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

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Brief about the ITU-APT Foundation of India (IAFI)

ITU-APT Foundation of India (IAFI) is a non-profit, non-political, non- partisan registered foundation. IAFI is working for last 20 years with the prime objective of encouraging involvement of professionals, corporate, public/private sector industries, R&D organizations, academic institutions, and such other agencies engaged in development of ICT sector, in the activities of the International Telecommunication Union (ITU) and the Asia Pacific Telecommunity (APT). Further details regarding IAFI are available on our website https://iafi.in

The Foundation has been recognized as an International/Regional Telecommunications Organization by the ITU, as IAFI is a sector Member of the ITU Radiocommunication Sector (ITU-R), ITU Development Sector (ITU-D) and ITU Telecommunication Standardization Sector (ITU- T) and affiliate Member of Asia Pacific Telecommunity (APT) which manifests its usefulness to the Indian Telecom industry. The Foundation members are entitled to participate and contribute to the activities of ITU-R, ITU-D, ITU-T and APT. Over the last three years, IAFI has submitted more than 100 contributions for the work of all the three sectors of the union, especially in the Spectrum Area.

IAFI has acquired credibility and reputation as a specialized stakeholder group in "spectrum innovation" in the country and also in the region. It is a key driving force in spectrum discussions in the country especially on spectrum as a key resource for digital transformation through IMT, Wi-Fi, Satellite services.

IAFI also carries out capacity building activities in the region. Our key participants include government and industry. It is critical to note that different government agencies have competing demands in spectrum viz. defence, broadcasting, public, space services. These stakeholders are essential for any fruitful discussions on spectrum enablement. The Government has come out with an innovative policy on spectrum regulatory sandboxes. IAFI could play an important role in building awareness, capacities in SMEs and Start-ups in exploiting the government initiatives and spreading these best practices in the other countries in the region.

IAFI key roles and activities include:

1. **Promotion of ICT Development:** The foundation actively promotes the development and deployment of ICT infrastructure and services across India. By collaborating with various stakeholders, including government bodies, industry leaders, and academic institutions, it strives to create an enabling environment for the growth of the ICT sector.
2. **Standards Development and Implementation:** IAFI actively contributes to the development and implementation of international standards in telecommunications. It plays a key role in representing our interests in global forums, such ITU, APT, UNO, WTO, etc and ensures that our perspective is effectively incorporated into the standards-setting process.
3. **Research and Development:** The foundation fosters research and development activities in the field of telecommunications. By supporting innovative research projects, it aims to address emerging challenges, explore new technologies, and promote cutting-edge solutions that can benefit both the industry and society at large.

4. **Capacity Building and Training:** Recognizing the importance of human capital in driving the growth of the telecommunications sector, the foundation organizes capacity-building programs and training workshops. These initiatives aim to enhance the skills and knowledge of professionals working in the field, enabling them to stay abreast of the latest advancements and best practices.
5. **Policy Advocacy:** IAFI actively engages in policy advocacy to influence decision-making processes related to ICT. It works closely with regulatory bodies and government agencies to provide inputs on policy formulation, regulatory frameworks, and spectrum management, ensuring that they align with the evolving needs of the industry and society.
6. **Industry Collaboration:** The foundation facilitates collaboration and networking among industry players, academia, and research organizations. It organizes conferences, seminars, and industry forums where stakeholders can exchange ideas, share experiences, and explore opportunities for partnership and cooperation.
7. **Digital Inclusion and Empowerment:** With a focus on promoting digital inclusion, the foundation works towards bridging the digital divide and ensuring that the benefits of ICT reach all sections of society. It supports initiatives that empower marginalized communities, promote digital literacy, and leverage technology for social and economic development.

Through its diverse range of activities, IAFI remains committed to driving the growth and development of the telecommunications sector in India. By fostering collaboration, advocating for sound policies, and promoting innovation, the foundation is playing a pivotal role in shaping India's digital future and contributing to the country's socio-economic progress.

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Executive Summary of our comments

Satellite-based communication systems can provide coverage to the remotest and most inaccessible areas of a geographically widespread country like India. At present, many sparsely populated areas, including those of strategic importance and those important from a socio-economic perspective, do not have mobile terrestrial coverage or other forms of connectivity. Communication satellites have the potential to bridge this gap by providing services to even the remotest areas.

Satellite-based communication systems caters to strategic national requirements and improve the disaster resilience of the country as well as connect industrial units located in faraway locations which are otherwise difficult to connect. The high speed ubiquitous broadband to the consumers, where they directly compete with the terrestrial mobile as well as fixed wireless networks, are the primary targets for the new NGSO Direct to Devise Satellite based Communication systems being addressed in this consultation. Further, they can will also provide connectivity in the traditional satellite market i.e. Government agencies, including Defence, disaster recovery, cellular backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc.

Our proposals in this response are only for assignment of non-IMT spectrum. Any satellite constellation intending to use IMT spectrum assigned to terrestrial networks shall have a mutual commercial agreement with licensed operators to utilize their spectrum or take spectrum on a market-based mechanism.

Spectrum Charging: while we fully support the administrative allocation for FSS spectrum assignment, as the right mechanism for allocating spectrum, TRAI and the Government should price the satellite spectrum in a manner that addresses the concerns related to fair competition and provide a level playing field for offering of services directly to retail customers, ensuring that there is no predatory pricing by the satellite operators. It is however worth noting that despite good terrestrial coverage in Metro and cities, the use of satellite services in these urban scenarios will complement the terrestrial coverage in unconnected homes.

Additionally, IAFI encourages TRAI to consider lower spectrum prices (for example, no spectrum charge) for the traditional use cases of satellite services for the traditional market i.e. consumers in rural and remote areas and for Government agencies, including Defence, disaster recovery, cellular backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc., could be priced differently

Validity Period: It is critical that all necessary regulatory requirements are clarified by the regulator/licensor at the earliest. While we have recommended 20 year validity for spectrum licenses in our response, considering the nascent nature of this industry and the need for urgent utilisation of already available satellite resources, the Authority can also consider a lesser validity period, say 3- years, to enable an early launch of services in some cases.

Services to be provided under NGSO MSS for D2D should not be licensed under VSAT license and instead be licensed under the Satellite based Access Authorization (SAA) as these services are **directly competing with terrestrial networks.** To ensure level playing field, the spectrum pricing for NGSO MSS services for D2D should be benchmarked with the market discovered pricing of spectrum for terrestrial network. For MSS band spectrum shall

be assigned on exclusive basis, also as it is typically at lower frequencies and the spectrum cannot be shared among satellite operators. The possibility of auction to determine the market price can be explored.

For FSS bands, the spectrum should be assigned administratively on non-exclusive basis, when it can also be shared among operators (e.g. microwave frequencies). In case the spectrum is to be assigned on exclusive basis to any one operator, the possibility of market mechanism may be further explored.

There should be no differentiation between NGSO and GSO spectrum pricing when providing similar services.

Further this response also does not cover the satellite based IOT communications for which a separate framework has been recommended.

Q-1. **Which frequency band(s)/ range(s) should be considered for the assignment to NGSO based Fixed Satellite Services for providing data communication and Internet service?**

Please provide a detailed response separately for the user link and feeder link.

IAFI Comments

For NGSO-based Fixed Satellite Services (FSS) providing telecommunications services, including mobile communications, data communication and internet services, two types of frequency bands are needed

1. Frequency Bands for Gateway Links – uplink and down link
2. Frequency Bands for subscriber Links – uplink and down link

Most of the present and planned NGSO constellations **are** primarily classified under the **Fixed Satellite Service (FSS)** as they aim to deliver high-speed, low-latency broadband connectivity primarily for stationary or fixed terminals, targeting enterprise, government, maritime, aviation, and remote regions. Additionally, these constellations also support **mobility applications** using **Earth Stations in Motion (ESIMs)** under FSS licensing, allowing it to offer connectivity to moving platforms, such as ships, airplanes, and land vehicles. This enables them to provide flexible broadband services to both fixed and mobile users, though it remains under the broader FSS classification rather than MSS.

Most suitable frequency bands for FSS uplinks (gateways and subscribers links) are:

• **Ka band (26.5-30.5 GHz):** The Ka-band is a popular choice for NGSO satellites because it offers high data rates and low latency. It can be affected by rain fade, which can reduce the availability of the service. However, fade countermeasures techniques are typically deployed

• **Ku band (10-21 GHz):** The Ku-band is another popular choice for NGSO satellites. It offers lower data rates than the Ka band, but it is less affected by rain fade.

A. KA Band

In the Ka band, NGSO (Non-Geostationary Orbit) satellites primarily operate in two main frequency ranges for uplink and downlink communications:

1. **Uplink (Earth to Space):** 27.5 – 30.5 GHz
2. **Downlink (Space to Earth):** 17.7 – 20.2 GHz

These ranges are part of the broader Ka band (26.5 – 40 GHz), widely used for high-capacity, low-latency satellite internet due to its capability to support higher data rates and capacity. NGSO satellite constellations, such as those operated by Starlink, Telesat and OneWeb, etc frequently use these frequencies for their high-density, low-latency broadband services. The Ka band ranges for NGSO satellites are typically divided between gateway links and user links:

1. **Gateway Links (Backhaul):**
   - **Uplink (Earth to Space):** ~27.5 – 30.0 GHz
   - **Downlink (Space to Earth):** ~17.7 – 20.2 GHz
   -

Gateways serve as central communication hubs connecting the satellite constellation to terrestrial networks, often supporting higher power and data throughput for backhaul connections.

2. **User Links (Direct to Customer):**
    a. **Uplink (Earth to Space):** ~28.35 – 29.1 GHz
    b. **Downlink (Space to Earth):** ~18.3 – 18.8 GHz and 19.7 – 20.2 GHz

Spectrum access directly affects NGSO satellite capacity and thus the ability to serve India in a cost-effective manner. As such, IAFI is of the view that the frequency ranges for assignment should largely be consistent to those assigned to the Fixed Satellite Services in accordance with the current Radio Regulations. This allows NGSO satellite operators to have equal access to the satellite spectrum available in the provision of services.

In consideration that there are NGSO satellite operators that use the same frequency bands for feeder and user links, IAFI do not propose segmenting the satellite frequency bands specifically for eitherlinks. These novel satellite constellations have the ability to optimize the allocation of resources, including spectrum, to the user and feeder links, thereby efficiently allocating the frequency range available, as and when required.

In the case of the Ka-band, IAFI proposes the following frequency ranges:

Feeder Link (GHz)	
Earth-to-space	**Space-to-Earth**
17.7 – 18.6 18.8 – 20.2	27.5 – 29.1 29.5 – 30.0

User Link	
Earth-to-space	**Space-to-Earth**
17.7 – 18.6 18.8 – 20.2	27.5 – 29.1 29.5 – 30.0

B Ku Band

In Non-Geostationary Satellite Orbit (NGSO) networks, the Ku-band spectrum commonly used for gateway and user links typically spans specific frequencies within the Ku-band range (10.7–12.7 GHz for downlink and 14–14.5 GHz for uplink), but the exact frequencies can vary depending on regulatory approval, operator choice, and local conditions. Here's an overview of the common allocations:

1. User Links (Terminals):

- Downlink (Satellite to User Terminal): 10.7–12.7 GHz

- Uplink (User Terminal to Satellite): 14.0–14.5 GHz

2. Gateway Links:

- Downlink: 10.7–12.7 GHz (can be the same as user downlink but often separated geographically)

- Uplink: 13.75–14.5 GHz, or 17.3–17.8 GHz in certain cases where dedicated gateway links are desired for more bandwidth. The Ku-band is chosen for NGSO networks due to its balance of bandwidth availability and manageable atmospheric attenuation, which allows for relatively high data rates and reliable connections.

Factors to consider when choosing between Ka-band and Ku-band:

a. Geographic location**:** Regions with higher rainfall or cloud cover may favour Ku-band due to its lower susceptibility to atmospheric attenuation, albeit Ka system deploy fade countermeasures techniques
b. Required data throughput**:** Ka-band is better suited for high-capacity applications like 5G backhaul and broadband internet.
c. Antenna size**:** Ka-band antennas are generally smaller, but potentially more complex than Ku-band antennas.
d. Regulatory constraints**:** Local regulations may limit the availability of certain frequency bands in specific regions.

In the case of the Ku-band, IAFI proposes the following frequency ranges:

Feeder Link (GHz)	
Earth-to-space	**Space-to-Earth**
13.75–14.5 GHz, 17.3–17.8 GHz	10.7-12.7

User Link (GHz)	
Earth-to-space	**Space-to-Earth**
14.0-14.5	10.7-12.7

In many cases, a combination of Ka-band and Ku-band can also be used to provide a more resilient and flexible service**.** This approach can help mitigate the effects of atmospheric attenuation and interference, while also offering a wider range of data rates to meet the needs of different users.

In case of Ku-Ka band, IAFI proposes the following frequency ranges

(Note: Entire Frequency Ranges may not be used- see Radio Regulations and NFAP for Details)

Feeder Link (GHz)	
Earth-to-space	**Space-to-Earth**
13.75–14.5 17.3 –20.2	10.7-13.25 27.5 – 30.0

User Link (GHz)	
Earth-to-space	**Space-to-Earth**
17.3 – 20.2 14.0-14.5	27.5 – 30.0 17.7- 20.2

These frequency bands are planned for GEN-1 Satellites and some operators also have ITU Filing in the Q/V band (37.5-52.4 GHz) for its future GEN-2 feeder links.

Considering the availability of the ecosystem, it will appropriate that same frequency bands may be adopted for NGSO FSS operations.

Q-2. **Which frequency band(s)/ range(s) should be considered for the assignment to GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet service. Please provide a detailed response separately for the user link and feeder link.**

IAFI Comments

Most of the present and planned NGSO constellations **are** primarily classified under the **Fixed Satellite Service (FSS)** as they aim to deliver high-speed, low-latency broadband connectivity primarily for stationary or fixed terminals, targeting enterprise, government, maritime, aviation, and remote regions. Additionally, these constellations also support **mobility applications** using **Earth Stations in Motion (ESIMs)** under FSS licensing, allowing it to offer connectivity to moving platforms, such as ships, airplanes, and land vehicles. This enables them to provide flexible broadband services to both fixed and mobile users, though it remains under the broader FSS classification rather than MSS.

NGSO (Non-Geostationary Orbit) satellites can also provide MSS (Mobile Satellite Services) and the user can then access various MSS services, such as voice calls, text messaging, and data connectivity, directly to the mobile handset. Technology is still in the developing stage. For NGSO (Non-Geostationary Orbit) Mobile Satellite Services (MSS), the primary frequency bands include portions of the L band and the S band, which are well-suited for mobile communications due to their resilience to weather and relatively low attenuation.

1. L Band (1–2 GHz) - L band is frequently used for MSS, as it provides reliable connections for small, mobile terminals in various conditions (e.g., for voice, data, and GPS services). NGSO operators in the L band include Iridium and Globalstar, offering global voice and data services for aviation, maritime, and land-based users.

2. S Band (2–4 GHz) - S band can support slightly higher data rates than L band and is also used for MSS applications, including voice and data. NGSO satellites operating in S band include systems designed for IoT, machine-to-machine communication, and some broadband applications.

Other bands, such as the Ka and Ku bands, can also support MSS services but are less common due to their susceptibility to weather-related attenuation.

Further, IAFI suggest that frequency bands for direct to Device MSS should be considered only after 2027, after the results of WRC-27 agenda items are known. Also, the proposed frequency bands under these agenda items are likely to be similar to the IMT bands and may require a separate pricing discussion.

Q-3. What should be the maximum period of assignment of spectrum for –

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

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

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

IAFI Comments

To ensure certainty in continuity of satellite service and reduce any administrative overheads, IAFI is of the view that the validity of spectrum assignment for NGSO-based FSS should be

20 years in line with the period of validity of the service authorization. In fact, the longevity of the constellation is guaranteed by replacing satellites as needed when they reach the end of life.

Furthermore, contrary to the other views reflected in this consultation paper stating that the (NGSO) business potential would emerge after some years of operations, the business potential for NGSO is already apparent and is further supported in various articles1 given the vast benefits that NGSO satellites bring.

Regarding Assignment of Spectrum for GSO/NGSO Satellites, it is widely recognized that satellite communications offer a robust and versatile means of connecting the unconnected, particularly in challenging environments such as rural, remote, mountainous areas, disaster-prone zones, and for critical applications in defense, maritime, and disaster recovery.

Satellite spectrum is a shared resource, as the same spectrum is used by multiple users, so the Administrative Assignment is the most suitable approach for assigning the FSS spectrum in a non-exclusive manner for the following reasons:

a. 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.
b. 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.
c. Globally, most of the countries 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.

Considering the dynamic nature of satellite technology, especially NGSO Satellites and the potential for rapid technological advancements, a flexible and adaptable approach to spectrum assignment should be adopted. Spectrum should be initially assigned for duration of at least 20 years and should be periodically reviewed after five years.

Spectrum assignments should be renewed based on a comprehensive evaluation of the service provider's performance, adherence to regulatory standards, and the continued viability of the technology. Renewal could be contingent upon factors such as the adoption of advanced technologies or the provision of services to underserved regions. To foster efficient spectrum utilization and innovation, service providers should be permitted to engage in trading and sharing arrangements.

Roll-out obligations are regulatory measure typically used for terrestrial operators, to address their shortcomings, 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.

[1] https://spacenews.com/ngso-revenue-to-overtake-geostationary-market-by-2028/

Consequently, imposing roll-out obligations on satellite service providers may create unnecessary burdens and obstruct the efficient deployment of satellite networks,

Q-4. For assigning spectrum for NGSO-based communication services, whether every ITU filing should be treated as a separate satellite system?

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

IAFI Comments

NGSO satellites could be supported by several ITU satellite filings. A new satellite filing may be submitted when additional satellites are launched to augment the existing capacity of the existing NGSO filings. Therefore, IAFI is of the view that every ITU filing should not be treated as a separate satellite system.

NGSO (Non-Geostationary Satellite Orbit) Satellites orbiting at a lower altitude than geostationary satellites and offering lower latency. NGSO satellites require larger number of satellites for global coverage, compared to GSO. The ITU typically considers NGSO constellations as a single entity for filing purposes, but in some NGSO constellations are covered by more than one ITU filing.

Q-5. Whether the provisions of ITU-RR are sufficient to resolve interference related challenges and coordination issues? If not, what additional conditions should be prescribed while assigning frequency spectrum for

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

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

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

IAFI Comments:

IAFI is of the view that the existing provisions prescribed in the ITU-RR (and highlighted in this consultation paper) are sufficient for the protection of GSO and terrestrial services. These internationally agreed provisions have been agreed upon and worked well in many countries without major issues.

Sufficient provisions are already exists in the ITU-RR to resolve interference related challenges and coordination issues.

Q-6. For satellite earth station gateways of different satellite systems operating in the same frequency range, whether there is a need to prescribe a protection distance or any other measures to avoid interference from each other -

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

(b) Between the gateways of NGSO systems?

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

IAFI Comments:

As mentioned in Q5, IAFI is of the view that there is no need for the prescription of any additional conditions including separation distances between gateways of satellite systems. Coordination of gateways are typically left between satellite operators during site selection.

No protection distances are required between GSO and NGSO, and operators/service providers can be licensed after ensuring that such inter-system coordination has been duly notified and/or such protection mechanisms, as prescribed by Article 22 and Resolution 76, have a favourable finding by the ITU.

Multiple gateways of GSO systems using the same spectrum can coexist in the same location, thanks to the angular separation and satellite selection, as it is the case in the various teleports around the world.

GSO and NGSO gateways can also coexist, due to various implementation of GSO arc avoidance by NGSO systems to comply with EPFD limit.

In most of the Ka-band (17.7-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz) there are equivalent power flux density (epfd) limits on NGSO to protect GSO (RR. 22.2). These limits are established by ITU, ensure non-interference and therefore no coordination is required.

Q-7. **In case the spectrum assigned for satellite gateway links is also assigned to terrestrial networks such as Fixed Service, IMT etc., what protection distance or criterion should be included in the terms and conditions of the assignment of spectrum for satellite gateway links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.**

IAFI Comments:

Fixed Service and Gateways can be coordinated as both locations are known. In the case of the 28 GHz, IMT was not identified in this band. However, similar terrestrial sharing studies was conducted by Task Group 5/1 for WRC-19 on the 26 GHz. The results of the studies[2] showed possible separation distance of up to 10km between FSS earth station and IMT station. While the sharing studies are solely based on the 26 GHz, it is expected for this separation distance to be lesser than those reflected in TG5/1 in the case of the higher attenuation of Radio Frequency signals in the 28 GHz

Article-21 of the Radio Regulation is meant for coexistence of terrestrial and space services sharing frequency bands above 1 GHz. Interference between a satellite earth station and a microwave station may occur when they operate on similar frequencies or when they are located in close proximity to each other. Following mitigation measures can be adopted to avoid interference between these two types of stations.

[2] Please refer to CPM19-2 report page 172 Section 2/1.13/3.2.1.3

a. It should be ensured that satellite stations and microwave stations operate on different frequency bands or using frequency coordination to prevent interference.

b. Selecting sites that are far apart or with suitable terrain features (e.g. hills or mountains) to reduce the likelihood of interference.

c. Using directional antennas with high gain and narrow beam-widths to minimize the amount of energy radiated in unwanted directions.

d. Transmission power of the stations can be adjusted to minimize interference.

e. Using filters to eliminate or reduce the amount of unwanted signals or noise that can cause interference.

f. Maintaining communication and coordination between the operators of the satellite station and the microwave station to ensure that any interference is identified and addressed promptly.

The spectrum allocated for satellite gateway links should be protected from interference from terrestrial networks, such as Fixed Service, IMT, etc., to ensure the reliable and efficient operation of both satellite and terrestrial services. To achieve this, appropriate protection distances or criteria should be included in the terms and conditions of the spectrum assignment for satellite gateway links.

Protection Distance:

The protection distance is the minimum physical separation required between a satellite gateway link and a terrestrial network to prevent harmful interference. This distance depends on various factors, including:

a. Frequency band - Higher frequency bands generally require smaller protection distances due to their shorter propagation paths.

b. Antenna characteristics - The gain and beam-width of the satellite gateway antenna and the terrestrial network antenna influence the level of interference.

c. Power levels - The transmitting power of both the satellite gateway and terrestrial network equipment affects the interference potential.

d. Environmental conditions - Factors like terrain, vegetation, and atmospheric conditions can impact the propagation of radio waves and the required protection distance.

In addition to the above, following points may be considered.

a. Dynamic spectrum management - Exploring the use of dynamic spectrum management techniques to optimize spectrum utilization and minimize interference, particularly in congested frequency bands.

b. Emerging technologies - Considering the impact of emerging technologies, such as 5G and satellite internet, on spectrum requirements and interference mitigation strategies.

c. Environmental impact - Assessing the potential environmental impact of satellite gateway links and terrestrial networks, and taking appropriate measures to mitigate any negative effects.

By carefully considering these factors and implementing appropriate protection measures, it is possible to ensure the coexistence and efficient operation of satellite gateway links and terrestrial networks, thereby maximizing the benefits of both technologies.

Q-8. In case the spectrum assigned to the satellite user link is also assigned to terrestrial networks such as Fixed Service, what criterion should be included in the terms and conditions of the assignment of spectrum for satellite user links to avoid any interference to/ from terrestrial networks? Please provide a detailed response alongwith international practice in this regard.

IAFI Comments:

In the case of known Very Small Aperture Terminals (VSATs) location or Gateway earth stations, they can be coordinated with the Fixed Services. In the case of user terminals that are on mobile platforms such as Earth Stations in Motion (ESIM), sharing conditions could be adopted from relevant resolutions from the outcomes of past WRCs such as Res 123 (WRC-23) and Res 169 (WRC-19) for protection of terrestrial services in the Ka-band for NGSO and GSO ESIMs.

Q-9. Whether there is a need to prescribe any conditions to mitigate the risk of scarcity of satellite gateway sites? If yes, please provide a detailed response alongwith international practice in this regard.

IAFI Comments:

There should no need to prescribe any conditions to mitigate the risk of scarcity of satellite gateway sites. Contrary to Paragraph 3.32, there is no need for a predefined minimum distance as this should be determined between operator to define during the coordination process. Newer NGSO satellite systems, leverage on Optical Inter-Satellite Links that allow constellations to make efficient use of gateway earth stations by limiting their numbers.

Q-10. In addition to the roll-out conditions recommended by TRAI for satellite-based Telecommunication Service Authorisation through its recommendations on the Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023 dated 18.09.2024, whether there is a need to impose certain additional roll-out obligations for the assignment of frequency spectrum for –

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

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

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

IAFI Comments:

Apart from the cost incurred from the spectrum licence, it will be the satellite operators' inherent interest to commence service provision as soon as possible for revenue generation. Hence, IAFI is of the view that there is no need to impose any additional roll-out obligations for the assignment of shared frequency spectrum.

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 un-served or underserved areas. This approach will enable satellite operators to contribute in bridging the digital divide effectively and ensure that their services are available to those who need them most.

As mentioned in the TRAI's recent recommendations dated 18-09-2024, on the Framework for Service Authorizations, roll-out obligations for GMPCS and VSAT CUG services are well defined. NGSO-based Fixed Satellite Services (FSS) and GSO/NGSO-based Mobile Satellite Services (MSS) are still in their developmental stages and technological development for necessary ecosystem may take few more years. Therefore, if any roll-out obligation is to be considered for these emerging technologies, a minimum prescribed period of five years should be set. This would allow sufficient time for the development and deployment of these technologies, considering their current state of evolution.

Despite strong interest from service providers in the recent 26 GHz spectrum auction for 5G services, the lack of a mature global ecosystem for this frequency band poses a significant challenge. Limited infrastructure and device availability have hindered the timely deployment of 5G services, potentially affecting the realization of the benefits associated with the acquired spectrum and compliance with rollout obligations.

Q-11. Whether there is a need to introduce a provision for surrender of frequency spectrum prior to the expiry of the period of validity of spectrum assigned for –

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

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

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

IAFI Comments:

Yes, there is a need to introduce a provision for the surrender of frequency spectrum prior to the expiry of the assigned period for NGSO-based Fixed Satellite Services (FSS) and GSO/NGSO-based Mobile Satellite Services (MSS). This provision would provide flexibility to licensees in managing their spectrum holdings, allowing them to adapt to changing market conditions, technological advancements, or business strategies.

Following Terms and Conditions can be adopted.

1. Notice Period - Licensees should be required to provide a specified notice period to the regulatory authority before surrendering their spectrum. This would allow the authority to plan for the reallocation of the spectrum and minimize disruption to other services.

2. Surrender Fee - A surrender fee could be imposed to discourage frivolous surrenders and to recover any administrative costs associated with the process. The fee could be calculated based on factors such as the amount of spectrum surrendered, the remaining validity period, and the market value of the spectrum.

   Clause 2.2(viii) of the Guidelines for surrender of Access Spectrum by Access Service Providers dated 15.06.2022 (**"Spectrum Surrender Guidelines"**), provides that "*On surrender of spectrum,* ***no future instalments with respect to surrendered spectrum will be required to be paid after the date of surrender***." However, clause 2.2(ix) provides that "*There shall be* ***no refund of any payment made, either as full or partial upfront payment or instalments or pre-payments****, towards the acquisition of such spectrum*."
   To promote fairness and transparency, it is essential to implement a policy that waives future payments for surrendered spectrum. If no prepayments have been made, there should be no further financial obligations. In cases where pre-payments exist, a full refund should be provided.

   If a refund is not feasible, the spectrum charges should be adjusted against deferred spectrum payments or future spectrum acquisitions by the service provider.

3. Minimum Spectrum Holding Period - To prevent speculative acquisition and resale of spectrum, a minimum holding period could be stipulated before a licensee is allowed to surrender their spectrum. This would ensure that the spectrum is used for its intended purpose and not merely as a speculative asset.

4. Obligations of the Licensee - Licensees surrendering their spectrum should be required to fulfil any outstanding obligations, such as paying fees or meeting performance targets.

A well-defined surrender process can reduce the administrative burden on the regulatory authority and improve the overall efficiency of spectrum management. Introducing a provision

for the surrender of frequency spectrum for satellite services can provide a valuable tool for managing spectrum resources and promoting a dynamic and competitive market. By carefully considering the associated terms and conditions, regulatory authorities can ensure that the surrender process is fair, efficient, and beneficial to both licensees and the public.

Q-12. Whether there is a need to prescribe timelines for processing the applications for the assignment of frequency spectrum for-

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

(d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response with justifications.

IAFI Comments:

IAFI is of the view that there is a need for the prescription of a reasonable timeline for the processing of applications for assignment of frequency spectrum as this will allow the satellite operators to prepare and plan in advance in anticipation for service commencement in any commercial agreements.

There is a need to prescribe timelines for all regulatory permissions, like processing of applications for the assignment of frequency spectrum for NGSO-based Fixed Satellite Services (FSS) and GSO/NGSO-based Mobile Satellite Services (MSS). Clear timelines provide investors with certainty, encouraging them to invest in these technologies. Timely processing can foster competition among service providers, leading to lower prices and better services for consumers. Similarly, delays in spectrum assignment can hinder the efficient use of a valuable resource.

It will be appropriate to use “Saral Sanchar Portal” for all types of clearances and approvals, and timely disposal.

By implementing these measures, regulatory authorities can ensure that the assignment of frequency spectrum for satellite services is efficient, transparent, and beneficial to both licensees and the public.

For GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services prescribed timelines will provide regulatory clarity and certainty, enabling companies to strategically plan their investments and establish operations in India ahead of commercial deployment. For local startups and smaller companies, this will also instil confidence in their investors by ensuring a stable and predictable business environment. Such assurance can lead to increased funding opportunities, thereby fostering innovation and growth within the local ecosystem.

Q-13. Whether there are any other suggestions related to assignment of spectrum for-

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

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

Please provide a detailed response with justifications.

IAFI Comments

IAFI is of the view that there should not be any unnecessary provisions or regulations related to the assignment of spectrum that could inevitably translate to higher operating costs for the use of NGSO satellites. More importantly, provisions relating to the assignment of spectrum for NGSO FSS should be consistent and similar to that of GSO FSS to prevent any discriminatory provisions in favour of one satellite orbit over the other.

Q-14. **Should spectrum charges for NGSO-based FSS providing data communication and Internet services, be levied:**

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

Please provide a detailed justification for your answer.

IAFI Comments

IAFI is of the view that spectrum charges could either be based on a percentage of the AGR (e.g. 1% as already previously recommended also by TRAI); or on a per MHz basis provided that these fees are reasonable and sustainable for NGSO operations on the long-term basis, bearing in mind of the higher order millimetre-wave frequency bands utilized in newer satellite systems and their corresponding multiple GHz of bandwidth. It is clear for instance that the formula Royalty, R (in Rs.) = 35000 x Bs would lead to astronomical amounts in the case of bandwidth in the order of GHz.

As mentioned in the Consultation Paper that "Satellite spectrum is generally assigned through an administrative mechanism internationally and spectrum charges are levied in the form of an administratively determined fee. It may be noted that the spectrum charges levied in other countries for satellite communications services are generally low on a per MHz basis".

IAFI is of the view that the method of levying spectrum fees/charges should be based on AGR for the NGSO-based FSS, and should be paid annually by linkage to the AGR. It will ensure the true value of spectrum. Formula based on the quantum of spectrum may make sense where spectrum is individually and exclusively assigned to a specific user on administrative basis, such as for captive purposes, but it is not the right method for satellite services where the same spectrum is shared by multiple operators

Q-15. In case it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

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

ii. An alternative approach (please specify)?

Please provide a detailed justification to support your answer.

IAFI Comments

IAFI is of the view that spectrum charges should not be based on the DoT order dated December 11, 2023. To illustrate, the formula royalty applied to a 4 GHz spectrum will lead to 280 million Indian Rupees worth of fees and is not sustainable for any satellite operator as they progress to the utilization of higher order frequency in future.

So, IAFI does not support that spectrum charges should be levied on per MHz basis for NGSO-based FSS, as suggested in the DoT letter dated 11-12-2023

As mentioned in Q14 above, reasonable spectrum fees could be referenced from both Singapore and Malaysia in the region as mentioned in this TRAI consultation.

Q-16. If it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a percentage of AGR basis:

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

Please provide a detailed justification for your answers.

IAFI Comments

As also mentioned in Q14, IAFI is of the view that the appropriate percentage of the AGR should not be more than 1% and this charge should be applicable to both GSO and NGSO based FSS providing data communication and internet services.

As mentioned also in the response to Q10, it is of the interest of satellite operations to use spectrum efficiently to maximize the capability of the provision of services. Hence, there is no need for any unnecessary charges to be specified to address the concern on the use of inefficient utilization of spectrum.

IAFI is of the view that reasonable spectrum charges should be 1% of the AGR. This will be a good reflection of the true value of spectrum, as directly and uniquely link to the actual spectrum use in the country.

High spectrum fees will prove as a disincentive to operators to efficiently/flexibly use spectrum and should not become an artificial barrier to entry.

Q-17. Considering the Adjusted Gross Revenue (AGR) based charging methodology currently followed for Commercial VSAT and in view of the enhanced scope of the

Satellite service authorisation, what should be the spectrum charge, as a percentage of AGR, that should be levied on GSO-based FSS?

Or,

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

Please provide a detailed justification for your answer.

IAFI Comments

TRAI in its recommendation dated 27-12-2018 proposed that –

1. The formula based spectrum charges should be replaced with AGR based spectrum charges in respect of provision of services by BSNL under its license for 'Provision and Operation of Satellite based services using Gateway installed in India' under 'sui-generis' category. These charges would cover the entire spectrum charges for handsets as well as for gateway.
2. The Authority recommends that the spectrum charges should be levied at 1% of the AGR of BSNL's satellite based services under 'suigeneris' category.
3. VSAT services of BSNL are GSO-based FSS service.

Above recommendations were accepted by the DoT. In view of the enhanced scope of the Satellite service authorisation**,** IAFI is of the view that reasonable spectrum charges should be 1% of the AGR, for the GSO-based FSS services. This will be a good reflection of the true value of spectrum, as directly and uniquely link to the actual spectrum use in the country

Q-18. Should spectrum charges for GSO and NGSO-based MSS that provide voice, text, data, and Internet services be levied?

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

Please provide a detailed justification for your answer.

IAFI Comments

Spectrum charges for MSS systems used for specified applications such as traditional satellite market i.e. Government agencies, including Defence, disaster recovery, cellular backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc, should be charged on a fixed nominal fee to offset administrative costs incurred by the regulator.

We strongly discourage a % of AGR basis fee for MSS spectrum. A % of AGR basis fee, considering license fees are also levied as a % of AGR, will compound the regulatory tax on a company's revenues in country. This will inevitably harm the long-term sustainability of MSS satellite operators in India. It will also raise companies' operating costs in India to a level that could result in more expensive services.

Please note that this comment does not apply to D2D type of MSS service.

Q-19. If it is determined that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a per MHz basis, should these charges be calculated based on:

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

Please provide a detailed justification to support your answer.

IAFI Comments

Spectrum charges for MSS systems used for specified applications such as traditional satellite market i.e. Government agencies, including Defence, disaster recovery, cellular backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc, should be charged on a fixed nominal fee to offset administrative costs incurred by the regulator.

Q-20. If it is decided that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a percentage of AGR basis:

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

Please provide a detailed justification for your answers.

IAFI Comments

Spectrum charges for MSS systems used for specified applications such as traditional satellite market i.e. Government agencies, including Defence, disaster recovery, cellular backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc, should be charged on a fixed nominal fee to offset administrative costs incurred by the regulator.

Q-21. Whether there are any other issues/suggestions relevant to the spectrum charging for:

i. **NGSO/GSO based FSS providing data communication and Internet services.**
ii. **NGSO/GSO based MSS providing voice, text, data, and Internet services. The response may be submitted with proper explanation and justification.**

IAFI Comments

In summary our proposals are:

1. 1% of AGR for NGSO systems in Ku, KA and higher bands
2. Nominal /NIL Spectrum charges (to offset administrative costs incurred by the regulator) for MSS systems used for specified applications such as traditional satellite market i.e. Government agencies, including Defence, disaster recovery, cellular

backhaul in rural and remote areas, industrial and commercial users in in rural and remote areas, etc,

3. Pricing for Direct to device to follow market principles and to deter any predatory pricing. This does not include the gateway spectrum which should be charged as a backhaul for D2D