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GSOA[1] would like to thank the Telecom Regulatory Authority of India for the opportunity to comment on the Consultation Paper on the Assignment of Spectrum for Space-based Communication Services (the "Consultation").

GSOA is the CEO-driven association representing global and regional satellite operators, and it provides a platform for collaboration between satellite operators globally and a unified voice for the sector. Our vision is to help policymakers improve the state of the world by continuously bridging digital, education, health, social, gender and economic divides across diverse geographies and mature and developing economies.

This Consultation is of extreme importance to the satellite industry; GSOA is keen on sharing the global industry's perspective on the questions outlined in the annex of this letter, as these decisions will significantly impact the future of satellite services in India.

At a high level, GSOA does not believe the auction mechanism is appropriate for the Satellite spectrum. The spectrum utilisation by the satellite industry differs significantly from that of mobile operators, particularly concerning the exclusivity of spectrum usage for defined terms of the license. The satellite systems are designed to operate in harmony with other satellite systems within the same frequency band, employing coordination mechanisms to prevent harmful interference and use the same frequency bands across large geographic regions on a shared basis. Therefore, the concept of exclusive spectrum use, as commonly applied in the mobile industry, does not apply to the satellite industry, underlining the need for different approaches to spectrum allocation and management.

Furthermore, satellite spectrum auctions could create 'gatekeepers' who control large blocks of spectrum. These gatekeepers could prevent the entry of additional terrestrial or satellite operators, thus creating a highly anti-competitive environment. This contradicts the principle of fostering enhanced competition. Powerful industry players with deep pockets could exploit this system to obstruct new entrants and fair competition. The Competition Commission of India would have to closely monitor this aspect.

For satellite operators aiming to provide affordable, ubiquitous services, it's crucial to seek economies of scale but get a spectrum across multiple global administrations. The cost and complexity of navigating diverse licensing regimes are already significant, but auctions introduce uncertainty and expense to the global licensing model. If the government's priority is digital inclusivity, particularly for India's most underserved citizens, auctioning spectrum could result in services becoming prohibitively expensive or, worse still, entirely unavailable for these potential consumers.

Finally, high spectrum costs, typically resulting from auctions, can pose significant challenges to emerging space-tech startups, potentially stifling innovation. This would undermine the "Made in India" campaign and discourage numerous Indian startups seeking to make strides in this field.

[1] The members, activities, and other details about GSOA can be found at www.gsoasatellite.com

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Given these considerations, there's no need to entangle the Government of India in the complications of a satellite spectrum auction as this consultation proposes. The long-standing international practice and India's policy for over two decades indicate the way forward. We advocate for the continuation of administrative allocation to ensure the healthy, competitive growth of the satellite sector in India.

GSOA and its members remain at your disposal for any further discussion on this important initiative.

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GSOA views on Assignment of Spectrum for Space-based Communication Services

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.

Spectrum assignments for space-based communications rely on the harmonized allocation of the frequency bands for space services agreed upon internationally by ITU through the WRC process. All the frequency bands for space services are publicly available and are published in the ITU Radio Regulations, to which India is a signatory Member State.

The Indian National Frequency Allocation Plan (NFAP-2022) has also been updated to reflect the outcome of WRC-19. It includes all the frequencies allocated by the Indian administration to various types of satellite communications services (e.g. FSS, MSS, BSS). All these bands need to be considered for allocation for relevant satellite service in accordance with relevant provisions of the Radio Regulations

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:

The next difficulty of the set of proposals presented in this consultation paper relates to an apparent contradiction on the assessment about how much spectrum is needed (quantum) by space-based communications.

A recent study from VVA and LS Telecom[2] showed that globally, the socio-economic benefits stemming from Satellite Communications are projected to grow in the upcoming eight years to almost 250 billion by 2030. This growing impact will be driven mainly by broadband on the move and broadband for domestic and non-domestic purposes. Broadband on the move has the most substantial growth potential. Broadband for domestic and non-domestic purposes is expected also to have a growing impact due to its societal development aspects, bringing considerable indirect benefits to society in general. These three use cases combined are forecasted to generate almost 250$ Billions of socio-economic benefits by 2030, coming from less than 150$ Billion in 2022.

The increased demand for space-based communications to bridge the digital divide and enable broadband in full mobility nationwide (land, sea and air) requires full access to the spectrum bands agreed for space services, achieved through delicate compromises in the WRC multilateral agreements. Those agreements (of which India has been part) are largely a response to demand considerations.

For example, the Ka-band (27.5 – 30 GHz) has been protected by WRCs for satellite communications in response to of satellite services' demands, including FSS GSO and NGSO (I.e., for ubiquitous FSS and the growing ESIM applications). Restricting spectrum supply to the Ka-band will be detrimental to achieving all the benefits available to India from Ultra High Throughout Satellite networks, which rely on full access to this band to meet demand.

[2] https://gsoasatellite.com/wp-content/uploads/VVA_LSTelcom_Socio-Economic-Value-of-Satcom_24032023.pdf

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In terms of contradictions, for example, the consultation paper asks about "quantum of spectrum needed to meet demand of space-based communication services" in Question 2, but then later in the paper TRAI's states that "27.5-28.5 GHz is identified for IMT in India" (for example, in Questions 10 and 11). We note that Ka band uplink (27.5-30 GHz) is used by FSS (GSO and NGSO), gateways, ubiquitous FSS and ESIM user terminals almost globally. So, it becomes unclear whether or not the consultation is considering the decisions made internationally on matters concerning supply of spectrum to meet demand in India and internationally.

Any plan to use Ka band spectrum, in part, shared or in full, for terrestrial IMT would be inconsistent with a spectrum policy positioned to achieve an adequate quantum of spectrum for space services to meet today's demands and to satisfy the growing demand in the long term. It is not feasible, in one hand, to seek a supply-demand balance on spectrum for space-based communications, while, in the other hand, plans are being suggested to assign half of the 28 GHz band to terrestrial services; constraining the potential spectrum supply that satellite services require.

GSOA is of the view that the supply-demand references presented in the consultation paper are in contradiction. Suppose India is fully committed to advancing its national interests in space communications through enabling the full availability of satellite services for ubiquitous broadband, in that case it is an urgent requirement to assign the full spectrum to satellite to all applications of FSS, including the full 28 GHz band (27.5-29.5 GHz) 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.

Terrestrial cellular operators have historically had exclusive spectrum rights. In contrast, Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) spectrum allocations in the C, Ku and Ka bands operate non-exclusively. Space-based communication systems for the provision of FSS are designed to reuse the same spectrum multiple times, enabling them to service numerous countries simultaneously. This distinction is crucial for ensuring satellite systems can efficiently and effectively serve a wide range of users without unnecessary constraints or limitations.

Satellite spectrum usage can vary in terms of geographic scope. While user terminals require nationwide coverage, other earth stations may only need access to specific locations. This flexibility enables satellite operators to tailor their services to diverse customer needs, further enhancing the value and versatility of satellite communications.

It is well known that national territorial boundaries do not restrict satellite spectrum. More importantly, unlike terrestrial mobile network operators, multiple satellite operators utilize the same frequencies across numerous satellites without causing interference. The satellite spectrum is shared among various operators within the FSS and BSS sectors and through the deployment of satellites in both geostationary (GEO) and non-geostationary (non-GSO) orbits. These operators also coordinate with one another to share the same frequencies across their services. This shared usage model necessitates close collaboration and coordination among stakeholders to prevent interference and optimize spectrum utilization. Consequently, unlike the mobile access spectrum, the FSS and BSS satellite spectrum is never exclusively assigned.

The coordination of satellite spectrum usage takes place at a global level, adhering to strict ITU Radio

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Regulations. The ITU plays an essential role in promoting the efficient use of satellite spectrum and facilitating the implementation of various coordination and interference mitigation techniques that help maintain a harmonious and well-regulated satellite communications environment.

Satellite systems operate within a predefined range of frequencies, which are filed with the ITU and undergo a lengthy and rigorous process of notification and registration into the Master International Frequency Register (MIFR). Once a satellite system's frequencies have been registered, they cannot be altered based on the outcome of spectrum assignment decisions in a specific market. This highlights the importance of long-term planning and international coordination in the satellite industry. Operators must carefully plan their spectrum resources to ensure reliable customer service.

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 up to 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.

As explained in the previous answer, satellite spectrum, specifically within the Fixed Satellite Service (FSS) domain, cannot be allocated exclusively. Therefore, an auction model cannot be considered.

Exclusive access to the spectrum may form the foundation of an auction or a comparative process. Bidders in such a model compete for spectrum, expecting exclusive access. In contrast, sharing of frequencies between satellite operators enables large capacities to be available over a given geographical area. Attempts to create exclusivity by dividing the satellite spectrum would limit its use to only a few operators, significantly diminishing its value.

Additionally, concepts such as block size, spectrum cap, and intra-band share originate from terrestrial mobile spectrum management and do not apply to non-exclusive satellite spectrum.

As emphasized earlier, the FSS satellite spectrum is shared among multiple operators and coordinated at the ITU level. The entire frequency band must be allocated on a non-exclusive basis. the Segmenting the frequency band into portions or blocks, akin to terrestrial spectrum management practices, would lead to the fragmentation of the satellite spectrum, subsequently diminishing throughput and data speeds in proportion to the fragmentation. This fragmentation would considerably reduce spectrum usage efficiency, contravening any spectrum policy's fundamental objective, namely enhancing usage efficiency. Moreover, some system design requires access to the full band to provide uninterrupted service.

Q6. What provisions should be made applicable on any new entrant or any entity who could not acquire spectrum in the auction process/assignment cycle?

a) Whether such entity should take part in the next auction/ assignment cycle after expiry of the validity period of the assigned spectrum? If yes, what should be the validity period of the auctioned/assigned spectrum?

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b) **Whether spectrum acquired through auction be permitted to be shared with any entity which does not hold spectrum/ or has not been successful in auction in the said band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction?**

c) **In case an auction based on exclusive assignment is held in a spectrum band, whether the same spectrum may again be put to auction after certain number of years to any new entrant including the entities which could not acquire spectrum in the previous auction? If yes,**

   i. **After how many years the same spectrum band should be put to auction for the potential bidders?**

   ii. **What should be the validity of spectrum for the first conducted auction in a band? Whether the validity period for the subsequent auctions in that band should be co-terminus with the validity period of the first held auction?**

Unlike terrestrial operators, who have access to various spectrum bands and can enable or disable their base stations based on demand and network requirements, satellite systems are designed to operate consistently on the same frequency range across the globe, as per their ITU filings. Satellite beam sizes can range from wide beams covering entire continents and across country borders. A satellite network cannot select alternative frequencies for use and is subject to spectrum already assigned per market, resulting in a need for a global approach to spectrum sharing by satellite operators at ITU. This harmonized approach ensures that all satellite operators coordinated through the ITU process can deliver seamless, reliable services to users worldwide, regardless of the specific country or region in which they operate.

Ensuring fair and comprehensive access to satellite spectrum is essential for fostering a competitive and innovative satellite communications ecosystem. Therefore, limited or partial access to the required spectrum through various assignment cycles, as done for terrestrial spectrum assignment, can severely hinder an operator's ability to provide service in that market. In such a scenario, consumers are adversely affected, as they lose out on the potential benefits with increased competition and greater choice among service providers could bring.

The allocation of satellite spectrum should consider the extensive societal advantages that satellite services offer, including disaster recovery and universal connectivity. These essential services depend on satellite spectrum availability and efficient utilization of satellite spectrum to function effectively and support public safety, environmental monitoring, and national security. For public interest, having multiple satellite players in the market can significantly benefit the population, as it drives innovation and expands the reach of essential services. Granting exclusive access to the spectrum not only diminishes competition but also precludes the presence of global players capable of tackling the digital divide and extending connectivity to underserved regions.

The US Orbit Act 2000 exemplifies the importance of safeguarding the public interest in satellite spectrum allocation. The legislation aims explicitly to prevent the assignment of *international* orbital locations or spectrums used to provide vital services through competitive bidding. By doing so, the Orbit Act underscores the need to prioritize the public interest and maintain the unique characteristics of satellite spectrum allocation that enable delivering essential services to communities worldwide.

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**

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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.

For FSS, spectrum shared basis is the only viable approach to ensure the efficient utilization of this resource. This principle allows multiple satellite operators to access and coordinate spectrum usage, promoting optimal use of the available frequencies.

The framework for coordination already exists at the ITU level and should not be determined at the national level. By adhering to the current ITU Radio Regulation and Coordination framework, 99.95% of the spectrum assigned to satellite networks has been free from reported harmful interference. This impressive statistic demonstrates the robustness of the existing framework. The principle that the right to use orbital and spectrum resources for a satellite network or system is acquired through negotiations has proven to be the most effective means of achieving rational, cost-effective, and efficient spectrum and orbital management.

The UK's Office of Communications (OFCOM) highlights the importance of ITU coordination by stating[3] that they "do not issue licences for radio transmissions by satellites in space. The ITU coordinates spectrum use by satellites."

Another example is Australia, the Australian Communications and Media Authority (ACMA) has established the "Foreign Space Objects Determination" framework. This framework allows satellite operators from other countries to obtain the authorization to use their satellite systems to provide services within Australian territory. Once the foreign satellite operator has obtained the Foreign Space Objects Determination from ACMA and adhered to the class license's technical, operational, and administrative conditions, they are authorized to use all the specified frequency bands for communication with their space objects. This approach enables a more streamlined and efficient process for foreign satellite operators to gain access to the Australian market while ensuring the proper management and coordination of the radiofrequency spectrum.

Satellite spectrum auctions present a significant challenge also in terms of flexibility. Once the spectrum has been auctioned, assigned and the complex set of rules agreed upon, these regulations cannot be altered during the licenses' tenure. This inflexibility means that new operators cannot be inducted.

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.

GSOA is against the introduction of IMT in the frequency bands 27.5-28.5 as this will not accomplish a balanced spectrum supply to meet the demands for space-based communications or meet the forecast of spectrum demand addressed by WRCs agreements.

Although flexibility in spectrum usage may result in more efficient utilization, adhering to ITU Radio Regulations is crucial. For instance, a terrestrial operator cannot provide satellite services without an appropriate service agreement with a licensed satellite operator and coordination with other satellite

[3] https://www.ofcom.org.uk/__data/assets/pdf_file/0018/229311/statement-ngso-licensing.pdf

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operators, even if they have access to the necessary spectrum. Suppose an assignee attempts to use geographical separation between mobile and satellite use, regardless of whether coordination occurs on the satellite side., coordination under such circumstances would be highly complex and impractical.

It is essential to recognize and respect the distinct requirements and operational characteristics of satellite and terrestrial services to prevent interference and maintain the overall effectiveness and efficiency of the communication ecosystem. Proper adherence to ITU Radio Regulations and coordination between relevant stakeholders is vital to ensure harmonious coexistence of various communication services.

The 28GHz band (27.5-30 GHz) has long been designated for satellite service, providing essential communication capabilities. When terrestrial mobile services are authorized within this band, it poses a significant risk of interference and disruption to satellite operations. It must be noted that the ITU WRC in 2015 and 2019 did not accept the 28GHz band as a potential IMT band. Instead, the ITU Member States collaborated to harmonize a substantial 17 GHz of other mmWave bands specifically for 5G deployment, mitigating the need for utilizing the 28GHz band.

Several countries that initially deviated from ITU recommendations by allocating the 28GHz band for terrestrial mobile services are now reevaluating their decisions and taking corrective actions:

o The US FCC chairwoman admitted[4] that the commission's early focus on millimeter wave for 5G deployment was misguided. As a result, Verizon is now reportedly divesting some of its 28GHz spectrum holdings in the secondary market.

o In South Korea, the government revoked the 28GHz band licenses of two operators who demonstrated insufficient commitment to expanding their 28GHz networks. The Ministry of Science and ICT's (MSIT) assessment noted that the operators' efforts fell significantly short of expectations, with only 10% of the promised terminal devices built over three years. In May 2023, one of the major operators, SKT, has explicitly given up on using the 28GHz for 5G as “It is practically impossible to utilize 28 GHz for business-to-consumer (B2C) transactions."5. As a result, no mobile operator is using 28GHz in Korea, despite being the first country to be interested in the band.

As a more suitable alternative, the 26GHz band has been identified for IMT at the ITU level and offers a better opportunity for global harmonization. This approach ensures that the 28GHz band remains reserved for satellite services while providing ample spectrum for 5G and future mobile technologies in other mmWave bands.

We also note that approximately 30% of the 26 GHz band was left unsold in the 2022 auction in India (6), which puts significant doubt on any claims being made by IMT equipment vendors that India needs to continue to accommodate unrealistic IMT spectrum demands in mmWave bands.

Consequently, GSOA recommends that TRAI advise the DoT to refrain from licensing the 27.5-28.5 GHz

[4] “I think that the FCC made a mistake a few years ago when it focused all of its energies in the early 5G days on spectrum called millimeter wave. Those are airwaves that are really high up there they have lots of capacity but their signals don't travel very far. And so what that means is that you have to have lots of ground based facilities to make those signals viable. And that's a really costly thing to do. And so, if we just relied on millimeter wave spectrum we'd actually grow the digital divide with 5G.” – Jessica Rosenworcel. Jul 16, 2021 https://www.meritalk.com/articles/fcc-acting-chairwoman-future-of-5g-goes-far-beyond-the-smartphone/.

5 SK Telecom to Stop Using 28 GHz Band for 5G: Report (telecomtalk.info)

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band for 5G at this stage and instead conduct a thorough assessment of the genuine requirements and development of the mobile ecosystem within this frequency range.

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?

IMT operation should be on a non-interference/non-protection basis to ensure that satellite services in the 28GHz band continue to operate without harmful interference.

Q12. Whether there is a requirement for permitting flexible use between CNPN and space-based communication services in the frequency range 28.5-29.5 GHz?

Private networks using 5G technology is for accessing the economies of scale of the IMT ecosystem and making best use of the lower cost equipment to implement a private network. Implementing such a network outside of the globally harmonised IMT spectrum band is defeating the purpose. It is, therefore, better to find an alternative IMT band instead for CNPN instead of 29GHz. Any approach to licensing Captive Non-Public Networks (CNPN) must be on a non-interference/non-protection basis to ensure that satellite services in the 28GHz band continue operating without harmful interference.

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Q15. What should be the methodology for assignment of spectrum for user links for space-based communication services in L-band and S-band, such as-

a) Auction-based
b) Administrative
c) Any other?

As discussed earlier, it is critical that since satellite spectrum is inherently global that no satellite spectrum be auctioned.

This includes the mobile satellite service (MSS). In recent years, there has been an increasing demand for using MSS, particularly in providing emergency services. In India, MSS could, in particular, improve coverage of rural areas in the Community, thus bridging the digital divide in terms of geography, strengthening cultural diversity and contributing to the competitiveness of Indian ICT industries. However, the high-upfront investment required for developing MSS systems and the associated high technological and financial risks necessitate an administrative framework for licensing complete MSS spectrum, so that they remain economically viable.

Such an approach, as is found in the European assignment of the 2 GHz MSS band, should include the applicant meeting specific minimum requirements and milestones, such as operational experience, planned coverage, etc. and a reasonable, cost-based licensing and annual fee.

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).

Administrative assignment is the most suitable approach for assigning the FSS spectrum in a non-exclusive manner for the following reasons:

The administrative assignment ensures that satellite spectrum is assigned efficiently and effectively, shared and coordinated at a global level, making it unnecessary to limit the number of operators or impose artificial scarcity. It also ensures adherence to ITU Radio Regulations and maintains the overall effectiveness and efficiency of the communication ecosystem.

The administrative assignment takes into account the broader societal benefits provided by satellite services, such as disaster recovery, weather forecasting, and defense communications. These essential services rely on the availability and efficient use of the satellite spectrum.

In line with international best practices, auctioning the satellite spectrum is not a desirable solution in the Indian context. Different from terrestrial mobile operators, multiple satellite operators can reuse the same frequency range. An auction for satellite spectrum would artificially limit the number of satellite operators sharing the spectrum and exclude them from the market as different.

Globally, countries all follow administrative assignments for satellite spectrum, as it aligns with international regulations and best practices. It supports the ongoing growth and development of the satellite communications industry while safeguarding the essential services that satellite networks provide.

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

Assigning user links on a national level is indeed a logical approach for licensing satellite services, as it offers several advantages that cater to the unique nature of satellite communications:

- Fixed Satellite Services inherently provide extensive coverage, making them ideal for serving vast geographical areas within a country. National-level licensing ensures satellite user devices can be used consistently and seamlessly across the nation.

- Satellite services are characterized by their transportable nature, allowing users to maintain connectivity even when moving between different locations. By assigning user links nationally, o regulators can ensure that users can fully leverage the benefits of mobile satellite services without encountering licensing restrictions or limitations based on regional boundaries.

- National-level licensing streamlines the administrative process for regulators and satellite service providers, avoiding the need for managing multiple regional licenses. This simplified approach reduces bureaucratic hurdles, making it easier for providers to deploy their services nationwide.

- Satellite services play are a critical role in disaster recovery and emergency response efforts. By assigning user links nationally, regulators can facilitate the rapid deployment of satellite communications during emergencies, ensuring that vital services remain accessible even in remote or affected areas.

- Satellite services have the potential to bridge the digital divide by providing connectivity to underserved and rural areas. National-level licensing enables satellite operators to offer services to a broader user base, promoting digital inclusion and ensuring that all citizens have access to essential communications services.

Q18. In case it is decided to auction user link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

N/A

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.

Assigning satellite spectrum for gateway operations administratively is the only appropriate approach, given the considerations presented in the previous answers to questions 4-6.

Gateway frequencies are used at specific locations, making them even more suitable for sharing among satellite operators. This localized usage of frequencies allows for greater coordination and sharing of spectrum resources, promoting more efficient utilization of the available frequencies. By allocating the gateway spectrum administratively, regulators can facilitate sharing these resources, ensuring that each operator can establish and maintain their gateway infrastructure at the designated locations. This approach maximizes the efficient use of the spectrum.

Furthermore, a competitive bidding process for the gateway spectrum may create contradictions with existing regulatory requirements in India to establish a gateway in the country. Failure to obtain the necessary gateway spectrum through an auction might result in satellite operators being unable to meet their regulatory obligations,

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leading to an artificial barrier to compliance.

Gateway operations are critical to maintaining the reliability and resilience of satellite networks. By assigning gateway spectrum administratively, regulators can ensure that satellite operators have the necessary resources to establish robust and reliable communications links between satellites and terrestrial networks, ultimately contributing to the overall stability of the satellite communications ecosystem.

Q22. Considering that (a) space-based communication services require spectrum in both user link as well as gateway link, (b) use of frequency spectrum for different types of links may be different for different satellite systems, and (c) requirement of frequency spectrum may also vary depending on the services being envisaged to be provided, which of the following would be appropriate:

(i) to assign spectrum for gateway links and user links separately to give flexibility to the stakeholders? In case your response is in the affirmative, what mechanism should be adopted such that the successful bidder gets spectrum for user links as well as gateway links.

or

(ii) to assign spectrum for gateway links and user links in a bundled manner, such that the successful bidder gets spectrum for user link as well as gateway link? In case your response is in the affirmative, kindly suggest appropriate assignment methodology, including auction so that the successful bidder gets spectrum for user links as well as gateway links.

Gateway and user links spectrum should be assigned administratively, and separately for user and gateway links, as the gateway operator may not necessarily be the same entity as the service provider, and the spectrum may not be the same. However, it is clear that about the same system/network, assignment for user links and gateway links are necessary and cannot go one without the other. For example, a satellite service provider cannot operate if only partial or no gateway link is assigned, even with access to all its required user link spectrum.

It is clear that for the same system/network, the assignment of both user links and gateway links is vital. A satellite service provider could only operate effectively if they have only partial or no gateway link spectrum assigned, even when granted full access to their required user link spectrum. Consequently, a coordinated approach to assigning spectrum for user links and gateway links is necessary to ensure the seamless operation of satellite services.

However, separate assignments for user and gateway links should be considered. Satellite service providers need to have the flexibility to obtain authorizations as their needs evolve after receiving licenses. Moreover, the gateway operator might not necessarily be the same entity as the service provider, and the spectrum requirements may differ. Adopting this approach allows satellite operators to respond effectively to changing demands and needs, efficiently using spectrum resources and delivering quality satellite services.

Q24. What should be the eligibility conditions for assignment of spectrum for each type of space-based communication service (as mentioned in the Table 1.3 of this Consultation Paper)? Among other things, please provide your inputs with respect to the following eligibility conditions:

a) Minimum Net Worth
b) Requirement of existing agreement with satellite operator(s)
c) Requirement of holding license/ authorization under Unified License prior to taking part in the auction process.

Again, GSOA is against any auction for satellite spectrum. However, it is essential that the process of assigning satellite spectrum is transparent, non-discriminatory, and promotes healthy competition in the market, and some minimum eligibility criteria for administrative assignment would be required to deter speculative application.

For example, the applicant should hold the unified licensed entity. The applicant should also be able to demonstrate its compliance with the ITU Radio Regulations.

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Q25. What should be the terms and conditions for assignment of frequency spectrum for both user links as well as gateway links for each type of space-based communication service? Among other things, please provide your detailed inputs with respect to roll-out obligations on space-based communication service providers. Kindly provide response for both scenarios viz. exclusive assignment and non- exclusive (shared) assignment with justification.

In the context of administrative assignment for satellite spectrum allocation, it is essential to ensure that the duration of the license provides stability and confidence for operators to invest and maintain their services. A minimum license period of 10-15 years, with presumption of annual renewal, can offer the necessary long-term assurance for operators to plan and implement their services effectively.

"Roll-out" obligations are a regulatory measure typically used to address the shortcomings of terrestrial operators, who tend to focus their network deployment in revenue-generating areas. In contrast, satellite services aim to fill the gaps left by terrestrial networks and provide coverage in areas where traditional terrestrial networks cannot reach or are not cost-effective. Consequently, imposing roll-out obligations on satellite service providers may create unnecessary burdens and obstruct the efficient deployment of satellite networks.

Instead, a more flexible and supportive regulatory framework should be established for satellite services, focusing on facilitating deployment to address coverage gaps and enhance connectivity for unserved or underserved areas. This approach will enable satellite operators to contribute to bridging the digital divide effectively and ensure that their services are available to those who need them most.

Q26. Whether the provisions contained in the Chapter-VII (Spectrum Allotment and Use) of Unified License relating to restriction on crossholding of equity should also be made applicable for satellite- based service licensees? If yes, whether these provisions should be made applicable for each type of service separately? Kindly justify your response.

Restrictions on cross-holding of equity do not make sense for satellite-based service licensees, as there is no need to hold any spectrum, given that the spectrum can be shared.

Q27. Keeping in view the provisions of ITU's Radio Regulations on coexistence of terrestrial services and space-based communication services for sharing of same frequency range, do you foresee any challenges in ensuring interference-free operation of space-based communication network and terrestrial networks (i.e., microwave access (MWA) and microwave backbone (MWB) point to point links) using the same frequency range in the same geographical area? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

Article 21 of the Radio Regulations establishes diverse coexistence criteria for terrestrial and space services sharing frequency bands above 1 GHz. For instance, for their protection receiving stations in the fixed service operating in frequency bands shared with space radiocommunication services (space-to-Earth) should 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° concerning the direction of the geostationary-satellite orbit. Other measures for terrestrial services to implement are provided in Section II of Article 21 (21.3 to 21.7, including Table 21-2). Measures for satellite earth stations are provided in Sections III and IV in the form of EIRP limits and minimum elevation angle. Finally, measures to be applied by transmissions from space stations are established in Section V in the form of power-flux density limits in Table 21-4.

Additionally, for terrestrial stations and earth stations, operating in frequency bands shared with equal rights between terrestrial radiocommunication and space radiocommunication services shall be selected considering the relevant ITU-

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R Recommendations concerning appropriate geographical separation between earth stations and terrestrial stations. A good example is ITU-R Recommendation ITU-R SM.1448-1 on the Determination of the coordination area around an earth station in the frequency bands between 100 MHz and 105 GHz.
To answer the specific question, and given the above, the coexistence between space-based communication services and terrestrial services does not represent any challenge as the existing regulatory framework provided by the ITU Radio Regulations and Recommendations is complete and comprehensive. Particularly for terrestrial services such as microwave access (MWA) and microwave backbone (MWB) point-to-point links, the coexistence with satellite services is a common scenario where both services have operated for decades.

Q28. In what manner should the practice of assignment of a frequency range in two polarizations should be taken into account in the present exercise for assignment and valuation of spectrum? Kindly justify your response.

The use of polarization should not be considered, as it is up to the licensee to use the assigned spectrum efficiently.

a) **Q29. What could be the likely issues that may arise, if the following auction design models (described in para 3.127 to 3.139) are implemented for assignment of spectrum for user links in higher bands (such as C band, Ku band and Ka band)?Model #1: Exclusive spectrum assignment**
b) **Model#2: Auction design model based on non-exclusive spectrum assignment to only a limited number of bidders**

What changes should be made in the above models to mitigate any possible issues, including ways and means to ensure competitive bidding? Response on each model may kindly be made with justification.

Issue of Model #1

As mentioned in response to questions 4-6, the exclusive spectrum assignment model is not suitable for satellite operators.

Concepts such as spectrum blocks and spectrum caps are specific to terrestrial mobile spectrum management and do not apply to satellite services. Satellite systems operate within a predefined range of frequencies, which have undergone a lengthy and rigorous process of notification and registration with the ITU, ultimately leading to inclusion in the Master International Frequency Register (MIFR). As a result, satellite operators cannot selectively choose frequencies based on market spectrum assignments.

Issues of Model #2:

This model creates artificial scarcity by limiting the number of licenses available for satellite operators.

o The satellite spectrum is inherently sharable among satellite operators and coordinated globally. By restricting the number of operators in a particular market, the full potential of the spectrum is not being utilized, which goes against the fundamental principle of efficient spectrum management.

Moreover, suppose the Indian authorities choose to limit the number of operators in their market for the purpose of increasing government revenue. In that case , it will negatively impact not only the satellite operators who do not obtain a license but also the consumers in India. As a result, Indian consumers will have fewer choices compared to other markets. Reduced competition often leads to higher consumer prices and lower adoption rates, further exacerbating the digital divide.

Implementing Model #2 may inadvertently hinder the development of satellite services within India, stifling innovation and potentially delaying the deployment of advanced satellite communication technologies. Creating an environment with limited competition could discourage new entrants and reduce the incentives for existing operators to invest in network improvements, ultimately diminishes the quality of service provided to the end-users.

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Q30. In your opinion, which of the two models mentioned in Question 29 above, should be used? Kindly justify your response.

As explained in the previous answer, GSOA opposes both models as the auction is not an appropriate spectrum assignment method for Fixed Satellite spectrum.

Q33. What could be the likely issues that may arise, if Option # 1: (Area specific assignment of gateway spectrum on administrative basis) is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues?

The administrative assignment for gateway links is the most appropriate approach for managing the satellite spectrum. This method has been successfully implemented in numerous countries worldwinde, ensuring efficient coordination and allocation of spectrum resources for satellite operators.

Globally, it is the only approach to managing satellite the gateway spectrum.

The proposal to use auction-determined prices for user links as a basis for charging for spectrum for gateway links is not an appropriate approach for managing satellite spectrum. This method could have several negative consequences for the satellite industry and the end-users it serves.

First, without repeating all the arguments presented above, the auction is not a valid method to assign a User link spectrum.

Secondly, the pricing mechanisms for user links and gateway links should be kept separate as they serve different purposes and are subject to other regulatory and technical requirements.

Q34. What could be the likely issues, that may arise, if Option # 2: Assignment of gateway spectrum through auction for identified areas/ regions/ districts is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues? In what manner, areas/ regions/ districts should be identified?

Auctions for gateway links are an unsuitable approach for spectrum allocation in the satellite industry. As opposed to terrestrial networks, satellite operators require only a limited number of gateways to serve a large geographical area, such as India. In such cases, spectrum scarcity is not a pressing concern, and alternative allocation methods, such as administrative assignment, are more appropriate.

Moreover, the flexibility of gateway infrastructure allows for the coexistence of multiple satellite systems in the same location. Geostationary satellite operators (GSOs) can share gateway locations without causing interference or affecting the performance of their respective networks. Additionally, these GSO gateways can even be collocated with Non-Geostationary Satellite Orbit (NGSO) antenna farms, further demonstrating the efficient use of available resources.

Q35. In your view, which spectrum assignment option for gateway links should be implemented?

By employing an administrative assignment approach instead of auctions for gateway links, regulators can better ensure the efficient use of spectrum resources, reduce potential conflicts among operators, and promote the seamless operation of satellite networks. This approach also allows for a more focused consideration of public interest objectives and the unique technical requirements of satellite services, ultimately benefiting both the industry and consumers.

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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.

[CG: this should be cost recovery, with no variants]

When setting spectrum charges for administrative assignments, regulators should consider the following factors:

- Spectrum pricing should be based on the cost of managing and regulating the spectrum. For instance, in the UK, Ofcom utilizes an administrative incentive pricing (AIP) system that reflects the cost of managing the spectrum. Similarly, in the US, the FCC uses a cost-based approach for spectrum fees. In addition, most of Europe, including UK, the US and other countries such as UAE, follow cost-recovery or administrative-based spectrum pricing models, ensuring fair allocation and affordability for satellite operators and the public. Emulating these models will ensure that pricing remains fair and affordable for satellite operators.

- High spectrum prices ultimately affect end-users, particularly those in remote areas where satellite connectivity is the only viable option. By keeping spectrum charges reasonable, regulators can encourage satellite service providers to offer competitive pricing, making connectivity more accessible for consumers in underserved regions.

- Governments and regulatory bodies should prioritize the allocation of spectrum to services that benefit society, such as disaster recovery and universal connectivity, . This approach emphasizes the importance of public interest over revenue generation. By focusing on the societal benefits of satellite services, regulators can ensure that policies support the nation's overall well-being rather than solely aiming for financial gains.

- For user links, considering that the main concern seems to be the discovery of the "true value of spectrum", it is reasonable to use the already proposed 1% of the AGR or waive it since this spectrum is used primarily for connecting the Unconnected. This is a good reflection of the actual value of spectrum, as directly and uniquely linked to the actual spectrum use in the country.

- For gateway links, bearing in mind that the gateway is considered an infrastructure, also to comply with Indian regulatory requirements, and involves a significant upfront financial investment, spectrum cost should be reasonable and aimed at solely covering administrative costs. This fee could be fixed per gateway or based on an affordable bandwidth multiplying factor.

Q39. Should the auction determined prices of spectrum bands for IMT /5G services be used as a basis for valuation of space-based communication spectrum bands

i. **For user link**
ii. **For gateway link**

Please support your answer with detailed justification.

It is not appropriate to price satellite spectrum based on 5G spectrum prices for several reasons, including but not limited to the following arguments:

- Mobile and satellite services cater to different target markets. While mobile operators primarily focus on densely populated urban areas, satellite services address the connectivity needs of rural and

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remote populations. These distinct target markets require different pricing models and policies.

- Mobile and satellite services have distinct operational and deployment cost structures. Satellite operators face significant upfront costs for satellite manufacturing, launch, and operations, while mobile operators have ongoing costs related to infrastructure deployment and maintenance costs. Pricing satellite spectrum based on the mobile economic model could impose an undue financial burden on satellite operators and hinder the growth and development of satellite services.

- Satellite services are crucial in bridging the digital divide by providing connectivity in areas where the traditional mobile network operator (MNO) business model has failed. High spectrum prices for MNOs often result in prioritizing revenue generation and concentrating network deployment in urban areas. As a consequence, rural and remote areas are left underserved. By adopting a different pricing model for satellite spectrum, regulators can ensure that the connectivity needs of these underserved areas are better addressed.

- Basing satellite spectrum pricing on the mobile economic model does not account for the specific requirements of universal connectivity. Satellite services are vital in providing essential communication services in areas where terrestrial networks are unavailable or not cost-effective. Applying the same pricing model as mobile operators could make satellite services unaffordable for the very communities they are meant to serve, further exacerbating the digital divide.

Q44. Whether international benchmarking by comparing the auction determined prices of countries where auctions have been concluded for space-based communication services, if any, be used for arriving at the value of space-based communication spectrum bands:

I. For user link

II. For gateway link

If yes, what methodology should be followed in this regard? Please give country-wise details of auctions, including the spectrum band/quantity put to auction, quantity bid, reserve price, auction determined price etc. Please support your response with detailed justification.

No other administration has ever auctioned this type of spectrum. One or two countries in the Americas auctioned only orbital slots but found major problems and later discontinued.

The United States passed legislation that is still in effect today (the ORBIT Act) that prohibits the FCC from auctioning satellite spectrum and requires the President to advocate against international satellite spectrum auctions7.

Based on that experience, neither they nor any other country would want to go that way again.

As noted in the consultation paper, “US, Mexico, and Brazil had attempted to sell frequencies for satellite usage but eventually did not succeed and at last resorted to administrative licensing.”

The single case found is that of the MSS “S-band” auction held by Saudi Arabia, and this single case is noted. There are several reasons why this case was a one-off and never replicated elsewhere. We note first that the MSS spectrum

7 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.

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is also subject to multilateral agreements for frequency use, for example, the L band Multilateral MoU (MLM), which would preclude issuing rights outside that MoU (Region 1 and Region 3 are part of the MoU). Half of the S-band spectrum blocks auctioned in Saudi Arabia were sold for terrestrial use (3GPP), and the other half of the S-band blocks were sold as MSS; however, the MSS blocks were sold with a path to convert their usage to terrestrial. Therefore, it is arguable whether the Saudi Arabia auction of the S band spectrum was targeted for space-based communications instead of replicating a terrestrial assignment. Nonetheless, this scenario is very different than FSS, where sharing is much easier due to coordination between satellite operators. In another much more comprehensive consultation, CITC made it. clear that satellite bands were out of the discussion for auction and are protected. "Continued guaranteed and protected access to all existing satellite bands for current and future uses, which include L, C, Ku and Ka, bands..."

Q45l. Should the international administrative spectrum charges/fees serve as a basis/technique for the purpose of valuation in the case of satellite spectrum bands

- **i. For user link**
- **ii. For gateway link**

Please give country-wise details of administrative price being charged for each spectrum band. Please specify in detail terms and conditions in this regard.

An international benchmark could be considered for spectrum pricing, but it is essential to carefully select the data points, considering markets with similar needs and stages of development. Comparing India's spectrum pricing to markets with comparable demand and progress will provide a more accurate and relevant benchmark for spectrum pricing.

Q46. If the answer to above question is yes, should the administrative spectrum charges/fees be normalized for cross country differences? If yes, please specify in detail the methodology to be used in this regard?

To ensure a fair and meaningful comparison, socio-economic factors, such as income distribution and the digital divide, must be considered , as they can influence the demand for connectivity and spectrum pricing decisions. The unit price should be adjusted by factors such as Gross Domestic Product per capita (GDPPC) or Purchasing Power Parity (PPP). This adjustment will account for differences in economic conditions and purchasing power across the selected markets, providing a more accurate and meaningful benchmark for India's spectrum pricing decisions.

Q48. Should the valuation arrived for spectrum for user link be used for valuation for spectrum for gateway links as well? Please justify.

It is not appropriate to use the valuation of the user link spectrum as a basis for determining the valuation of the gateway link spectrum, as the nature of spectrum usage and the associated impacts are significantly different between the two.

While the user link spectrum is utilized nationwide, the gateway link spectrum is employed in specific locations only. This means that the value assigned to national spectrum usage should not be applied to location-specific use as the context and scale are different. Since the potential for spectrum denial to other users is minimal, a cost recovery administrative approach would be more suitable for valuing the gateway link spectrum, as it considers the limited impact on other users.

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Q49. If the answer to the above is no, what should be the basis for distinction as well as the methodology that may be used for arriving at the valuation of satellite spectrum for gateway links? Please provide detailed justification.

Spectrum costs should be reasonable and aimed primarily at covering the administrative costs associated with managing, monitoring, and regulating the gateway satellite spectrum. This approach encourages more efficient and equitable spectrum use, fostering innovation and ensuring the sustainability of the satellite industry. It can also promote a healthy satellite industry that can continue providing essential services, such as disaster recovery, encouraging innovation, and fostering competition.

A fixed fee for satellite spectrum allocation can be calculated based on the estimated costs of managing and regulating the spectrum. This approach simplifies the fee structure and provides a clear understanding of the financial requirements for satellite operators.

Alternatively, the fee structure can be based on a reasonable bandwidth multiplying factor, where the fee is proportional to the spectrum the operator uses. This method encourages efficient spectrum use and considers the varying requirements of different satellite services and operators. In this approach, the bandwidth multiplying factor should be carefully chosen to ensure that it accurately reflects the administrative costs and does not create undue financial burden on operators.

Several countries adopt an administrative fee-only approach for satellite gateway spectrum allocation, which primarily covers the costs of managing, monitoring, and regulating the spectrum. (See examples in our response to Q38)