".

Copy to:

Secretary, DoS, for kind information please.

Annexure-1.2: DoT's letter dated 16.08.2022

(with its Annexure-I)

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. J-19022/01/2022-SAT

Date: 16 August, 2022

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)/5G-reg.

Reference: TRAI letter No. C-15/2/(1)/2021-NSL-II dated 23rd November 2021.

Sir,

In response to DoT's reference dated 13.09.2021, Telecom Regulatory Authority of India (TRAI), vide its above referenced letter (enclosed), requested DoT to provide additional information in respect of space-based communication services.

2. In this regards, the following information is provided to TRAI with a request to provide the recommendations on 7(c) of the DoT's letter No. L-14006/01/2021-NTG dated 13.09.2021 (enclosed).

2.1 Details of the frequency bands and quantum of spectrum available in each band required to be put to auction and associated information in respect of space-based communication:

- (a) The frequency bands and quantum of spectrum that may be considered by TRAI for providing recommendations with respect to space-based communication services are provided in **Annexure-I**.
- (b) These frequency bands include "Planned bands" that when used by GSO systems in accordance with Appendices 30, 30A & 30B of Radio Regulations are reserved by ITU for use by National systems. Use of 'Planned Bands' by foreign GSO satellites is not permitted in India. TRAI may, *inter-alia*, take into account this aspect with respect to GSO systems, in the consultation process. Further, the NGSO network has to provide the protection to GSO networks as per ITU framework.

- (c) While Annexure-1 includes both spectrum band and quantum of spectrum in each band, however, the demand of spectrum is not known. Therefore, TRAI, through consultations, may assess the demand for space-based communication services and accordingly provide recommendations on the quantum of spectrum in each band required to be put to auction.

2.2 Whether spectrum for space-based communication is being envisaged to be assigned on exclusive basis or will the same be shared among multiple service licensees:

- (a) It is envisaged to auction the Space Spectrum on exclusive basis. TRAI may explore the feasibility and procedure of sharing auctioned spectrum among multiple service licensees. TRAI may provide recommendations on sharing of auctioned frequency bands between satellite networks and terrestrial networks also, the criteria for sharing and appropriate interference mitigation techniques for sharing and coexistence.
- (b) In frequency bands 27.5-28.5 GHz (identified for IMT) and 28.5-29.5 GHz (being studied for Captive Non-Public Networks), TRAI may recommend mechanism for sharing of auctioned frequency bands in which both IMT/CNPN and satellite based services (both user terminal and Gateways) can be provided in a flexible manner.

2.3 Details of spectrum assignment mechanism and methodology of charging currently being followed by DoT for space-based communication services:

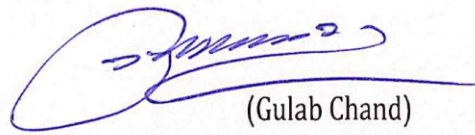
- (a) Spectrum for space based communications services is currently being assigned through administrative mechanism with formula-based charging for some applications and percentage AGR based charging for others. This assignment is subject to conditions provided in the WPC Wing OM No. R-11014/15/2012-NT(Pt.) dated 05 January 2021(revised from time to time)- **Annexure-III**.
- (b) Relevant spectrum charging orders are provided in **Annexure-IV**. Spectrum charges are levied as per administrative orders issued in 2012. Commercial VSAT operations are governed by an order issued in 2003 where charges were levied on a revenue sharing basis. This order is under revision, where the percentage AGR basis charging has been retained but a uniform rate of charging is proposed. Until June, 2021, the spectrum charges for Mobile Satellite Service provided by BSNL ("Sui generis") were being levied on formula basis. However, in June 2021, a separate order for this service has been issued, as per which spectrum charges are being collected from M/s BSNL on a revenue sharing basis, with retrospective effect (from the date of inception of this service). In 2021, spectrum charges for captive VSAT users were also modified.

3. Since the service providers may require spectrum both in user link as well as in feeder link, TRAI may take inputs from the stakeholder and recommend the appropriate auction methodology so that the successful bidder gets spectrum for user link (shared with IMT in flexible) as well as feeder link.



4. In addition, TRAI is requested to provide any other recommendation as 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 ITU-R Radio Regulations.

This issues with the approval of the competent authority.



(Gulab Chand)
Joint Wireless Advisor

Enclosure:

1. **Annexure-I**: Frequency bands to be considered by TRAI for providing recommendations with respect to space-based communication services.
2. **Annexure-II**: Frequency assignment issued in these bands.
3. **Annexure-III**: WPC Wing OM No. R-11014/15/2012-NT(Pt.) dated 05 January 2021
4. **Annexure-IV**: Extant Spectrum charging orders.
5. TRAI letter No. C-15/2/(1)/2021-NSL-II dated 23rd November 2021.
6. DoT letter No. L-14006/01/2021-NTG dated 13.09.2021.

Frequency bands to be considered by TRAI for providing recommendations with respect to space-based communication services

1. TRAI can consider the following frequency bands for providing recommendations with respect to space-based communication services.

- i. 10.7- 12.75 GHz (space to Earth)
- ii. 12.75-13.25 GHz (Earth-to-space)
- iii. 13.75- 14.5 GHz (Earth-to-space)
- iv. 17.7-18.6 GHz (space to Earth) [17.7-18.4 is used for Earth to space also]
- v. 18.8-19.3 GHz (space to Earth)
- vi. 19.3-19.7 GHz (space to Earth)
- vii. 19.7-21.2 GHz (space to Earth)
- viii. 27.5-29.5 GHz (Earth-to-space) [27.5-28.5 GHz has been identified for implementation of IMT in India]
- ix. 29.5- 31 GHz (Earth-to-space)

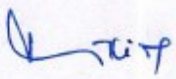
2. TRAI can however provide recommendations for other frequency bands also.

Note: The Planned bands are:

- i. 12.75 -13.25 GHz & 6725-7025 MHz (Uplink) and 10.7-10.95 GHz, 11.2-11.45 GHz & 4500-4800 MHz (Downlink): FSS Plan (RR Appendix 30B)
- ii. 11.7-12.2 GHz (Downlink) : BSS Plan (RR Appendix 30)
- iii. 14.5-14.8 GHz & 17.3-18.1 GHz (Uplink): BSS feeder links Plan (RR Appendix 30A)

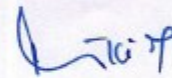


Annexure-1.3: DoT's reference letter dated 11.07.2024

J-19034/003/2024-SAT Government of India Ministry of Communications Department of Telecommunications WPC Wing, Sanchar Bhawan, New Delhi-110001	
To The Secretary, Telecom Regulatory Authority of India 4th to 7th Floor, Tower-F World Trade Centre, Nauroji Nagar New Delhi-110029	<div style="text-align: right;">11 July, 2024</div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"><div style="font-size: small;">भारतीय दूरसंचार विनियामक प्राधिकरण महानगर दूरसंचार भवन, नई दिल्ली-०२ पंजीकरण सं. 30564-</div><div style="text-align: center; color: red; font-weight: bold; font-size: large;">11 JUL 2024</div><div style="font-size: small;">ई ऑफिस सं.</div></div>
Subject: Seeking TRAI recommendations on terms and conditions of spectrum assignment including spectrum pricing for certain satellite-based commercial communication services.	
Sir, TRAI in its letter No. C-15/2/(2)/2022-NSL-II dated 08 February 2024 requested DoT to review its earlier reference No. L-14006/01/2021-NTG dated 13/09/2021 to TRAI seeking their recommendations for auction of spectrum for space-based communication services in view of the provisions of the Section 4 & First Schedule of the Telecommunications Act 2023.	
2. It is to inform that a reference dated 21/06/2024 has already been sent to TRAI for seeking recommendations on terms and conditions, including fees or charges, for authorization to provide telecommunication services (including satellite-based communication services) as per the provisions of the Telecommunications Act, 2023.	
3. Since the last reference dated 13/09/2021 to TRAI on spectrum for space-based communication services, a few Unified Licenses with VSAT CUG, Global Mobile Personal Communication by Satellite (GMPCS), NLD and ISP Category 'A' authorizations have been issued by DoT for providing satellite-based communication services through Non - Geostationary Orbit (NGSO) satellites. For assignment of spectrum to such licensees, terms and conditions of spectrum assignment including spectrum pricing need to be finalized.	
	

4. Keeping in view the provisions of Section 4 and the First Schedule of the Telecommunications Act-2023, in terms of Section 11(1)(a) of TRAI Act 1997, TRAI is requested to provide its recommendations on terms and conditions of spectrum assignment including spectrum pricing while accounting for level playing field with terrestrial access services for the following satellite-based communication services:

- i. NGSO based Fixed Satellite Services providing data communication and Internet services. In its recommendations, TRAI may take into account services provided by GSO-based satellite communication service providers.
- ii. GSO/ NGSO based Mobile Satellite Services providing voice, text, data, and internet services.



(M Revathi)

Joint Wireless Adviser

Annexure 3.1: Existing/ planned deployments by various satellite operators in NGSO

(enclosed with the DoT's letter dated 16.08.2022)

Existing/Planned deployments by various satellite operators in NGSO

(as per information available in Public domain)

Sl. No	Satellite Operator	Deployment (Frequency Bands)	Planned Satellite numbers	Live Satellite numbers	Frequency Bands (in GHz)			
					User Link		Feeder Link	
					Space to Earth	Earth to Space	Space to Earth	Earth to Space
1.	SpaceX (USA)	Ku/Ka* (1 st Gen)	4408	1892	10.7-12.75	14-14.5	17.8-18.6 18.8-19.3	27.5-29.1 29.5-30.0
		Ku/Ka/E* (2 nd Gen)	30000	-	10.7-12.75 17.8-18.6 18.8-19.3 19.7-20.2	12.75-13.25 13.85-14.5 28.35-29.1 29.5-30.0	17.8-18.6 18.8-19.3 71-76	27.5-29.1 29.5-30.0 81-86
		V Band*	7518	-	37.5-42.5	47.2-50.2 50.4-52.4	37.5-42.5	47.2-50.2 50.4-52.4
2.	Kuiper Systems (Amazon) (USA)	Ka Band	3236	-	17.7-18.6 18.8-20.2	28.35-29.1 29.5-30	17.7-18.6 18.8-20.2	27.5-30 37.5-42.0 42.0-42.5
		Ku/V***	7774	-	10.7-12.7 37.5-42.0 42.0-42.5	12.75-13.25 14-14.5 47.2-50.2 50.4-51.4	37.5-42.0 42.0-42.5	47.2-50.2 50.4-51.4
3	Boeing (USA)	V	5921	-	37.5-42	47.2-50.2 50.4-51.4	37.5-42	47.2-50.2 50.4-51.4
4	Astra Space (USA)	V	13620	-	37.5-42	47.2-50.2 50.4-51.4	37.5-42	47.2-50.2 50.4-51.4
5	OneWeb (UK)	Ku/Ka (Phase 1)	648	394	10.7-12.7	12.75-13.25 14-14.5	17.8-18.6 18.8-19.3 19.7-20.2	27.5-29.1 29.5-30.0
		Ku/Ka (Phase 2)	6372	-	10.7-12.7	12.75-13.25 14-14.5	17.8-18.6 18.8-19.3 19.3-19.7 19.7-20.2	27.5-29.1 29.1-29.5 29.5-30.0
		V Band	6372	-	40.0-42.0	48.2-50.2	37.5-42.5	42.5-43.5 47.2-50.2 50.4-51.4
6	O3B (UK)	Ka	70	20	17.8-18.6 18.8-20.2	27.5-30	17.8-18.6 18.8-20.2	27.5-30
		V	24	-	37.5-42	47.2-50.2 50.4-51.4	37.5-42	47.2-50.2 50.4-51.4
7	Telesat (CANADA)	Ka Band**	300	-	17.8-18.6 18.8-19.3 19.7-20.2	27.5-29.1 29.5-30	17.8-18.6 18.8-19.3 19.7-20.2	27.5-29.1 29.5-30
		V Band**	1671	-	37.5-42	47.2-50.2 50.4-51.4	37.5-42	47.2-50.2 50.4-51.4

*SpaceX not seeking authorization in USA for 12.7-12.75 GHz; 40-42.5 GHz & 51.4-52.4 GHz

**The frequency band 50.4-51.4 GHz is presently not identified in the USA for FSS.

*** 42-42.5 GHz (non-USA only)

Annexure 4.1: DoT's order dated 11.12.2023 (with Schedule VII)

Government of India
Ministry of Communications
Department of Telecommunications
Wireless Planning and Coordination Wing
20, Ashoka Road, Sanchar Bhawan, New Delhi

No. P-11014/34/2009-PP

Dated: 11.12.2023

ORDER

Subject: Spectrum Charges for Assignment of Frequencies to Captive Users (being charged on formula basis) for different types of Radiocommunication Services and applications.

In pursuance of the powers conferred under section 4 of the Indian Telegraph Act, 1885 (13 of 1885) and in supersession of this Ministry's Orders Nos. P-11014/34/2009-PP (I), (II), (III) & (IV) each dated 22.03.2012, the Central Government has decided that assignment of radio frequency spectrum to all users to whom radio frequency assignment is made through administrative process and spectrum charges are calculated based on a formulae, shall be made as per the methodology defined in this order.

2. Upon successful processing of application for assignment of radio frequency, a Letter of Intent (LoI) will be issued to the applicant which include, among others, information about the license fee and royalty charge (collectively called spectrum charges) required to be paid. Spectrum charges shall be informed for the full period of the assignment requested. If the request for assignment is for a period more than one year, the applicant can opt to pay the license fee and royalty annually, in advance for each year.

3. Immediately thereafter, but in any case not later than sixty (60) days from the date of issue of the LoI, the applicant shall pay the spectrum charges for issue of Decision Letter (DL), if otherwise permissible.

3.1 If the payment is not received within 60 days from the date of LoI, the application shall be treated as cancelled and the frequency shall be freed for assignment to other applicants. The applicant will have to submit a fresh application if they still want the frequency assignment.



4. A Construction Period of three months is permitted for the purpose of import of the equipment, site preparedness, deployment, etc. and spectrum charges be levied, after three months' period from the 1st day of the month of date of issue of LoI.

4.1 Three months' construction period shall not be applicable for temporary frequency assignment (assignment issued for the period less than one year). In such cases, spectrum charges shall be applicable from the 1st day of the month of date of issue of LoI.

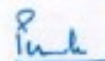
5. Initially, DL shall be issued with a validity of 15 months (one year plus three months of construction period) from the 1st day of the month of date of issue of LoI that can be further extended for a period of another one year subject to payment of annual spectrum charges, in advance. For example: If date of issue of initial LoI is 20th August 2023, the spectrum charges will be levied from 1st November 2023 and the initial DL will be valid upto 31st October 2024. Further extension of one year will be expired on 31st October 2025.

5.1 In no case DL be renewed further, however, extension of another one year may be considered for Government users under certain circumstances subject to payment of annual spectrum charges, in advance.

6. The spectrum charges, comprises of Royalty and License fee, shall be calculated for following radiocommunication services as per the enclosed schedules:

Schedule No.	Radiocommunication Services and applications	Page No.
I	Terrestrial Broadcasting service	6-7
II	Land Mobile Service (up to 375 kHz)	8-13
III	Maritime Mobile Service	14-16
IV	Aeronautical Service	17-18
V	Radar under Radionavigation Service and Radiolocation Service	19-20
VI	Fixed and Mobile Service (Multi-channels Multiplexed)	21-23
VII	Satellite Based Services (FSS, BSS, MSS, EESS)	24-26

6.1 All the above services have been defined in the National Frequency Allocation Plan of India (NFAP). The latest NFAP is available in DoT's website (www.dot.gov.in).



6.2 Spectrum charges, mentioned in all the schedules, are annual charges, unless otherwise specified.

6.3 Royalty charge has been made independent of numbers of equipment/set, unless otherwise specified. However, license fee will be applicable on them. Therefore, any increase/ decrease in the number of equipment (Fixed/ Mobile) in the existing frequency assignment shall require prior permission.

6.4 The spectrum charges due for different period shall be determined as follows:

License Period	License Fee Payable	Royalty payable after three months period from the 1 st day of the month of date of issue of LOI	Method of Payment
One calendar month or less	At specified rate given in various schedules	Annual Royalty divided by 12	Full License fee and Royalty to be paid in advance at the time of issue of DL/frequency assignment.
More than one calendar month but less than 12 months	At specified rate given in various schedules	On pro-rata basis. However, part of a month shall be taken as one month.	--do--
More than one year	At specified rate given in various schedules	On pro-rata basis. However, part of a month shall be taken as one month.	Pay the License Fee plus Royalty for the entire duration in advance at the time of issue of DL/frequency assignment or pay it in annual advance instalments.

7. Generally, there shall be no limit on number of frequency(ies) applied for any type of services. However, number of frequency(ies) shall be assigned subject to availability, technical justification, regulatory feasibility etc.



8. Renewal of Frequency Assignment:

8.1 The assignee shall be responsible for keeping the frequency assignment current and up to date until its surrender/ cancellation. To this effect, the assignee shall, at least 30 days before the end date of the validity of the frequency assignment, pay through Saral Sanchar Portal, the spectrum charges for the renewal of his/her existing frequency assignment.

9. Frequency assignment/ authorization Modification Fee:

9.1. Applicable fees for modification in the frequency authorization/ frequency assignment shall be charged at the rate of Rs. 1000/- per modification.

10. Cancellation/ Surrender of Frequency Assignment:

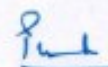
10.1 The assignee shall surrender the frequency assignment, if no longer required. To this effect the assignee shall apply for cancellation through Saral Sanchar Portal in accordance with OM No. L-14027/210/2020-WF dated 27.07.2023. Failure to surrender a frequency assignment within the stipulated time shall result in accrual of spectrum charges and late fee.

10.2 Non-purchase of equipment/ non-utilization of frequency assignment shall not be ground for exemption from payment of spectrum charges.

10.3 On surrender of frequency assignment, after adjustment of due spectrum charges, the balance amount will be either adjusted against other active frequency assignments or refunded to the applicant.

11. Late fee for delayed payment of Spectrum Charges:

11.1 Late fee shall be payable by the assignee on the frequency assignment for delay in payment of spectrum charges (Royalty and License fee) or any other dues payable against the frequency assignment. In this regard, any payment reflected in DoT's account after the midnight (2400 Hrs.) of the end date will be considered as a delay in payment irrespective of the date on which such transaction was initiated by the assignee of the frequency assignment.



11.2 The rate at which Late Fee is levied for a Financial Year shall be 2% added to one-year Marginal Cost of Lending Rate (MCLR) of State Bank of India, on the beginning of the Financial Year i.e. 1st April.

11.3 The Late Fee shall be compounded annually, subject to minimum annual Late Fee of Rs. 250/- per Frequency Assignment. A part of the month shall be considered as a full month for the purpose of calculation of Late Fee. A month shall be an English calendar month.

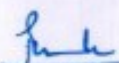
12. The applications for the frequency assignment shall continue to be processed through DoT's online portal (Saral Sanchar portal). Further, all renewals, cancellations, import permission, surrenders will also be issued through online portal (Saral Sanchar) as per prevailing instructions issued from time to time.

13. Any issue either arising due to interpretation of this Order or new uses/applications not covered in the said Order shall be referred to the Standing Committee constituted vide WPC Wing OM of even No. dated 11.12.2023.

14. This Order issues with the approval of competent authority.

15. This Order shall come into force with effect from 01st April 2024. However, the revised spectrum charges on existing frequency assignments shall be applicable from the date of next renewal cycle.

Enclosure: As above.


11.12.2023

(P S M Tripathi)

Sr. Deputy Wireless Adviser to the Govt. of India

वी.एस.एम. त्रिपाठी/P.S.M. TRIPATHI
वरिष्ठ उप संचार सलाहकार
Senior Deputy Wireless Adviser
संचार विभाग, भारत सरकार
Deptt. of Telecom, Govt. of India
नई दिल्ली/New Delhi

To,

1. All concerned.
2. Wireless Finance Division
3. Wireless Monitoring Organisation
4. IT cell, DoT - for publication on DoT Website
5. ITPC, BSNL, Pune to send text messages to all licensee informing them about the new orders on frequency assignment.

Schedule-VII: Satellite based Services.

General:

- (i) Satellite based Service includes Fixed Satellite Services (FSS), Broadcasting Satellite Services (BSS), Mobile satellite Services (MSS) and Earth Exploration Satellite Services (EESS)
- (ii) The standard annual royalty factor shall be Rs. 35,000/- per frequency. The same rates will be applied for all applications under FSS, BSS, MSS and EESS together with the relevant Bandwidth Factor (Bs) given in Table-1 below to arrive at the amount of Annual Royalty (R) per frequency payable for an Uplink or Downlink.
- (iii) Royalty charges shall not be applicable on remote terminals of Data collection platforms. Only the license fee will be paid.
- (iv) Bandwidth factor for the bandwidth will be calculated in the multiple of 500 kHz and the remainder will be calculated using increments of 100 kHz.
- (v) The royalty will be charged on the total bandwidth assigned i.e., including any guard bands etc.
- (vi) The royalty charges for Earth-Exploration Satellite Services / Meteorological Satellite Service, will be calculated only once for every frequency carrier used by the remote users under these services.
- (vii) For Space Operation Services (TTC operation), the fixed royalty charges of Rs 1,50,000/- per Earth Station per annum will be levied.
- (viii) Royalty charges will be levied in respect of frequencies transmitted from or into Indian territory.



- (ix) For DSNG/SNG, the royalty charges will be levied for the frequencies used on both uplinks and downlinks. In case the same frequency carrier is used by the user from different OB vans belonging to licensee, additional royalty @ 25% of the basis royalty will be charged. However, if the additional OB vans are deployed within the same venue, e.g. a stadium, additional royalty @ 25% of the basis royalty will not be charged.
- (x) For temporary Up linking, a minimum royalty equivalent to that for one month will be charged.

h

Part-I (Royalty Charges)

1. Annual Royalty Charges for Satellite Based Services:

$$\text{Annual Royalty (R)} = \text{Rs. } 35000 \times B_s$$

Table-1: Calculation of Bandwidth Factor (Bs)

S. No.	Total Assigned Bandwidth		Bandwidth Factor (Bs)			
			For uplink		For downlink	
			Broadcast*	Others	Broadcast	Others
(i)	Up to and including 100 kHz	Up to and including 100 kHz [i.e., BW ≤ 100 kHz]	0.25	0.20	Nil	0.20
(ii)	500 kHz, Bs is either of these three	More than 100 kHz to up to and including 250 kHz [i.e., 100 kHz < BW ≤ 250 kHz]	0.60	0.50	Nil	0.50
(iii)		More than 250 kHz to up to and including 500 kHz [i.e., 250 kHz < BW ≤ 500 kHz]	1.25	1.00	Nil	1.00
(iv)		More than 500 kHz [i.e., BW > 500 kHz]	Total Bs			

*Broadcast in this case means those uses that are related to transmission of television content through satellite, and include, teleports, DSNG vans, DTH, HITS etc.

Total Bs = [Appropriate Bs from row (iii) above × bandwidth in number of multiple of 500 kHz] + [Appropriate Bs from row (i) above × number of multiple of 100kHz or part thereof in balance bandwidth]

where,

Balance bandwidth = remainder of [bandwidth/ 500 kHz]

Part-II (License fee)

License Fee for wireless stations operating under Satellite Services (FSS, BSS, MSS) including Standby sets

S. No.	Type of Wireless station License	Annual License Fee (in Rs.)
1	Fixed Earth station DTH/ Teleport/ DSNG/NLD/ILD/DCP/IP-II	1000 per station
2	Captive VSAT/Inmarsat Earth Station	500 per station
3	Vehicle Mobile/ Handheld Mobile station	250/- per station



Annexure 4.2: DoT's circular no. R-11014/2001-LR dated 16.04.2003

Government of India
Ministry of Communications & Information Technology
Department of Telecommunications
(WPC Wing)

No.R-11014/9/2001-LR

Dated: 16th April, 2003

ORDER

Subject: WPC spectrum charges (Royalty and License fee) for Commercial/Captive VSAT Networks - Change over to Revenue Share.

The issue regarding the payment of WPC spectrum charges (Royalty and License fee) for commercial and captive VSAT networks has been reviewed and the following has been decided by the competent authority:

1. Commercial VSAT networks

1.1 WPC spectrum charges under the Revenue Share Regime shall come into force from the quarter beginning 1st January, 2003 and shall be as under:

Range of data rate	Revised WPC spectrum charges
Up to 128 KBPS	3.0% of AGR
Higher than 128 KBPS and up to 512 KBPS	3.5% of AGR
Higher than 512 KBPS and up to 2 MBPS	4.0% of AGR

Note: (A) The percentage of revenue share as WPC spectrum charges indicated above comprises both royalty and license fee.

(B) The highest data rate of any VSAT in the network shall be the deciding factor for the percentage revenue share towards the spectrum charges.

1.2 Adjusted Gross Revenue (AGR) for the purpose of levying WPC spectrum charges shall be same as specified under the main DOT License Agreement.

1.3 Payment of WPC spectrum charges shall be on advance quarter basis and payable within 15 days of the commencement of the respective quarter; failing otherwise the same shall invoke penal interest as per the procedure in vogue in the main DOT License.

Penal interest shall be levied as per existing norms, procedure terms and conditions in vogue for delayed/ non payments for main DOT License Agreement.

1.5 Financial settlement/accounting of spectrum charges based on Estimated/Actual/Audited AGR's (subject to physical verification) shall be undertaken on quarterly/financial year basis on the same line/procedure and term and conditions as applicable in main DOT license agreement.

1.6 Estimated/Actual AGR's duly authenticated by the authorized signatory have to be submitted at the time of making quarterly payments.

1.7 All dues up to 31st December, 2002 shall be settled on the basis of the then existing formulae.

2. Captive VSAT Networks:

The issue of WPC spectrum charges for captive networks has also been reviewed and it has been decided to maintain status quo, while allowing data rate up to 512 Kbps, as there is no concept of revenue share in captive VSAT networks.

3. These orders come into force from the quarter commencing 1st January, 2003.

4. This issues with concurrence of Wireless Finance branch of WPC Wing vide their U.O. no. 323/WPF/03 dated 10/4/2003.



(ASHOK KUMAR)
Joint Wireless Advisor
to the Government of India

Copy to:

1. All VSAT Captive/Commercial Service Providers.
2. WPC, Finance Branch.
3. VSAT Service Providers Association