

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

**Comments**

Under mentioned frequency bands may be used for assignment to NSGO based FSS for providing data and internet service in the user link and feeder link

**User link:**

**Ku Band:** It is widely used in broadband Internet and television services

Downlink: 10.7 – 12.7 GHz

Uplink: 14-14.5 GHz

**Ka Band:** The Ka-band has higher bandwidth and it allows for higher data throughput and better frequency reuse capabilities.

Downlink: 17.7-21.2 GHz

Uplink: 17.7-21.2 GHz

**Feeder Link:**

**Ka Band:** NSGO satellite systems like Starlink and OneWeb use Ka-band for their feeder link operations

Downlink: 17.7-21.2 GHz

Uplink: 27.5-31 GHz

**Reference:** ITU Radio Regulations, 2020. Article 5: frequency allocation

**Q2. Which frequency band(s)/ range(s) should be considered for the assignment to GSO/ NSGO 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.**

**Comments**

Under mentioned frequency bands may be used for assignment to GSO/NSGO based MSS for providing voice, text, data and internet service in the user link and feeder link

**User Link:**

**L-Band:** . It is extensively used for voice, messaging, and low-data-rate applications.

Downlink: 1525-1559 MHz

Uplink: 1626.5-1660.5 MHz

**S-Band:** S-band offers more bandwidth than L-band, allowing for better data services

Downlink: 2170-2200 MHz

Uplink: 1980-2010 MHz

**Ku-Band:** This band is suitable for providing high speed mobile Internet

Downlink: 10.7-12.7 GHz

Uplink: 14-14.5 GHz

**Ka-Band:** It is used for capacity for high-speed mobile broadband services

Downlink: 17.7-21.2 GHz

Uplink: 27.5-31 GHz

**Feeder Link:**

**C-Band:**

Downlink: 3.7-4.2 GHz

Uplink: 5.925-6.425 GHz

**Ku-Band:**

Downlink: 10.7-12.7 GHz

Uplink: 14-14.5 GHz

**Ka-Band**

Downlink: 10.7-12.7 GHz

Uplink: 14-14.5 GHz

**Reference:** ITU Radio Regulations, 2020. Article 5: frequency allocation

**Q3. What should be the maximum period of assignment of spectrum for - (a) NGSO based Fixed Satellite Services for providing data communication and Internet services, and (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response alongwith international practice in this regard.**

**Comments**

**NGSO-based Fixed Satellite Services (FSS) for Data Communication and Internet Services:**

NGSO systems involve large investments in designing, manufacturing, implementing and maintaining satellite networks. Operators pour in a huge amount of capital to execute the project, accordingly they need equally large time to recover the revenue.

Hence it is recommended that a period of 15-20 years is required to cater for revenue recovery as well as absorption of new technology in the existing system so as to cover the gaps.

International Practices:

**US:** The Federal Communications Commission (FCC) grants spectrum licenses for satellite services with a term of 15 years. **Ref:** FCC report 2018.

**European Union:** In the European Union, the spectrum for satellite communications is assigned for up to 20 years. **Ref:** ECC Report 227 on Use and assignment of frequency bands for MSS.

### **GSO/NGSO-based Mobile Satellite Services (MSS) for Voice, Text, Data, and Internet Services:**

Data rate offered by MSS is not considerable to be qualified for providing long service. Mobile telecommunication technology is evolving at a fast pace and MSS may not last long in this era as it has limited data rate and applications. In addition, spectrum may not be optimally utilised. Keeping all these aspects in mind it is recommended that MSS should not be continued for long duration and should be allotted the spectrum not exceeding 5 years.

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

#### **Comments**

No, operators should be provided with the flexibility. Filing should not be tagged to the satellite system. Filing should be based on frequency bands and its targeted services.

Unless there is any specific reason for specific satellite systems are brought out vis-s-vis frequency bands allocated to the application.

International Practice

With increase in mega-constellations such as Starlink and OneWeb, there's increasing pressure on ITU with efficient spectrum usage. The ITU has recently been considering the possibility of more flexible approaches for NGSO filings, focusing on optimizing spectrum sharing and reducing administrative burdens.

**Q5. Whether the provisions of ITU-RR are sufficient to resolve interference related challenges and coordination issues? If not, what additional conditions should be prescribed while assigning frequency spectrum for (a) NGSO based Fixed Satellite Services for providing data communication and Internet services; and (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response alongwith international practice in this regard.**

#### **Comments**

The ITU Radio Regulations (ITU-RR) gives a basic outline for managing satellite spectrum, but with advent and fast evolving technology, more number of NGSO and GSO/NGSO networks. The burden on this agency is far greater than it was before. So collaboration with other agencies is need of the hour.

International Practices

**US:** Imposes spectrum-sharing rules beyond ITU-RR.

**Japan:** Enforces stricter coordination and sharing requirements, especially for high-density LEO constellations.

**Q6. For satellite earth station gateways of different satellite systems operating in the same frequency range, whether there is a need to prescribe a protection distance or any other measures to avoid interference from each other– (a) Between the gateways of GSO and NGSO systems; and (b) Between the gateways of NGSO systems? If yes, please provide a detailed response alongwith international practice in this regard.**

### **Comments**

Yes, appropriate distance should be maintained to ensure no interference between different services.

**Between the Gateways of GSO and NGSO Systems:** gateways of GSO and NGSO may sometimes operate in the same frequency bands. So there are high chances of interference.

**Protection measures:** A few kilometers of distance between the gateways may be maintained depending on the antenna size, transmission power and other environmental factors.

**Between the Gateways of NGSO Systems:** when multiple NGSO gateways are deployed the complexity increases due to constantly moving satellites and frequency congestion.

**Protection measures:** individual users directly communicate with the satellite may be one of the viable options to mitigate these problems.

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

### **Comments**

To avoid interference between satellite gateway links and terrestrial following measures should be adopted:

**Minimum Separation Distances:** At least a distance of 10 to 100 kms should be maintained between any two gateways based on the terrain where the gateways are installed.

**Coordination Zones:** geographic zones should be defined in prior around gateways where terrestrial deployments are already existing.

**Power Limits:** Impose power limits on both satellite and terrestrial services to maintain interference-free operation.

### **International Practice**

**US:** The FCC ensures coordination zones around satellite gateways to protect them from interference by terrestrial services.

**European Union:** their guidelines recommend defining coordination zones around satellite gateways and imposing power limits on satellite and terrestrial systems.

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

### **Comments**

When the spectrum assigned to satellite user link and terrestrial network is the same then there may be high chances of occurrence of interferences due to same frequency usage by both the networks. This can result in very harmful interference.

Some measures to avoid interference between satellite user links and terrestrial networks like Fixed Services:

**Minimum Elevation Angles:** Define minimum elevation angles for satellite terminals to reduce ground-level interference.

**Power Limits:** Impose strict Power limits for satellite transmissions.

**Geographical Separation:** Establish minimum separation distances and coordination zones in areas with co-channel or adjacent-channel operations.

**Frequency Coordination:** Frequency coordination before deploying new satellite or terrestrial services in shared bands.

### **International Practices:**

**US:** The FCC has defined power limits and coordination requirements to avoid interference. FCC mandates strict power limits to protect terrestrial services from interference. It also requires coordination agreements between operators.

**European Union:** They emphasize frequency coordination and the establishment of geographical separation zones to minimize interference. They also prescribes

minimum elevation angles and power limits to prevent interference between satellite terminals and terrestrial networks.

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

### **Comments**

Yes. Due to the growing satellite service demands, proportionately the requirement for gateway sites is also growing. There are increasing satellite constellations which further demands increasing number of gateway sites. However there is scarcity of such resources due to geographical restriction, interference issues etc. These problems have to be mitigated to ensure optimum utilisation of resources. Some of the measures which can be adopted to mitigate such issues are:

**Shared Infrastructure:** Encourage shared use of gateway facilities to optimize limited suitable sites and reduce interference.

**Adopting Distributed Gateway Architecture:** Implement a distributed deployment approach to avoid over-concentration in single locations.

**Enhance Coordination and Spectrum Reuse:** Establish coordination guidelines and leverage dynamic spectrum sharing tools to manage interference effectively.

### **International Practices:**

**US:** The FCC has adopted rules to encourage the sharing of gateway sites among satellite operators.

**European Union:** CEPT promotes co-location and shared-use models for gateway sites.

**Q10. In addition to the roll-out conditions recommended by TRAI for satellite-based Telecommunication Service Authorisation through its recommendations on the Framework for Service Authorisations to be Granted Under the Telecommunications Act, 2023 dated 18.09.2024, whether there is a need to impose certain additional roll-out obligations for the assignment of frequency spectrum for (a) NGSO based Fixed Satellite Services for providing data communication and Internet services; (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response alongwith international practice in this regard.**

### **Comments**

Yes, there is a need to impose additional roll-out obligations

**Area Coverage Obligations:** Set minimum coverage targets, with specific focus on rural and inaccessible regions.

**QoS:** Define minimum data speed, latency, and uptime requirements to ensure reliable services.

**International practices:**

**US:** The FCC imposes both coverage and service quality obligations.

**European Union:** CEPT sets obligations to offer consistent service quality across EU member states, with additional requirements for ensuring reliable communication in remote regions.

**Q11. Whether there is a need to introduce a provision for surrender of frequency spectrum prior to the expiry of the period of validity of spectrum assigned for - (c) NGSO based Fixed Satellite Services for providing data communication and Internet services; (d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? If yes, what should be the process, and associated terms and conditions such as minimum period of spectrum holding, notice period, surrender fee, etc.? Please provide a detailed response with justifications.**

**Comments**

Yes, there should be a provision to surrender the spectrum in both the FSS and MSS cases. However the operators should strictly abide the rules. Some of the reasons for having such provisions are stated below:

**Efficient Spectrum Utilization:** if the spectrum is not being used by a particular operator the same can be allocated to the other who is ready to provide the service.

**Changes in business model:** when an operator has changed his business model and no longer ready to provide service using the allocated spectrum.

**Avoiding Spectrum Holding:** spectrum is a very costly resource. Leaving such resource unutilised is not a viable option. So the spectrum can be allocated to the another operator who pledges to provide service efficiently.

**International Practices:**

**US:** The FCC allows spectrum licensees to return their licenses voluntarily. Licensees can surrender their spectrum without incurring significant penalties, but the spectrum must be returned in full compliance with the FCC's rules, and all financial obligations must be settled.

**European Union:** In the EU, operators can surrender their spectrum, provided they adhere to the conditions set out in their license agreements. CEPT member states generally require operators to clear outstanding financial obligations before surrendering spectrum.

**Q12. Whether there is a need to prescribe timelines for processing the applications for the assignment of frequency spectrum for- (c) NGSO based Fixed Satellite Services for providing data communication and Internet services; (d) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response with justifications.**

**Comments**

Yes, there is a need to prescribe timelines for processing applications for the assignment of frequency spectrum. Reasons for the same are appended below:

Promoting Efficiency and Planning for the operators.

Ensuring Market Competitiveness and Innovation.

Facilitating Efficient Spectrum Management.

Promoting transparency among all the stakeholders.

Conforming with International Practices.

**International practices:**

**US:** The FCC prescribes a fixed timeline for processing spectrum applications i.e within 6 to 12 months.

**European Union:** CEPT emphasizes a timeline of 6 to 9 months for reviewing and assigning satellite spectrum, focusing on transparency and procedural efficiency.

**Q13. Whether there are any other suggestions related to assignment of spectrum for- (a) NGSO based Fixed Satellite Services for providing data communication and Internet services; (b) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, and Internet services? Please provide a detailed response with justifications.**

**Comments**

**Some of the suggestions/recommendations are appended below:**

Spectrum Coordination.

Maintaining transparency in allocation of spectrum.

Ensuring rural area coverage.

Optimum utilisation of resources.

Innovation and utilising the existing infrastructure to the max possible.

Utilising the resources in shared manner to reduce the number of gateways.

Promoting Workable policy.

Enhancing spectrum coordination.

**Q14. Should spectrum charges for NGSO-based FSS providing data communication and Internet services, be levied: i. On a per MHz basis, ii. On a percentage of Adjusted Gross Revenue (AGR) basis, or iii. Through some other methodology? Please provide a detailed justification for your answer.**

**Comments**

The best approach for levying spectrum charges for NGSO-based FSS providing data communication and Internet services is a hybrid model that incorporates:

A base charge per MHz to replicate the spectrum held by the operator.

A variable charge as a lower percentage of AGR to align the cost with revenue and ensure fairness.

This hybrid approach promotes efficient spectrum use, ensures flexibility for operators.

**Q15. In case it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a per MHz basis, should these charges be calculated based on: i. The Department of Telecommunications (DoT) order dated December 11, 2023, or ii. An alternative approach (please specify)? Please provide a detailed justification to support your answer**

**Comments**

A tailored, flexible pricing approach based on service characteristics, coverage, and usage is recommended to maximize the efficiency and effectiveness of NGSO-based FSS operations.

**Q16. If it is decided that spectrum charges for NGSO-based FSS providing data communication and Internet services should be levied on a percentage of AGR basis: i. What should be the appropriate percentage of AGR? ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge? iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization? Please provide a detailed justification for your answers.**

**Comments**

In countries like the United States, spectrum fees for satellite services are minimal or calculated as a nominal administrative fee.

For NGSO-based FSS, an AGR percentage between 1% to 3% should be considered reasonable.

Also to ensure utilisation of the spectrum and avoid under underutilisation by any entity some annual fixed charges per MHz should be levied.

**Q17. Considering the Adjusted Gross Revenue (AGR) based charging methodology currently followed for Commercial VSAT and in view of the enhanced scope of the Satellite service authorisation, what should be the spectrum charge, as a percentage of AGR, that should be levied on GSO-based FSS? Or, Should some alternative spectrum charging methodology be used for determining spectrum charges for GSO-based FSS? Please provide a detailed justification for your answer.**

### **Comments**

AGR methodology is currently used in India. It involves charging operators a percentage of their Adjusted Gross Revenue (AGR), which is a fixed percentage of operators earning. The same may be applied on GSO-based FSS. The percentage levied on commercial VSAT is approximately 1-2%. This is a reasonable figure as it incentivise the operator for expanding its services.

**Q18. Should spectrum charges for GSO and NGSO-based MSS that provide voice, text, data, and Internet services be levied: i. On a per MHz basis, ii. On a percentage of AGR basis, or iii. Through some other methodology? Please provide a detailed justification for your answer**

### **Comments**

Hybrid model may be explored to levy charges which includes both the per MHz basis as well as percentage of AGR basis.

Per MHz ensures that a operator pays for the entire band of spectrum he possess and also utilises it optimally while AGR percentage accounts for revenue differences.

This practice discourages operator from holding the spectrum without utilisation.

**Q19. If it is determined that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a per MHz basis, should these charges be calculated based on: i. The Department of Telecommunications (DoT) order dated December 11, 2023, or ii. An alternative approach (please specify)? Please provide a detailed justification to support your answer**

### **Comments**

The DoT order dated December 11, 2023, gives out a framework for calculating spectrum charges based on frequency bands, satellite type, service area, or the mode of services (voice, text, data, or Internet). This is a comprehensive, aligns with the global standards and it might serve as a standardised mechanism.

Some of the advantages are:

Existing policies make it easier for operators to comply.

It's a clear policy and reduces the ambiguity and enhances transparency.

This policy considers the Indian market needs while aligning itself with the global standards.

**Q20. If it is decided that spectrum charges for GSO/NGSO-based MSS providing voice, text, data, and Internet services should be levied on a percentage of AGR basis: i. What should be the appropriate percentage? ii. Should a minimum spectrum charge be specified to address the issue of inefficient utilization of spectrum? If yes, what methodology may be used to determine the amount of the minimum spectrum charge? iii. Is there an alternative approach that could be followed to address the issue of inefficient spectrum utilization? Please provide a detailed justification for your answers.**

### **Comments**

Spectrum is a very potent resource, so it should be ensured that such resource should be utilised with optimum potential. When the spectrum is allocated to a particular entity it should be ensured that it is being used in the best possible manner. Apropos spectrum should be charged accordingly. Some of the suggestions for charging the spectrum are as given below:

**Percentage of AGR:** A rate of 1% to 3% strikes a balance between revenue generation and promoting investment in MSS.

**Minimum Spectrum Charge:** A charge equal to around 30% of the average market value per MHz should be considered.

**Q21. Whether there are any other issues/suggestions relevant to the spectrum charging for: i. NGSO/GSO based FSS providing data communication and Internet services. ii. NGSO/GSO based MSS providing voice, text, data, and Internet services. The response may be submitted with proper explanation and justification.**

### **Comments**

Transparency in allocation of spectrum must be ensured.

Absorption of new technology as well as new players in the market should be encouraged.

As far as possible policies should be aligned with the global standards to ensure standardisation.

