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Attention: Shri Akhilesh Kumar Trivedi
Advisor (Networks, Spectrum and Licensing)
Telecommunications Regulatory Authority of India
New Delhi
Email: advmn@trai.gov.in

Consultation Paper on Assignment of Spectrum for Space-based Communication Services

Respected Sir,

Viasat appreciates the opportunity to provide comments on the *Consultation Paper on Assignment of Spectrum for Space-based Communication Services*. Viasat submits these comments to provide input on some of the questions posed in the consultation paper ("consultation"). Viasat's comments address two groups of questions: a) the suitability of the assignment process being proposed, and b) the spectrum demand aspects. These two aspects are not fully considered in the proposals identified in the consultation. These points encompass questions 1, 2, 4 and 5 of the consultation and have a follow-up subset of questions (9, 10, 11, 13, 16, 17, 19, 23 and 38). Viasat has provided comments to those follow-up questions. Moreover, as also discussed in our comments below, there are some proposals that raise concerns because of the likely adverse impacts on other policy proposals being made on broadband issues in India.

The plan to auction exclusive spectrum rights for Fixed Satellite Service (FSS) geostationary (GSO) and non-geostationary (NGSO) satellite uses is of concern to the wider ICT industry (nationally and internationally) and the satellite industry, and should also be of concern to the whole-of-government for the following reasons:

1) Uncertainties that would be created by de-linking international orbital authorisation and coordination requirements from domestic licensing needed to use FSS (GSO and NGSO) satellite spectrum

Importantly, Viasat notes that satellite spectrum access is not independent of the associated – multi-laterally agreed – orbit parameters and planned service areas for FSS (GSO and NGSO). This is why it is referred to as the "spectrum-orbit resource." The management of these resources between nations falls under the auspices of the International Telecommunication Union (ITU). The nature of the use of the spectrum-orbit resource is multi-laterally governed by Member States in an international context, beyond India's sole jurisdiction. As a result of this multi-lateral process the use of orbital resources has a direct impact on the usability of the spectrum resource by any satellite operator. For these reasons, Article 44 of the ITU Constitution states that spectrum-orbit resources are to be shared among all countries and must be used in conformity with the ITU Radio Regulations.

Article 8 of the ITU Radio Regulations states that the rights and obligations of spectrum use by an administration are derived directly from the recording of frequency assignments in the ITU Master International Frequency Register (MIFR). Frequency uses by satellite systems not recorded in the MIFR cannot be protected and are not recognised internationally. Therefore, TRAI's proposal to begin issuing national exclusive spectrum rights for FSS (GSO & NGSO), via auction or any other mechanism, would not be in conformity with the international requirement to coordinate frequency assignments for satellite spectrum. Those spectrum-orbit coordination procedures are required to be followed for the use of any space radiocommunication services, given the international recognition those services are required to obtain before they can be deployed, for the protection to and from other users of the same spectrum-orbit resources. This successful inclusion of these spectrum-orbital assignments in the MIFR, through which they gain international recognition, subject to the multilateral provisions of the ITU Radio Regulations, means that the ability to use any national-level frequency licensing of space-based communications will depend, unavoidably, on a multiplicity of stakeholders beyond India's jurisdiction.

Moreover, other significant uncertainties will impact investment in space-based communications in India if auctions are considered as a spectrum assignment mechanism. For example, operators and the administrations that make those filings on behalf of satellite operators will have to coordinate their spectrum-orbit resource use across the globally established and shared spectrum regime under the ITU treaty obligations, but then they will also have to find a way to coordinate with an operator under a newly created regime of private-exclusive domestic licensees, only adopted by India. In practical terms, having the exclusive rights to use such frequencies nationally and exclusively in India would not guarantee the ability to use them in India because of the ITU overlay of international rules.

Furthermore, any requirement to have exclusive frequency licensees in India coordinate amongst themselves, based only on spectrum licensing in India is likely to significantly complicate the use of satellite spectrum in India as it would be separate from the parallel ITU international coordination process. Having two parallel regimes for Indian licensees, one for exclusive licensees and another for existing operators under the ITU shared regime, as applies to ISRO, is likely to further complicate an already complex international frequency coordination process for space radiocommunications.

2) Spectrum use by space-based communications networks have very different deployment characteristics than terrestrial networks

In the consultation, the proposal to auction frequencies used for space-communications networks assumes that those networks are designed and operated in the same way as terrestrial mobile networks. For example, in Question 5, TRAI seeks to identify a minimum spectrum "block size" and "minimum number of blocks". It is important to note that frequencies used by space-based communications networks are not implemented through the aggregation of standardised frequency carriers and waveforms, as is the case for terrestrial IMT standards such as 3GPP. In addition, satellite spectrum availability is directly proportional to the number of users than can be served by a satellite network (which is a fixed network design, hence the importance of making all the spectrum globally allocated to space services in the ITU Radio Regulations fully available to satellite systems).

Furthermore, any proposal to auction exclusive rights to frequency use for space-based communications on a national basis would not eliminate the multi-lateral nature of the spectrum-orbit resource management and would not qualify as a frequency assignment designed to serve space services. Such national assignment of

exclusive frequency rights would in practice qualify as another terrestrial frequency assignment, unserviceable for space services, because FSS (GSO & NGSO) have orbital conditions that need to be met and managed in coordination with other jurisdictions. This is because space services would still be fully dependent on the international coordination and agreement of their frequency-orbit resource use in the MIFR and holding national and exclusive frequency rights in India would not guarantee those international rights through the ITU MIFR process, could be used. Not being able to guarantee the use of exclusive rights to an Indian licensee through a competitive market-based and revenue generating process for the State would represent a complex scenario.

3) Unclear assessment of spectrum demand by space-based communications

The consultation seeks information on the "quantum of spectrum needed to meet demand of space-based communication services" in Question 2. In different questions of the consultation, however, TRAI states that "27.5-28.5 GHz is identified for IMT in India" (*see* Questions 10 and 11).

Viasat notes that the Ka band uplink (27.5-30 GHz) is globally allocated to and used by the FSS for users at fixed locations and on the move by Earth Stations in Motion (ESIM). Innovative satellite broadband services that are offered using these frequency bands require access to and use of the entire Ka band throughout India and other countries. Any inference that the 27.5-30 GHz band is partially identified for terrestrial IMT in India, or that part of this band may not be fully available for satellite broadband services in India, would be inconsistent with the international identification of spectrum through the World Radiocommunication Conference decisions (WRCs), and it would also be inconsistent with providing an unconstrained supply of spectrum for satellite broadband services in India.

An important aspect of the 27.5-30 GHz band is the fact that it is allocated and licensed in the vast majority of countries around the world for these satellite broadband services. This allows for contiguous spectrum access for innovative and ubiquitous satellite network designs and operations. This also allows satellite operators to provide greater speed and capacity to users and devices. Reducing the available bandwidth for satellite broadband services in the Ka band by either (i) restricting its use to gateways only in the 27.5-28.5 GHz band or (ii) denying access to the entire band for the full range of FSS GSO and NGSO uses will deprive India of critical satellite broadband connectivity to users at fixed locations and on the move.

Separately, India needs to prioritise spectrum for terrestrial IMT consistent with the requirements for that service. Global research[1] demonstrates that the highest demand for terrestrial IMT spectrum is in the mid-bands, while there is little demand for terrestrial IMT in the mmWave spectrum. Therefore, Viasat respectfully recommends that spectrum requirements for terrestrial IMT prioritize spectrum that is best suited for IMT services, such as the mid-band for IMT, and not in bands where there is little or no global uptake.

The same studies demonstrate that terrestrial IMT in the 27.5-29.5 GHz (28 GHz) band has not seen significant deployment by terrestrial IMT operators. Offering frequency bands for terrestrial IMT with low demand poses the risk of spectrum being underutilised by terrestrial players and depriving other existing and innovative services from being offered using that spectrum. This outcome will result in a costly regulatory failure for India, through the loss of substantial economic opportunities that could be better achieved by

[1] ABI Research: *Emerging Markets Broadband Objectives: Spectrum Requirements* (2021), https://go.abiresearch.com/lp-emerging-markets-broadband-objectives-spectrum-requirements.

allocating and licensing the 28 GHz spectrum band in full for satellite broadband services, and authorising terrestrial IMT in other globally harmonised bands. For example, Viasat notes that South Korea has not seen any material demand for terrestrial IMT services in the 28 GHz band[2]. Committing 28 GHz spectrum to terrestrial IMT will, therefore, risk the loss of GDP revenues per annum to India's economy on the order of USD72-184.6 billion[3]. India will be particularly vulnerable to demand constraints and higher costs if portions of the 28 GHz band are allocated to terrestrial IMT, because terrestrial IMT is being prioritised globally in spectrum below 6 GHz and because the 28 GHz band is not allocated globally for terrestrial IMT.

The economic benefits estimated for India and the cost advantages available from the 28 GHz band for satellite broadband services are only possible if the entire 27.5 – 29.5 GHz band is allocated and authorized for satellite broadband services throughout India using an administrative licensing regime (global practice). Using auctions and assigning exclusive spectrum rights in India for space-based communications is impractical.

Viasat looks forward to further discussions on these important issues. Viasat's detailed comments to the questions presented in the consultation document are provided in the attached annex.

Sincerely,

Cristian Gomez
Senior Director
Government & Regulatory APAC

Enclosed: Annex containing responses to the specific consultation questions.

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2 The Korea Herald, *Telecos lag in mmWave 5G equipment installation: lawmaker* (Sept. 10, 2021), http://www.koreaherald.com/view.php?ud=20210910000417.

3 Plum: *Expanding digital connectivity through satellite broadband in the 28 GHz band* (Oct. 2021), https://plumconsulting.co.uk/expanding-digital-connectivity-through-satellite-broadband-in-the-28-ghz-band/.

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ANNEX: RESPONSES TO THE QUESTIONS POSED

Q1. For space-based communication services, what are the appropriate frequency bands for (a) gateway links and (b) user links, that should be considered under this consultation process for different types of licensed telecommunications and broadcasting services? Kindly justify your response with relevant details.

Viasat's response: Viasat notes that the ITU Radio Regulations incorporate, in its table of allocations, the satellite bands necessary for satellite systems to function (i.e. L, S, C, Ku and Ka bands) for all the various current and planned satellite communication systems. TRAI can refer to the ITU Radio Regulations for a direct reference to the space services spectrum bands that ITU Members have agreed to allocate.

Viasat notes that all these satellite spectrum bands used internationally are not independent of the associated – multi-laterally agreed – orbit parameters and planned service areas. This is why it is referred to as the "spectrum-orbit resource" and its international management falls under the auspices of the International Telecommunications Union (ITU). The use of the spectrum-orbit resource, particularly in the case of FSS (GSO & NGSO), is multi-laterally governed by Member States in an international context, beyond India's national jurisdiction. The multi-lateral processes have a direct impact on the ability to use the international orbit-spectrum resource by any satellite operator or its filing administration. All frequency bands allocated to satellite services are governed internationally by the ITU Radio Regulations. Article 44 of the ITU Constitution states that spectrum-orbit resources are shared among all countries and must be used in conformity with the Radio Regulations. Article 8 of the ITU Radio Regulations states that spectrum use by an administration is derived directly from the recording of frequency assignments in the ITU Master International Frequency Register (MIFR).

Viasat is of the view that including any FSS (GSO & NGSO) satellite bands in auction processes is not a feasible policy, because the internationally-managed orbital component that enables frequency use of FSS cannot be de-linked from frequency use. Meeting the globally agreed ITU process for frequency use is a fundamental building block for developing and deploying satellite communication networks, and hence, we urge TRAI to:

a) Assign IMT spectrum to terrestrial mobile services in the bands identified for that purpose in the ITU Radio Regulations (i.e. 24.25-27.5 GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 GHz, 66-71 GHz and many others);
b) Assign the 27.5-30 GHz band for full use by FSS/ ESIM satellite services; and
c) Maintain the current administrative regime for spectrum used by satellite services, which is based on the globally shared spectrum-orbit resource managed by the ITU.

Q2. What quantum of spectrum for (a) gateway links and (b) user links in the appropriate frequency bands is required to meet the demand of space-based communication services? Information on present demand and likely demand after about five years may kindly be provided in two separate tables as per the proforma given below:

Viasat's response: there appears to be a level of contradiction on the approach about how much spectrum (quantum) is needed by space-based communications in the consultation document. Spectrum demand and its consequential allocation, and quantum, is largely addressed globally through the WRC process. From the WRC decisions, spectrum for space-based communications (and all other services) gets allocated and/or identified in response to demand, through lengthy deliberations and studies over four-year cycles.

The increased demand for space-based communications to bridge the digital divide and to enable broadband mobility on a nationwide basis (*i.e.*, land, sea and air) has been, and is being validated, through the international spectrum management processes, including at ITU World Radiocommunication Conferences (WRCs). For example, as a result of the deliberations at WRC-15 and WRC-19, it was decided that space-based communications require full access to the Ka band (27.5 – 30 GHz) for satellite Earth Stations in Motion (ESIM) broadband services around the globe. Restricting spectrum supply to the Ka band in India will be detrimental to the achievement of all the benefits available to India from Ultra High Throughout Satellite networks that are designed and being deployed to offers these important capabilities.

The consultation paper asks about "quantum of spectrum needed to meet demand of space-based communication services" in Question 2. Later in the paper, however, TRAI states that "27.5-28.5 GHz is identified for IMT in India" (for example, in Questions 10 and 11). We have noted in previous consultations that the Ka band uplink (27.5-30 GHz) is used and reused extensively by FSS (GSO and NGSO), gateways, ubiquitous FSS and ESIM user terminals around the globe based on recognized broadband connectivity service requirements for end users. More specifically, this band was rejected by the ITU and its Member States for identification for IMT.

Therefore, the following situations affect the quantum of spectrum necessary to fulfill the demands of High Throughput Satellite systems in the 28 GHz band, and will not accomplish a balanced spectrum supply to meet the spectrum needs of high-throughput space-based communications:

1) 27.5-29.5 GHz may be partially identified for IMT in India (exclusively or shared),

2) that part of this band (27.5 - 28.5 GHz) may not be available for its full use by satellite services in India (*i.e.*, ubiquitous FSS and ESIM), and

3) that part of this band (27.5 - 28.5 GHz) maybe constrained for its full use by satellite services (*i.e.*, ubiquitous FSS and ESIM) by sharing it with IMT, noting that 5G IMT is not designed to be compatible with satellite services in co-frequency and co-coverage, as stated in Resolution 212 (WRC-15).

We note that the full 26 GHz band (25.25-27.5 GHz) has already been identified for terrestrial IMT, even though it is not fully utilized. This fact is in addition to multiple other existing bands that have been identified for IMT. There are also new potential terrestrial IMT bands under discussion at WRC-23. In the 2022 IMT spectrum auction in India, approximately 30% of the 26 GHz band was not licensed, and rollout of terrestrial services in the 26 GHz band remains negligible. This further confirms that the demand for terrestrial IMT services in millimeter-wave spectrum bands has been over-estimated.

Any suggestion or plan to use the 28 GHz band spectrum, in part, shared or in full, for terrestrial IMT is inconsistent with a spectrum policy oriented to achieve the necessary supply of spectrum for space-based services to satisfy the growing demand for connectivity using those services in India. It is therefore not appropriate to identify more spectrum for terrestrial IMT in spectrum that is internationally identified for satellite broadband services resulting in unnecessarily constrained spectrum resources for satellite services in India.

Viasat is of the view that the supply-demand approaches presented in the consultation paper are in contradiction. If India is to be fully committed to advance its national interests in space-based broadband connectivity, this can only be achieved by enabling the full availability of the globally allocated spectrum for satellite services. It is a pressing requirement to assign the full Ka band to satellite broadband services in India – to all applications of the FSS. Ubiquitous FSS and ESIM require access to the full 28 GHz band (*i.e.*, 27.5-29.5 GHz) in order to meet today's demands, as well as the growing demand in the long term.

Q4. For space-based communication services, whether frequency spectrum in higher bands such as C band, Ku band and Ka band, should be assigned to licensees on an exclusive basis? Kindly justify your response. Do you foresee any challenges due to exclusive assignment? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

Viasat's response: Please refer to Viasat's response to Question 1. We also note that significant uncertainties will impact investment in space-based communications in India if auctions and exclusive rights are considered as the spectrum assignment mechanism. For example, operators and countries will have to continue to coordinate their spectrum-orbit resource use through the globally established and shared spectrum regime under the ITU, but then they will have to find a way to also coordinate with a newly created licensee in India. In addition, there will also be an issue with frequencies being exclusively assigned but detached from their international orbital resource which is managed by the ITU. Frequencies and orbits are both managed together through the ITU process, and their use is derived from the successful recording of the filing in the ITU's Master International Frequency Register (MIFR). In practical terms, if frequencies are not associated with the ITU spectrum-orbit management process, the use of in India (or anywhere) cannot be guaranteed because satellite spectrum use requires coordination with stakeholders outside of India's jurisdiction as part of the spectrum-orbit coordination process managed by the ITU and deriving from the international recognition granted by the MIFR process.

Any proposal to auction exclusive rights to frequency use for space-based communications on a national basis in India, without regard to the multi-lateral nature of the spectrum-orbit resource management, will not

qualify as a frequency assignment in the international context. Such national assignment of exclusive frequency rights would simply, in practice, qualify as another terrestrial frequency assignment, unserviceable for space-based services. This is because space-based services would still be fully dependent on the international coordination process associated with the ITU MIFR process. Simply obtaining national and exclusive frequency rights in India would, therefore, not guarantee those rights could be used. Not being able to guarantee the use of those exclusive rights within India would make the license unusable.

Furthermore, any requirement to have exclusive frequency licensees coordinate amongst themselves or develop their own coordination process, is likely to result in more dispute that would need to be resolved. Having two parallel regimes in India, one dealing with private-exclusive users and another for public-shared users (for example ISRO) is unlikely to simplify the already complex frequency coordination process for space-based communications, as well as being unlikely to provide investment certainty.

Furthermore, the consultation paper cites some examples of auctions in other jurisdictions. We note that those examples validate the industry view that auctions are not feasible for satellite spectrum, for the following reasons:

- As acknowledged by TRAI, only four countries have engaged in some form of competitive allocation in connection with space-based communications (*i.e.*, Brazil, Mexico, the United States, and Saudi Arabia). Three of those countries (*i.e.*, Brazil, Mexico and the United States) discontinued the auction system for satellite communications, as it was not practicable. These administrations rescinded that approach and moved back to an administrative assignment regime.

- The United States went even further and passed legislation that is still in effect today (*i.e.*, the ORBIT Act[4]) that prohibits the U.S. Federal Communications Commission (FCC) from auctioning satellite spectrum and requires the U.S. President to advocate *against* international satellite spectrum auctions.

- In the case of Saudi Arabia, portions of the MSS[5] "S[6] band" were auctioned only once in Saudi Arabia's history, and no other country has replicated that practice. There are several reasons why this case of MSS spectrum was a one-off, and has not been replicated anywhere else. Firstly, it is noted that MSS spectrum is subject to multilateral agreements for frequency use, for example, the L[7] band Multilateral MoU (MLM), which would preclude issuing rights outside that MoU (ITU's Region 1 and Region 3 are part of

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4 ORBIT Act: Open-Market Reorganization for the Betterment of International Telecommunications Act, Pub. L. No. 106-180, 114 Stat. 48 (2000), as amended, Pub. L. No. 107-233, 116 Stat. 1480 (2002), as amended, Pub. L. No. 108-228, 118 Stat. 644 (2004), as amended, Pub. L. No. 108-371, 118 Stat. 1752 (2004) (2004 ORBIT Act Amendments), as amended, Pub. L. No. 109-34, 119 Stat. 377 (2005) (2005 ORBIT Act Amendment), codified at 47 U.S.C. § 701 *et seq*., https://www.congress.gov/106/plaws/publ180/PLAW-106publ180.pdf.

5 MSS stands for Mobile Satellite Service.

6 S band refers to the frequency range around 2-4 GHz.

7 L band refers to the frequency range around 1-2 GHz.

the MoU). Secondly, in the case of the S band, some regions have allocated parts of this band to terrestrial services, including Saudi Arabia. Moreover, half of the S band spectrum auctioned in Saudi Arabia was sold specifically for terrestrial use (*i.e.*, 3GPP carriers), and the other half was sold as MSS. However, the MSS blocks were sold with a path to convert their usage to terrestrial services[8]. Therefore, it is arguable whether, in reality, the Saudi Arabia auction of S band spectrum was targeted for space-based communications for the long term. Instead, its conditions of use and expected deployment path, specific to Saudi Arabia, imply that only terrestrial services are going to be deployed this band in the long term – which is not consistent with a balanced supply-demand assessment for long term spectrum requirements for space-based communications. Furthermore, this auction ended up with only one buyer for all the lots on offer – placing significant doubts about the benefits of using the auction process.

Viasat urges TRAI to maintain the current administrative assignment regime. For the reasons noted above, it is not practical to discontinue the administrative assignment regime and replace it with a failed auction approach already tested and discontinued in other jurisdictions.

Q5. In case it is decided to assign spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services to licensees on an exclusive basis,

a. What should be the block size, minimum number of blocks for bidding and spectrum cap per bidder? Response may be provided separately for each spectrum band.
b. Whether intra-band sharing of frequency spectrum with other satellite communication service providers holding spectrum upto the prescribed spectrum cap, needs to be mandated?
c. Whether a framework for mandatory spectrum sharing needs to be prescribed? If yes, kindly suggest a broad framework and the elements to be included in the guidelines.
d. Any other suggestions to ensure that that the satellite communication ecosystem is not adversely impacted due to exclusive spectrum assignment, may kindly be made with detailed justification.

Viasat's response: Viasat notes that terrestrial mobile communications are not developed, planned or deployed in the same manner as space-based communications. In this consultation question, the characteristics of frequency carriers, equipment design and mobile network planning are being conflated with spectrum use by space services. For example, where TRAI wishes to identify a minimum spectrum "block size" and "minimum number of blocks", we note that satellite frequency use, by contrast to terrestrial services, is not implemented through the aggregation of standardised frequency carriers or waveforms as found in the terrestrial IMT standards such as 3GPP. Satellite systems are designed, coordinated and optimised to use the full allocation of frequencies (shared globally amongst all satellite operators). Furthermore, satellite spectrum availability has a direct impact on the number of users than can be served by a satellite network (which is a fixed design, hence the importance of spectrum availability and harmonization of the bands allocated to satellite services by WRCs).

[8] Excerpt from CITC public consultation document (section 3.4, page 10): "the winner of Block A2 may subsequently apply for an upgrade of its license to authorise the use of terrestrial technologies".

Q9. In case you are of the opinion that the frequency spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services should be assigned on shared (non-exclusive) basis, -

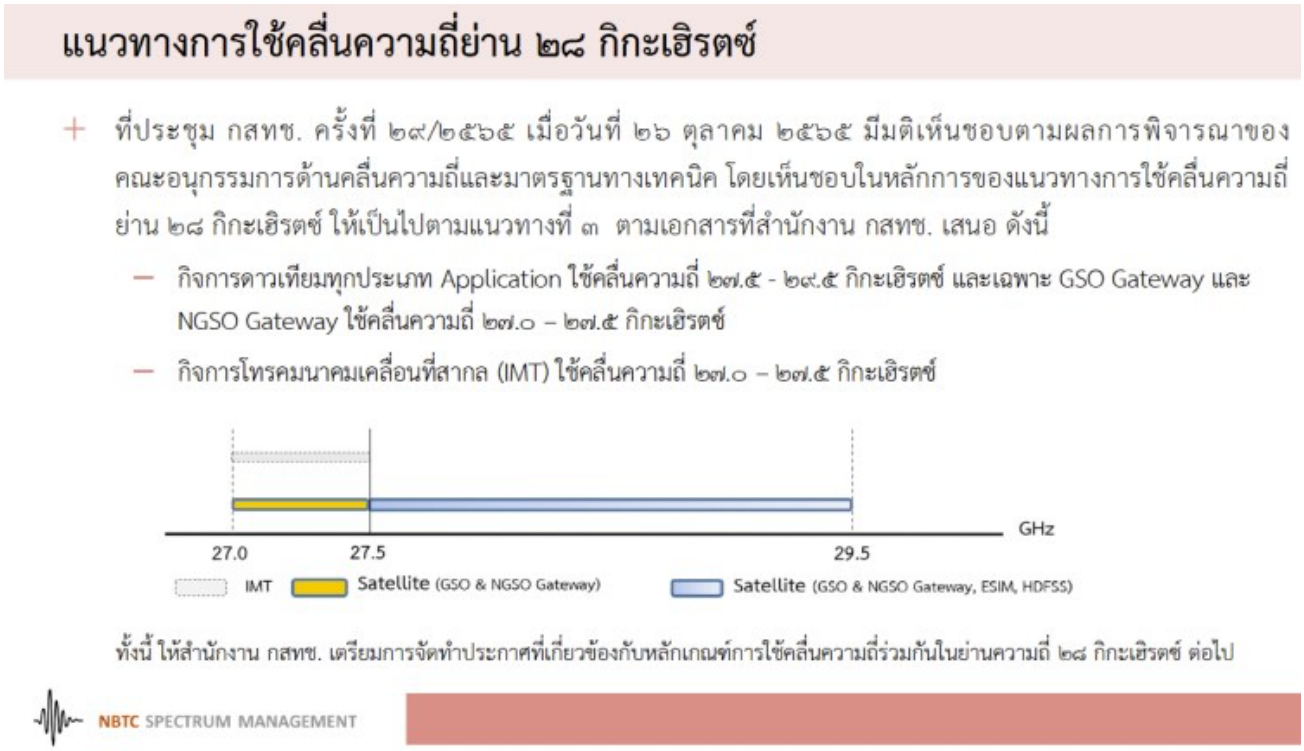
(a) Whether a broad framework for sharing of frequency spectrum among satellite communication service providers needs to be prescribed or it should be left to mutual coordination? In case you are of the opinion that broad framework should be prescribed, kindly suggest the framework and elements to be included in such a framework.

(b) Any other suggestions may kindly be made with detailed justification.
Kindly justify your response.

Viasat's response: Viasat supports assigning satellite frequency spectrum on a non-exclusive basis. The majority of the countries in the world rely on open regulatory regimes to allow competition of satellite broadband services under the ITU spectrum and orbital assignment process and national market access licensing. India will benefit from maintaining harmonised used of the Ka band with the rest of the world, as this band has emerged as the global choice for Ultra High Throughput Satellite systems, particularly for use by ubiquitous FSS for fixed users and on the move with ESIM. Over 100 countries have now adopted or are planning to use the Ka band, and the entire 28 GHz band (*i.e.*, 27.5-29.5 GHz), exclusively for FSS fixed users and on the move by ESIM.

Recent examples in the Asia Pacific region include China, Philippines, Australia, Thailand and many others. All these countries continue to maintain the globally-shared spectrum regime managed and coordinated by the ITU, and their frequency allocation is harmonised with the ITU Radio Regulations. Thailand for example – as a global tourism destination - has recognised the growing need for high-capacity broadband in mobility and has allocated the full 28 GHz for satellite connectivity to deploy ubiquitous FSS and ESIM for aviation, maritime and land users. The decision by the NBTC[9] is depicted below:

[9] The NBTC decision and related analysis can be found at: https://dpolit.com/2023/01/08/thailand-secures-next-generation-inflight-connectivity-nbtc-allocates-the-full-28-ghz-spectrum-band-for-satellite-broadband/.



Viasat strongly recommends that India consider a similar harmonised arrangement to the one adopted by Thailand, and to maintain the current non-exclusive spectrum regime managed through the ITU processes. Furthermore, the arrangements adopted by administrations such as Thailand, guarantee the global inter-operability and availability of ESIM services in a cost-effective manner, which is possible through the global economies of scale that exist in the 28 GHz band for satellite broadband services at fixed locations and on the move.

Q10. In the frequency range 27.5-28.5 GHz, whether the spectrum assignee should be permitted to utilize the frequency spectrum for IMT services as well as space-based communication services, in a flexible manner? Do you foresee any challenges arising out of such flexible use? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

Viasat's response: Viasat has previously explained in prior consultations before TRAI that terrestrial IMT/5G services are not designed to be compatible with satellite services. In order for India to be able to enjoy the benefits of both satellite broadband services and terrestrial IMT/5G, TRAI and DOT should allocate the entire 28 GHz band exclusively for satellite services and identify other frequency bands (*e.g.*, 24.25-27.5

GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 and 66-71 GHz), which have been globally harmonized by the ITU, for terrestrial IMT/5G.

The frequency range of the band identified for terrestrial 5G/IMT by the ITU at WRC-19 is 24.25-27.5 GHz (known as 26 GHz band), among other mmWave bands[10]. Spectrum above 27.5 GHz is not identified for terrestrial 5G/IMT by the ITU. In addition, the band 27.5-29.5 GHz has been protected by the ITU for satellite broadband services, including Earth Stations in Motion (ESIM) at WRC-19[11], and is under study for expanded satellite use in WRC-23 Agenda Items 1.16 (non-geostationary ESIM) and 1.17 (satellite-to-satellite links).

The ITU's Radio Regulations (RR), in accordance with No.31 of ITU's Constitution, is a binding international treaty. It identifies 41 Radio Services to which the spectrum - 8.3 kHz to 275 GHz - is allocated. India uses most of these radio services for terrestrial, maritime, aeronautical and space applications. Publications, including recommendations by the ITU, focus on optimizing and providing guidelines for spectrum use by its 193 member administrations. For example, the ITU adopted Recommendation ITU-R S. 2223 on "Technical and operational requirements for GSO FSS earth stations on mobile platforms in bands from 17.3-30 GHz" in 2011 and then updated it in 2016[12].

In the case of the 28 GHz band, satellite operators have made substantial investments based on the global validation of satellite broadband use of the band at both WRC-15 and WRC-19. The decisions of these Conferences provided confidence for those investments and the result is that satellite networks are being built and deployed around the world for expansive use of the 28 GHz band, using the globally shared spectrum coordination process managed by the ITU.

WRC-19, during its lengthy deliberations, adopted an identification of the 24.25-27.5 GHz band for terrestrial 5G/IMT. The Conference did not include the 27.5-28.5 GHz band as part of the 5G/IMT identification. Use of spectrum for terrestrial 5G/IMT in the 27.5-28.5 GHz band would be inconsistent with the ITU Radio Regulations, which are internationally binding treaty obligations.

In addition, the Parliamentary "Standing Committee on Information Technology (2020-21)" by the Seventeenth Lok Sabha in its report on "India's Preparedness for 5G" was presented to the Indian Parliament on 08 Feb. 2021 referred to the use of the spectrum for 5G IMT only up to 27.5 GHz and not up to 28.5 GHz (*see* page 143, para 29). Moreover, on page 141 of the report, paragraph 23, the Cellular Operators' Association of India (COAI) provided a recommendation of a spectrum block size of 400 MHz per 5G

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[10] *See* ITU Press Release, *WRC-19 identifies additional frequency bands for 5G*, (22 Nov. 2020) (those bands include the following: 24.25-27.5 GHz, 37-43.5 GHz, 45.5-47 GHz, 47.2-48.2 and 66-71 GHz), https://news.itu.int/wrc-19-agrees-to-identify-new-frequency-bands-for-5g/.

[11] *See* ITU Radio Regulations, adopting Footnote 5.517A authorizing geostationary ESIM as a part of the Fixed Satellite Service in the 27.5-29.5 GHz and 17.7-19.7 GHz bands.

[12] *See* ITU-R Recommendation S.2223, *Technical and operational requirements for GSO FSS earth stations on mobile platforms in bands from 17.3-30 GHz* (2011, revised 2016), https://www.itu.int/pub/R-REP-S.2223.

operator in the mmWave bands, which can be easily met within the 3.25 GHz of globally harmonized 5G/IMT spectrum in the 26 GHz band (*i.e.*, 24.25 to 27.5 GHz), identified by WRC-19. We note that the 26 GHz band was sold in India to mobile operators in 2022, who decided not to buy the full band (almost one-third of the spectrum blocks available were left unsold[13]).

Further, we note that there is a global lack of demand for terrestrial 5G IMT in the 28 GHz band (and in mmWave bands in general) given its high cost of deployment and reduced coverage (hundred metres) this spectrum can provide for terrestrial broadband. Demand studies support this view. Today there are examples of underutilisation and under-investment in South Korea, a failure to sell this spectrum for terrestrial 5G IMT in Brazil at auction, the United States pivot from mmWave to low- and mid-bands, the commitment of Europe to preserve the full 28 GHz band for FSS satellite and ESIM. In addition, China, Russia, Australia, Philippines, Thailand and dozens of other countries have all reject terrestrial 5G IMT in the 28 GHz band and instead authorized satellite broadband services across the entire 28 GHz band.

In addition, infrastructure costs for India will be significantly lower if the full 28 GHz band is assigned to satellite-powered broadband while rapidly deploying connectivity using Ultra-High Throughput satellite broadband that can cover the entire country. For example, the PM WANI initiative ise particularly well suited for expanding internet access rapidly and at lower cost across India. Recent infrastructure Total Cost of Ownership (TCO) studies confirm that satellite broadband is more cost effective when deployed as part of broadband solutions and even more cost effective when combined with Wi-Fi. The following snapshot displays a TCO comparison in one recent study[14]:

[13] Summary of spectrum sales, 2022: https://telecomtalk.info/india-5g-spectrum-auction2022-spectrum-acquisitions-details/539161/.

[14] Dedicating 28 GHz for satellite: benefits from Total Cost of Ownership: http://www.strategies.nzl.com/industry-comment/dedicating-28ghz-spectrum-band-to-satellite-services/.

The lowest cost alternative is scenario 3, followed by scenario 4. Both scenarios are more cost effective than the other two scenarios which include access over 5G technologies (Exhibit 4.2).

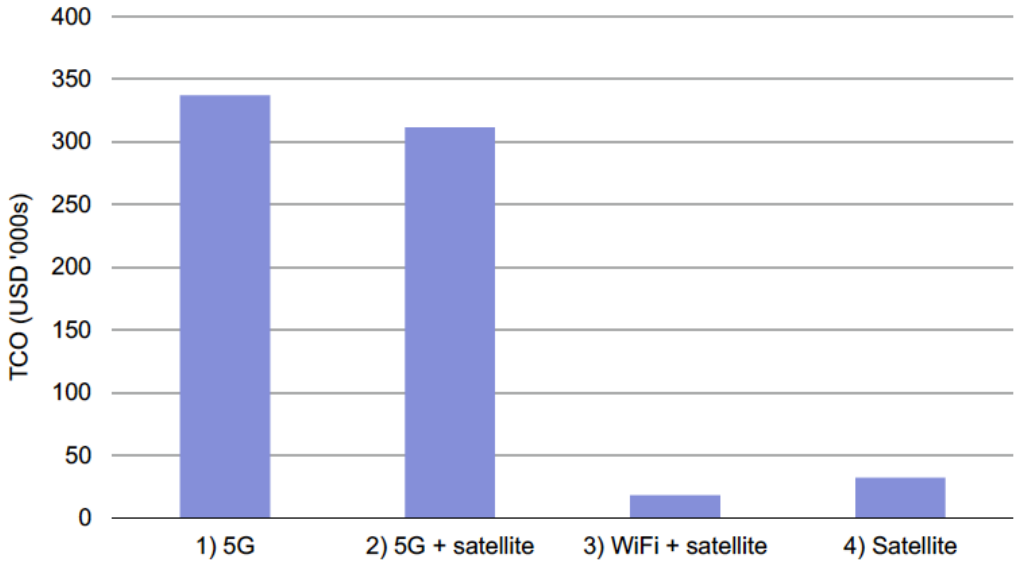

Exhibit 4.2: *Model results [Source: Network Strategies]*

India's vast territory, population density and demand for ubiquitous and reliable ultra-fast broadband requires careful allocation of spectrum resources to incentivize cost-effective deployment of broadband across India, with increased choices and solutions for consumers, businesses and government uses.

Spectrum access should be **prioritised according to demand** to those services that can realise the highest economic benefit for the citizens of India. For example, recent studies[15] indicate that countries are prioritising spectrum in the mid-bands (below 6 GHz) for the deployment of terrestrial 5G networks, with the majority of 5G deployments using the 3.5 GHz band.

[15] ABI Research: *Emerging Markets Broadband Objectives: Spectrum Requirements (2021)* https://go.abiresearch.com/lp-emerging-markets-broadband-objectives-spectrum-requirements.

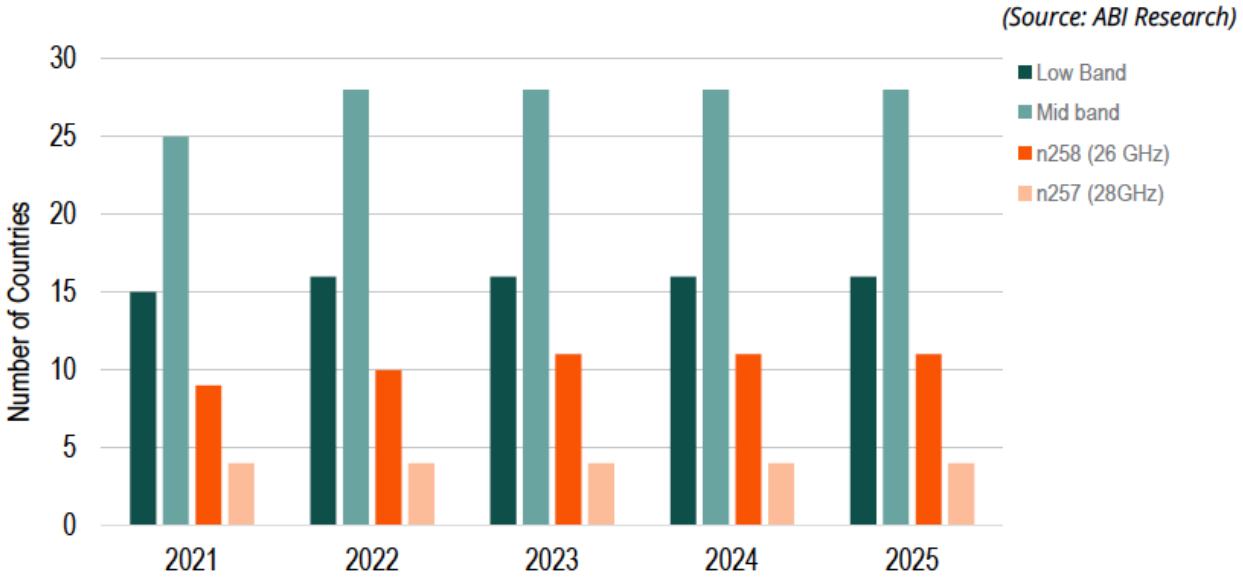

Figure 1. Current and expected spectrum allocation for terrestrial 5G in emerging markets, 2021-2025

In contrast, high bands in the mmWave spectrum **(26 & 28 GHz) are not being prioritised for terrestrial 5G/IMT** because of their high cost of deployment, greatly reduced coverage and limited ecosystem that can serve only niche applications, leading to a lack of demand. For India, the challenge to deploy terrestrial 5G/IMT is even greater, considering that 5G/IMT mobile networks must have access to fibre infrastructure (fibre availability in India represents only about 8% of the territory). The 26 GHz band (24.25 – 27.5 GHz) was globally harmonised for 5G (IMT) by the ITU at WRC-19 and Viasat supports use of the 26 GHz band for 5G/IMT in India. However, the **28 GHz band (27.5 – 29.5 GHz) is not a designated band for 5G/IMT by the ITU. The 28 GHz band is a critical band for advanced Ultra High Throughput Satellite networks, including for ubiquitous satellite ESIM[16] (maritime, aviation and land based) on a global basis, which has been validated by the ITU at WRC-19**.

Countries have prioritised the entire 28 GHz band (27.5 – 29.5 GHz) without fragmenting it or splitting it with 5G/IMT services, because 5G/IMT has vast amounts of spectrum available already (as seen in figure 1). For example, to fully benefit from the economics and national coverage of satellite-powered broadband, the entire European Union, most of the Americas, Africa, Middle East, China, Australia, and increasingly across ASEAN, have protected the band 27.5 – 29.5 GHz for its ongoing use for satellite broadband services.

[16] ESIM: Earth Stations in Motion. Satellite broadband connectivity for applications requiring mobility (*i.e.*, maritime routes and ports, aviation routes and airports, and ground-based mobility such as trains, trucks and government uses).

Satellite networks are dependent on the amount of spectrum available to deliver services, and any reduction of the available spectrum will impact the capacity available to users being served. The prioritisation of the full 28 GHz band for satellite broadband will have a significant impact for India in terms of the potential economic benefits India can achieve from the use of this spectrum[17]. Splitting or reducing the amount of spectrum available to satellite broadband services in the 28 GHz band will leave India unable to enjoy these benefits and will impair India's ability to successfully plan and accommodate emerging demands that only satellite-powered connectivity can achieve.

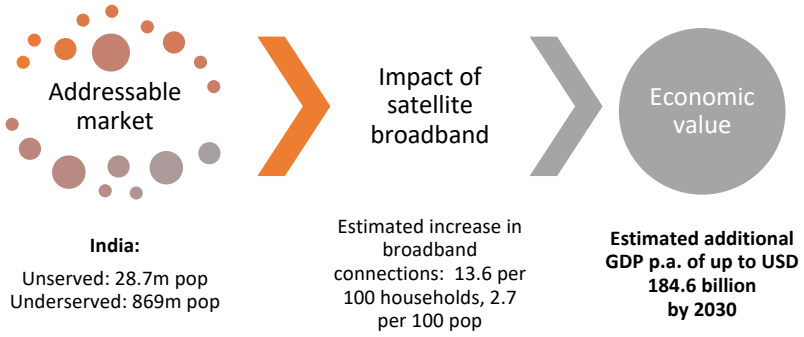

Figure 2. Estimated economic benefits of allocating the full 28 GHz band (27.5 – 29.5 GHz) for satellite broadband in India (Source: Plum Consulting, 2021)

In India, satellite-powered broadband deployment in the full 28 GHz band will contribute to economic benefits from:

- improved broadband service quality and ubiquitous access across urban and suburban areas,
- broadband connectivity for unserved and underserved communities,
- wider choice of broadband and pricing options, and
- new applications and connectivity services for expanding market segments, such as land, aeronautical and maritime transport routes, through ESIM.

This is particularly important in fulfilling India's commitments to connect 1.5 billion people in the next two years through the government led BharatNet and PM WANI projects.

The wider bandwidth which is possible through the use of the 27.5 – 29.5 GHz band for satellite means that satellite operators are able to deliver higher throughputs. Furthermore, new Ultra High Throughput Satellite

[17] Plum: *Expanding digital connectivity through satellite broadband in the 28 GHz band,* (Oct. 2021), https://plumconsulting.co.uk/expanding-digital-connectivity-through-satellite-broadband-in-the-28-ghz-band/.

systems operate multiple narrow spot beams that facilitate high frequency reuse, and these can be dynamically configured to adapt to traffic demand and user density. These advantages translate into lower cost-per-bit.

In summary, there is substantial evidence that the benefits of assigning the full 28 GHz band for satellite broadband services and using the existing administrative assignment approach (global practice) will bring the most benefit to India for this spectrum. TRAI should consider this evidence and allocate the full 27.5 – 29.5 GHz for satellite broadband, using the current administrative regime, while at the same time recognising that terrestrial 5G IMT is not designed to share spectrum with space-based communications, co-frequency and co-coverage.

Q11. In case it is decided to permit flexible use in the frequency range of 27.5 - 28.5 GHz for space-based communication services and IMT services, what should be the associated terms and conditions including eligibility conditions for such assignment of spectrum? Kindly justify your response.

Viasat's response: Viasat urges TRAI/DOT not to authorize satellite broadband and terrestrial 5G IMT in the same bands for the reasons explained above in response to Question 10.

Q13. Do you foresee any challenges in case the spectrum assignee is permitted to utilize the frequency spectrum in the range 28.5-29.5 GHz for cellular based CNPN as well as space-based communication services, in a flexible manner? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

Viasat's response: Yes, Viasat does foresee significant challenges with authorising terrestrial cellular services and satellite broadband services in the same band, because terrestrial cellular systems are not designed to be compatible with satellite systems co-frequency/co-coverage.

Q16. What should be the methodology for assignment of spectrum for user links for space-based communication services in higher spectrum bands like C-band, Ku-band and Ka-band, such as
(a) Auction-based
(b) Administrative
(c) Any other?
Please provide your response in respect of different types of services (as mentioned in Table 1.3 of this consultation paper). Please support your response with detailed justification.

Viasat's response: Viasat recommends that TRAI and DOT assign the spectrum for satellite broadband user links in the Ka band using an administrative methodology. As acknowledged by TRAI, only four countries have auctioned satellite spectrum (*i.e.*, Brazil, Mexico, United States, and Saudi Arabia) and three of those countries (*i.e.*, Brazil, Mexico and United States) decided not to auction satellite spectrum any further, as it was not practicable, and then rescinded that decision and reverted to administrative authorizations. In addition, the United States passed legislation that is still in effect today (the ORBIT Act[18]) that prohibits the U.S. Federal Communications Commission (FCC) from auctioning satellite spectrum and requires the U.S. President to advocate *against* international satellite spectrum auctions.

Q17. Whether spectrum for user links should be assigned at the national level, or telecom circle/metro-wise? Kindly justify your response.

Viasat's response: Viasat urges TRAI and DOT to assign satellite user terminal spectrum for the Ka band at the national level. Satellite broadband services are offered on a national, regional and even hemispheric basis. Therefore, the most efficient way to authorize those services is via a national license or authorization.

[18] ORBIT Act: Open-Market Reorganization for the Betterment of International Telecommunications Act, Pub. L. No. 106-180, 114 Stat. 48 (2000), as amended, Pub. L. No. 107-233, 116 Stat. 1480 (2002), as amended, Pub. L. No. 108-228, 118 Stat. 644 (2004), as amended, Pub. L. No. 108-371, 118 Stat. 1752 (2004) (2004 ORBIT Act Amendments), as amended, Pub. L. No. 109-34, 119 Stat. 377 (2005) (2005 ORBIT Act Amendment), codified at 47 U.S.C. § 701 *et seq*., https://www.congress.gov/106/plaws/publ180/PLAW-106publ180.pdf.

Q19. What should be the methodology for assignment of spectrum for gateway links for space-based communication services, such as
(a) Auction-based
(b) Administrative
(c) Any other?
Please provide your response in respect of different types of services. Please support your response with detailed justification.

Viasat's response: Viasat recommends that TRAI and DOT assign the spectrum for satellite broadband gateway links in the Ka band using an administrative methodology. As acknowledged by TRAI, only four countries have auctioned satellite spectrum (*i.e.*, Brazil, Mexico, United States, and Saudi Arabia) and three of those countries (*i.e.*, Brazil, Mexico and United States) decided not to auction satellite spectrum any further, as it was not practicable, and then rescinded that decision and moved back to administrative authorizations. The United States passed legislation that is still in effect today (the ORBIT Act[19]) that prohibits the U.S. Federal Communications Commission (FCC) from auctioning satellite spectrum and requires the U.S. President to advocate *against* international satellite spectrum auctions.

Q23. Whether any protection distance would be required around the satellite earth station gateway to avoid interference from other satellite earth station gateways for GSO/ NGSO satellites using the same frequency band? If yes, what would be the protection distance (radius) for the protection zone for GSO/ NGSO satellites?

Viasat's response: Satellite operators routinely coordinate the co-location of satellite gateway earth stations to avoid interference when using the same frequency bands. When filing satellite earth station applications, TRAI and DOT can request the location of the proposed gateway earth station and provide an opportunity for public review and comment to ensure that other operators are on notice of the intent to deploy a gateway earth station and are allowed to provide comments to TRAI and/or DOT prior to licensing.

Q38. In case it is decided for assignment of spectrum on administrative basis, what should be the spectrum charging mechanism for assignment of spectrum for space-based communications services
i. For User Link
ii. For Gateway Link
Please support your answer with detailed justification.

Viasat's response: As explained above, Viasat urges TRAI and DOT to assign satellite spectrum on an administrative basis for both user and gateway links. Viasat urges TRAI and DOT to charge an administrative fee based on the actual cost of processing the assignment applications (cost recovery).

[19] ORBIT Act: Open-Market Reorganization for the Betterment of International Telecommunications Act, Pub. L. No. 106-180, 114 Stat. 48 (2000), as amended, Pub. L. No. 107-233, 116 Stat. 1480 (2002), as amended, Pub. L. No. 108-228, 118 Stat. 644 (2004), as amended, Pub. L. No. 108-371, 118 Stat. 1752 (2004) (2004 ORBIT Act Amendments), as amended, Pub. L. No. 109-34, 119 Stat. 377 (2005) (2005 ORBIT Act Amendment), codified at 47 U.S.C. § 701 *et seq*., https://www.congress.gov/106/plaws/publ180/PLAW-106publ180.pdf.