CONSUMER PROTECTION ASSOCIATION
HIMMATNAGAR
DIST. : SABARKANTHA
GUJARAT

Comments on

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

Introduction :

We are thankful to TRAI for bringing up such type of consultation Paper. The "Terms and Conditions for the Assignment of Spectrum for Certain Satellite-Based Commercial Communication Services" are important for consumers in several ways:

1. Access to High-Speed Connectivity

Satellite-based communication services provide internet access in remote or underserved areas where traditional infrastructure (like fiber-optic cables or cell towers) is not feasible. These terms ensure that consumers in rural or geographically isolated areas have access to communication services, potentially reducing the digital divide.

2. Enhanced Service Quality

These regulations may influence the quality and reliability of satellite communication services. Ensuring that spectrum is allocated and managed properly helps avoid signal interference and ensures that consumers receive uninterrupted and high-quality service.

3. Consumer Choice and Competition

The terms and conditions governing spectrum assignment can foster competition among satellite service providers. Healthy competition often leads to better services, innovation, and lower prices for consumers. By regulating spectrum allocation fairly, the government prevents monopolies and encourages diverse service options.

4. Affordability

Spectrum assignment policies can impact the costs of satellite-based services. If the terms include provisions that make spectrum affordable for companies, these savings may be passed on to consumers in the form of lower subscription rates, especially in competitive markets.

5. Fair Usage and Data Privacy

Some terms might specify consumer protection standards, such as fair usage policies, data privacy rules, and network security. These provisions are vital to safeguarding consumer interests, ensuring that personal data is handled responsibly, and preventing the exploitation of bandwidth.

6. Expansion of Services (5G and IoT)

Spectrum allocation for satellite-based services can also support the expansion of emerging technologies, such as 5G networks and the Internet of Things (IoT). Consumers would benefit from improved connectivity for smart devices, better integration with modern applications, and faster internet speeds.

7. Disaster Management and Emergency Services

Satellite communications play a critical role during natural disasters or emergencies when ground-based networks may be damaged. Ensuring the proper allocation of spectrum to satellite services can help enhance disaster preparedness, ensuring that consumers can access emergency communication services when needed.

8. Environmental and Regulatory Impact

These terms could also contain clauses related to the environmental impact of launching and maintaining satellite constellations, which indirectly affect consumers by promoting sustainable practices within the satellite industry.

In summary, the "Terms and Conditions for the Assignment of Spectrum" influence service availability, quality, competition, and affordability, while also ensuring fair treatment of consumers and fostering technological growth. The overall goal is to create a balanced and competitive market that benefits end-users.

Issues for Consultation :

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.

Comments : No Comments.

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.

Comments : No Comments.

Q.3 What should be the maximum period of assignment of spectrum for – (c) NGSO based Fixed Satellite Services for providing data communication and Internet services, and

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

Please provide a detailed response along with international practice in this regard.

Comments : No Comments.

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.

Comments : No Comments.

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 along with international practice in this regard.

Comments : No Comments.

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–

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

(d) Between the gateways of NGSO systems?

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

Comments : Yes.

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 along with international practice in this regard.

Comments :

When spectrum is shared between satellite gateway links and terrestrial networks such as Fixed Service or IMT, careful planning is essential to avoid interference. Proper protection measures, such as defining minimum separation distances or setting interference thresholds, are critical in ensuring the services can coexist without significant issues. Let me break down the key points:

Protection Measures to Avoid Interference:

1. **Minimum Separation Distance**:
    - A minimum separation distance is used to keep satellite gateways and terrestrial stations (e.g., base stations or towers) physically far enough apart to minimize mutual interference. The

distance depends on the frequency, power levels, terrain, and other factors.

2. **Power Flux Density (PFD) Limits**:
    - Setting limits on the Power Flux Density ensures that signals from either the terrestrial or satellite systems do not interfere with each other. PFD limits are used to define how strong a signal can be when reaching the service area of the other network.
3. **Coordination Zones**:
    - TRAI may define coordination zones around satellite gateways where terrestrial networks need permission to operate or where interference mitigation measures are applied.
4. **Interference Criteria**:
    - **Interference-to-Noise Ratio (I/N)**: Ensuring that interference remains below a certain threshold relative to the noise level helps maintain service quality. Typically, the I/N ratio is kept below a threshold like -6 dB to ensure no significant impact.
5. **Frequency Coordination**:
    - Coordination agreements between satellite and terrestrial services can help prevent harmful interference. In some cases, time-sharing or adaptive power control can also be implemented.
6. **Antenna Orientation and Polarization**:
    - Proper alignment and cross-polarization of antennas can help minimize interference when using overlapping frequency bands.

Impact on Consumers and Consumer Services:

1. **Service Quality Issues**:
    - If proper protection measures aren't enforced, interference between satellite gateways and terrestrial networks can lead to degraded service quality. For terrestrial networks (like mobile services), interference could mean slower data speeds, dropped calls, or reduced coverage.
2. **Harmful Interference**:
    - Harmful interference is any interference that seriously degrades or disrupts the intended service. This could affect both satellite services (e.g., signal drop in the satellite gateway) and terrestrial services (e.g., poor network quality for mobile users).
3. **Mitigation Strategies**:
    - Proper coordination, spectrum planning, and adherence to established interference criteria are vital to minimize the risk of harmful interference. If these measures are well-planned and implemented, interference risks are significantly reduced, resulting in no adverse effects on consumers.

In summary, sharing spectrum between satellite and terrestrial networks requires clear protection criteria and interference mitigation strategies in the terms and conditions of spectrum assignments. When properly implemented, these measures should prevent harmful interference, thereby protecting the quality of service for consumers. However, without adequate protection, there is a risk that consumers may experience degraded service quality, which could be detrimental to both satellite-based and terrestrial communications services.

To avoid interference between satellite gateway links and terrestrial networks (such as Fixed Service, IMT, etc.) when they share the same spectrum, a protection distance or interference criterion needs to be established. Generally, the key considerations are:

1. Minimum Separation Distance:

- A minimum separation distance should be established between the terrestrial stations and satellite gateway stations. This distance is usually calculated based on a detailed radio frequency (RF) propagation model that takes into account factors such as frequency, terrain, antenna height, and transmission power.

2. Power Flux Density (PFD) Limits:

- Power Flux Density limits can be set to ensure that emissions from either terrestrial or satellite stations do not cause harmful interference. These limits ensure that the signal received at a certain distance is below a level that could interfere with the other service.

3. Coordination Zones:

- Coordination zones can be defined around the satellite gateway to ensure no terrestrial stations operate within that zone without coordination. These zones are determined based on path loss models to prevent interference.

4. Co-Channel and Adjacent Channel Interference Analysis:

- To minimize interference, the co-channel and adjacent channel interference must be analyzed, and acceptable thresholds need to be determined for each case.

5. Frequency Coordination Agreements:

- Where possible, coordination agreements with terrestrial service providers should be in place to manage spectrum sharing. Such agreements specify the procedures for preventing harmful interference, including adjustments in power levels, changes in antenna orientation, and agreements on usage times.

6. Interference-to-Noise Ratio (I/N) Criterion:

- An I/N ratio is often used as a criterion to establish whether the interference level is acceptable. For example, the interference level should be less than a certain dB threshold (e.g., -6 dB) relative to the noise level to ensure minimal impact on the receiver.

7. Use of Cross-Polarization:

- If the same frequencies are assigned for both satellite and terrestrial systems, the use of cross-polarization can help to reduce interference.

8. Monitoring and Mitigation Procedures:

- Continuous monitoring can be required to detect and mitigate any interference. This might include a mechanism for spectrum sharing based on time or dynamic spectrum access techniques.

The exact values for separation distance, PFD limits, or I/N ratios depend on specific frequency bands, technology, regulatory guidelines, and the propagation environment. These measures need to be incorporated into the terms and conditions of the spectrum assignment by the regulatory body to ensure coexistence without harmful interference.

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 along with international practice in this regard.

Comments :

When the spectrum assigned for satellite user links is also shared with terrestrial networks like Fixed Service, the terms and conditions for spectrum assignment need to include specific interference mitigation criteria to protect the quality of service for consumers. Here are the important criteria that should be incorporated:

1. Minimum Separation Distance

- A minimum distance between terrestrial transmitters and satellite terminals should be defined to prevent direct interference. The specific distance depends on the frequency, power levels, and terrain

characteristics. Regulatory bodies should determine these distances based on propagation studies.

2. Power Flux Density (PFD) Limits

- **Power Flux Density Limits** should be set for satellite user terminals to ensure their emissions do not interfere with terrestrial networks, and vice versa. These PFD limits are critical to managing the amount of signal that reaches unintended receivers.

3. Protection Zones

- **Protection zones** around sensitive locations (such as Fixed Service transmitters or satellite earth stations) should be established to limit overlap and mitigate potential interference. In these zones, the use of certain frequencies may be restricted or carefully coordinated.

4. Frequency Coordination and Dynamic Spectrum Management

- Spectrum sharing must be well-coordinated between satellite and terrestrial services. Dynamic spectrum access techniques, such as **cognitive radio** or **geolocation databases**, could be used to allow shared access while avoiding interference. Coordination agreements between operators help ensure no overlap during simultaneous operation.

5. Power Control and EIRP Limitations

- Both satellite and terrestrial transmitters should have restrictions on the **Effective Isotropic Radiated Power (EIRP)** to reduce the risk of interfering signals. Power control mechanisms can also adjust transmission power based on real-time conditions to avoid interference.

6. Cross-Polarization and Antenna Specifications

- To reduce interference, **cross-polarization** can be applied for shared frequencies. Additionally, strict requirements on **antenna directivity** and beam shaping should be enforced to minimize spill-over into areas where terrestrial services operate.

7. Interference-to-Noise Ratio (I/N) Criteria

- The **I/N ratio** is a measure used to ensure interference is within acceptable limits relative to the noise level. Setting an acceptable I/N threshold (e.g., -6 dB) is critical for minimizing the impact on service quality.

8. User Equipment Filtering

- **Advanced filtering** in both terrestrial and satellite user equipment can help mitigate the impact of nearby transmissions in shared frequency bands. This ensures that both satellite and terrestrial receivers can operate effectively without degrading consumer service quality.

9. Coordination Procedures and Complaint Resolution Mechanism

- An **effective coordination procedure** should be established to resolve interference issues if they arise. This includes having clear channels for handling consumer complaints, quick identification of sources of interference, and mechanisms for mitigating these issues promptly.

10. Spectrum Usage Restrictions for High-Density Areas

- In **high-density areas** where terrestrial networks are heavily used, restrictions may be placed on satellite user links operating in certain frequencies to reduce congestion and interference potential.

Consumer Benefits from These Measures:

1. **Maintained Service Quality**: By enforcing PFD limits, EIRP limitations, and separation distances, both satellite and terrestrial users benefit from consistent service quality without experiencing degradation due to interference.
2. **Increased Spectrum Efficiency**: Dynamic spectrum sharing and coordination procedures ensure that spectrum is used efficiently, which ultimately benefits consumers through better coverage, improved data rates, and fewer service disruptions.
3. **Lower Costs**: Effective interference management can reduce the need for additional infrastructure or mitigation measures, potentially lowering costs for both satellite and terrestrial service providers—savings that can be passed on to consumers.

4. **Minimized Disruptions**: With proper complaint resolution mechanisms, any interference issues that do arise can be quickly addressed, leading to minimal service interruptions for consumers.

Conclusion:

The terms and conditions for assigning shared spectrum should include minimum separation distances, PFD limits, interference criteria, coordination procedures, power control, antenna specifications, and filtering requirements to prevent interference. When these measures are effectively implemented, they help maintain a high quality of service for both satellite and terrestrial consumers, ensuring reliable and efficient communication services.

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 along with international practice in this regard.

Comments :

Yes, prescribing conditions to mitigate the risk of scarcity of satellite gateway sites is important, especially as the demand for satellite-based communication increases. Here are some measures and conditions that could be implemented to address this risk:

1. Site Sharing and Co-location

- **Co-location** of satellite gateway sites can be encouraged, where multiple satellite operators share the same gateway infrastructure.

This reduces the need for new gateway sites and optimizes the use of available resources.

- **Incentives** could be provided for operators to share existing sites, reducing duplication and promoting efficient use of space and infrastructure.

2. Efficient Spectrum Use

- Regulatory bodies can impose conditions on **spectrum efficiency** to ensure that gateway sites utilize spectrum optimally. By encouraging **frequency reuse** and advanced technologies like beamforming, more capacity can be supported with fewer gateway sites.

3. Flexible Licensing Policies

- Flexible licensing policies can be implemented that permit **dynamic spectrum sharing** and adaptive network configurations. This helps accommodate more satellite services without the need for new physical sites.

4. Alternative Technologies

- Encourage the use of **Virtual Network Functions (VNF)** and **cloud-based gateways** to reduce dependence on physical infrastructure. Leveraging software-defined networking (SDN) could also mitigate the need for new physical satellite gateway sites.

5. Geographical Diversity Planning

- To prevent clustering in high-demand areas, regulations could enforce **geographical diversity** in gateway site deployment. This ensures a balanced distribution of sites, which not only avoids scarcity in specific regions but also adds resilience to the network by diversifying locations.

6. Access to Strategic Locations

- Provide access to **government or public land** for satellite gateway infrastructure, especially in areas where land is scarce. Public-private partnerships (PPP) could help secure strategic locations for gateways without relying solely on the open market, which might be limited.

7. Use of Unmanned or Remote Areas

- Regulations could support the use of **remote areas** for gateway sites where land and interference conditions are less of a concern. Providing subsidies or easing administrative requirements for developing infrastructure in these areas could mitigate scarcity.

8. Promoting Smaller and Low-Power Gateways

- The development of smaller, **low-power gateways** that can be easily deployed in a variety of locations, including rooftops and other existing infrastructure, could alleviate the scarcity of large physical sites.

9. Gateway Site Database and Coordination Mechanism

- Establish a **centralized database** that tracks all available and potential gateway sites to prevent overlap and to assist new operators in finding suitable locations.
- Implement a **coordination mechanism** that allows operators to negotiate site sharing agreements, ensuring that resources are efficiently used and that the available sites are not monopolized by a few entities.

10. Regulations on Site Reservation

- Conditions could be set to prevent **speculative reservation** of satellite gateway sites by operators who do not intend to use them within a reasonable timeframe. Requiring a **use-it-or-lose-it** clause would help ensure that valuable site resources are not wasted.

Benefits of These Measures:

- **Efficient Utilization**: By encouraging site sharing and alternative technologies, the available sites can be used more efficiently, helping to prevent scarcity.
- **Reduced Costs**: Shared infrastructure means reduced capital and operational expenses, benefiting operators and ultimately the end users.
- **Enhanced Resilience**: Geographical diversity planning ensures that the satellite network is more resilient to failures, benefiting service continuity for consumers.

- **Improved Accessibility**: Making public lands available and promoting the use of remote areas make it easier to find suitable locations for new gateways.

Conclusion:

Prescribing conditions like site sharing, flexible licensing, geographical diversity, and alternative technologies is crucial to mitigate the risk of scarcity of satellite gateway sites. These conditions can lead to more efficient use of resources, lower costs, and better resilience, helping to address the increasing demand for satellite communications.

To mitigate the risk of scarcity of satellite gateway sites, international practices focus on a combination of site-sharing initiatives, efficient use of infrastructure, regulatory flexibility, and technology advancements. Here are key international practices:

1. Co-location and Site Sharing

- **Co-location of Satellite Gateways**: Countries like Australia and the United States encourage satellite operators to co-locate their gateways on existing infrastructure. By sharing facilities, multiple satellite systems can use the same physical gateway site, reducing the need for new sites and optimizing the use of land and resources.
- **Regulatory Support for Site Sharing**: Regulatory authorities in Europe and North America often promote **voluntary site sharing agreements** to ensure efficient usage of existing infrastructure.

Policies may include incentives or priority access for operators who co-locate with others.

2. Flexible Spectrum Licensing

- **Dynamic Spectrum Access**: Many countries, including the United States through the Federal Communications Commission (FCC), use flexible licensing that allows spectrum to be dynamically allocated based on real-time demand. This approach helps reduce the pressure on gateway sites by enabling more efficient use of spectrum.
- **Frequency Coordination**: In Europe, frequency coordination mechanisms are enforced by the **European Conference of Postal and Telecommunications Administrations (CEPT)** to reduce competition for physical sites by coordinating frequency use to avoid interference.

3. Use of Remote or Less Populated Areas

- **Deployment in Remote Locations**: In countries like Canada and Australia, satellite gateways are often placed in remote areas where there is less demand for land and minimal risk of interference from terrestrial systems. Regulatory bodies often incentivize the development of gateways in rural or less densely populated areas by simplifying administrative requirements and reducing costs.

4. Public-Private Partnerships (PPP)

- **Access to Government Land**: The United States and European countries have utilized public-private partnerships, allowing satellite operators to access government-owned or controlled land for gateway deployment. This helps mitigate scarcity by making strategic locations available without market competition.
- **Strategic Partnerships**: Countries like India, through ISRO, have formed partnerships with private entities to share gateway facilities, thus reducing the need for additional site infrastructure.

5. Virtual and Cloud-Based Gateways

- **Virtual Network Functions (VNFs)**: In the U.S. and Europe, satellite operators are increasingly utilizing cloud-based and software-defined gateways, which reduce the need for physical infrastructure. Operators such as OneWeb and SpaceX's Starlink have implemented **virtualized gateway systems** to manage satellite data through cloud infrastructure.
- **Software-Defined Networking (SDN)**: SDN is used to allow greater flexibility and to aggregate functions of multiple gateway sites, further reducing dependence on physical locations.

6. Advanced Antenna Technologies

- **Beamforming and Phased Array Antennas**: Globally, satellite operators are adopting advanced antenna technologies, such as beamforming and phased arrays, to concentrate signal strength

without needing multiple gateways. These technologies improve spectral efficiency, reducing the need for new gateway sites.

7. Database and Site Coordination

- **Centralized Gateway Site Database**: Europe and the U.S. use centralized databases that track available and occupied gateway sites. These databases facilitate coordination and sharing between satellite operators, reducing the likelihood of overlapping applications and ensuring efficient site use.
- **Harmonized Licensing and Coordination through ITU**: The **International Telecommunication Union (ITU)** helps countries coordinate satellite gateway site licensing internationally, minimizing interference and ensuring efficient use of available locations. The ITU plays a critical role in ensuring that gateway placements are harmonized to avoid clustering that could lead to site scarcity.

8. Leasing Unused Capacity

- **Gateway Site Leasing Agreements**: Countries in Asia and Africa have promoted **leasing unused capacity** at existing gateway sites to other operators, thereby reducing the need for new infrastructure. Operators can lease site access rather than investing in entirely new facilities.

9. Regulation on Exclusive Use Restrictions

- **Preventing Monopolization**: In some countries, regulatory frameworks prevent a single operator from monopolizing a strategic site. For example, the European Union encourages **open access to strategic gateway sites**, reducing the chances that any one operator can reserve and underutilize valuable locations.

10. Financial Incentives for Efficient Use

- **Tax Incentives or Reduced Licensing Fees**: Some countries, such as Australia, offer financial incentives like reduced fees or tax benefits for operators that use shared or co-located gateway sites. These incentives encourage efficient use of limited infrastructure and reduce the risk of scarcity.

Summary:

International practices to mitigate the scarcity of satellite gateway sites include:

- **Co-location and site sharing** to optimize existing resources.
- **Flexible spectrum licensing** and dynamic spectrum access.
- **Use of remote areas** for gateway deployment with fewer land and interference constraints.
- **Public-private partnerships** to make government-controlled land available.
- **Virtual and cloud-based solutions** to reduce dependency on physical sites.

- **Centralized databases and coordination** to avoid overlaps and facilitate sharing.
- **Regulatory incentives** to encourage efficient site use and prevent monopolization.

These practices, when implemented effectively, help ensure the efficient use of satellite gateway sites, minimizing the risk of scarcity while supporting the growth of satellite-based communication services globally.

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 –

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

Comments : Yes.

In addition to the rollout conditions recommended by the Telecom Regulatory Authority of India (TRAI) for satellite-based Telecommunication Service Authorization, it may be necessary to impose additional rollout obligations specifically for assigning frequency spectrum for Non-Geostationary Satellite Orbit (NGSO) based Fixed Satellite Services (FSS),

especially for providing data communication and Internet services. These additional conditions would help ensure effective service delivery, proper infrastructure deployment, and efficient utilization of assigned spectrum. Here are some additional rollout obligations that could be imposed:

1. Minimum Coverage Requirements

- **Broad Coverage Targets**: Obligations could be set for achieving a minimum level of coverage, especially in underserved and rural areas. This ensures that the NGSO-based services prioritize connectivity in areas that lack traditional terrestrial infrastructure.
- **Specific Geographical Coverage Metrics**: Require operators to provide a specific percentage of coverage (e.g., at least 90%) across targeted regions within a defined timeframe to guarantee widespread access to satellite-based services.

2. Quality of Service (QoS) Standards

- **Minimum Data Rates and Latency Targets**: Operators could be required to meet certain **minimum data rate** and **latency requirements** to ensure reliable internet and data services. Since NGSO satellites inherently offer lower latency than traditional geostationary systems, operators should be obligated to maintain low-latency standards.
- **Performance Reporting**: Mandatory **periodic reporting** on key QoS metrics such as data throughput, availability, and latency would ensure compliance with quality standards.

3. Service Availability and Resilience

- **Minimum Uptime Requirements**: Obligations could require operators to guarantee a **minimum uptime** (e.g., 99.9%) to ensure reliable service availability. This is particularly crucial for providing internet services in remote regions where reliability is essential.
- **Backup and Redundancy**: Operators should be required to implement **redundancy** and **backup systems** to maintain continuity in case of satellite failure. This includes measures to reroute traffic through other satellites in the constellation if any satellite goes offline.

4. Timeline for Deployment

- **Phased Rollout Schedule**: Define a **phased rollout timeline** with clear milestones for coverage and service availability. This helps prevent delays and ensures timely infrastructure development and service rollout.
- **Penalties for Non-Compliance**: Introduce penalties for not meeting rollout milestones or service availability targets to ensure operators adhere to their deployment commitments.

5. Spectrum Efficiency and Utilization Requirements

- **Efficient Spectrum Use Obligations**: Operators should demonstrate **efficient use of the assigned spectrum**. This could include meeting minimum spectral efficiency targets and utilizing adaptive modulation techniques to ensure spectrum is used optimally.

- **Dynamic Spectrum Sharing**: Encourage dynamic or shared use of spectrum where feasible, to enhance spectrum utilization and ensure coverage in underserved regions.

6. Interference Mitigation and Coordination

- **Interference Coordination Obligations**: Given the increased use of LEO and MEO satellites, operators should be required to coordinate with other satellite systems to prevent interference. **Interference mitigation mechanisms** should be clearly documented and submitted to the relevant authorities.
- **Regulatory Compliance**: Operators must comply with **international regulations** such as those prescribed by the **International Telecommunication Union (ITU)** to manage interference, orbital debris, and collision risks.

7. Consumer Protection Measures

- **Affordable Pricing in Rural Areas**: Given that NGSO-based services are intended to bridge the digital divide, operators could be required to offer **affordable pricing** for services in rural and underserved areas. Obligations could include offering plans that are economically feasible for low-income households.
- **Service Level Agreements (SLAs)**: Clear SLAs should be provided to end-users, detailing minimum data speeds, latency, uptime, and compensation in case of service outages.

8. Support for Public and Emergency Services

- **Provision for Public Institutions**: NGSO operators could be required to provide connectivity to **public institutions** (schools, healthcare centers, government offices) in underserved areas as part of their rollout obligations.
- **Emergency Services Support**: Ensure that satellite operators can provide connectivity for **emergency services** during natural disasters or other crises. This includes having bandwidth reserved for emergency communication purposes when needed.

9. Domestic Gateway Deployment

- **Domestic Gateway Obligation**: Operators should be required to establish **domestic gateway infrastructure** to ensure better control, latency reduction, and adherence to regulatory requirements. Domestic gateways also help in handling data in compliance with data localization requirements.
- **Interconnection and Redundancy**: Mandate **interconnection** between different gateways within the country for redundancy and increased resilience of the network.

10. Monitoring and Reporting Obligations

- **Regular Rollout and Performance Reporting**: Operators should provide **regular progress reports** on their rollout efforts and service quality metrics. This will help the regulator ensure compliance and track the progress of services being rolled out.

- **Regulatory Audits**: Routine audits by the regulator to verify that operators comply with their obligations, including coverage, quality, pricing, and infrastructure deployment.

11. Environmental and Safety Compliance

- **Environmental Impact Assessment**: Require operators to conduct **environmental assessments** related to the deployment of ground stations and gateways. The impact of gateway installations, particularly in ecologically sensitive areas, should be minimized.
- **Orbital Debris Mitigation**: Obligations to implement an **orbital debris mitigation plan** to ensure that satellite constellations are managed responsibly, including end-of-life procedures to avoid adding to space debris.

12. Local Employment and Skill Development

- **Local Workforce Involvement**: Obligations to involve the **local workforce** in the deployment and maintenance of satellite infrastructure can contribute to regional employment. Operators may be encouraged to **train local personnel** for operating and maintaining ground facilities.

Conclusion:

To effectively deploy NGSO-based Fixed Satellite Services and provide data and internet services, it is essential to impose additional rollout obligations alongside those recommended by TRAI. These could include coverage

requirements, QoS standards, deployment timelines, efficient spectrum utilization, coordination to prevent interference, consumer protection measures, support for public and emergency services, domestic gateway deployment, monitoring, and reporting obligations, environmental compliance, and promoting local employment. These obligations would help ensure that NGSO-based satellite services are rolled out efficiently, reach underserved areas, meet quality standards, and ultimately benefit consumers by providing reliable connectivity.

International Practice :

Internationally, regulatory authorities have introduced additional rollout obligations for Non-Geostationary Satellite Orbit (NGSO)-based Fixed Satellite Services (FSS) to ensure effective use of frequency spectrum, promote broadband access, and achieve equitable service delivery for data communication and Internet services. These obligations often aim to facilitate the rapid deployment of satellite services, maintain quality standards, and ensure service availability in underserved areas. Below are some international practices for NGSO-based FSS:

1. Coverage Obligations

- **Global and Regional Coverage Targets**: Many regulators, such as the **United States Federal Communications Commission (FCC)** and **European Conference of Postal and Telecommunications Administrations (CEPT)**, impose **coverage requirements** that compel NGSO satellite operators to provide wide geographic coverage,

including areas where traditional fiber or terrestrial wireless infrastructure is not economically viable. Operators must achieve either global or regional coverage, ensuring connectivity to underserved populations.

- **Rural and Remote Area Focus**: In countries like **Australia**, the obligations specifically prioritize coverage in **remote and rural areas**. This ensures that NGSO-based FSS services are extended to regions where other forms of connectivity are unavailable or inadequate.

2. Service Availability and Reliability Requirements

- **High Availability Standards**: Regulators such as **Ofcom** (United Kingdom) and **FCC** (United States) mandate high availability levels (e.g., **99.5% or higher**) to ensure that NGSO constellations provide consistent service quality. This is crucial for Internet and data communication, particularly in regions that rely solely on satellite-based connectivity.
- **Redundancy and Back-Up Systems**: To guarantee service continuity, NGSO operators are often required to deploy **redundant gateway infrastructure** and have backup systems to prevent downtime due to satellite or gateway issues.

3. Phased Rollout and Timeline Requirements

- **Milestone-Based Rollout Schedule**: In the **United States**, the FCC imposes milestone requirements that require operators to deploy and have a certain percentage of their constellation operational by set

deadlines. For example, a defined portion of satellites must be in orbit and operational within a specified time frame to ensure timely availability of services.

- **Coverage Timelines for Rural Areas**: Countries like **Canada** set timelines for expanding coverage to rural and underserved areas, ensuring that NGSO services address digital divide concerns promptly.

4. Quality of Service (QoS) Standards

- **Minimum Data Speeds**: Obligations regarding **minimum data rates** (both uplink and downlink) are common in many countries, such as the **United States** and **European Union**. NGSO operators are required to provide a baseline level of speed to ensure acceptable quality for data and Internet services.
- **Latency Standards**: NGSO operators are often obligated to meet specific **latency benchmarks**, given that they can provide lower latency compared to GSO satellites. Latency standards ensure NGSO services can meet the needs of modern applications like video conferencing and online gaming.

5. Spectrum Utilization and Sharing Obligations

- **Efficient Spectrum Use**: The **FCC** and **CEPT** enforce spectrum efficiency requirements for NGSO operators. This includes obligations to demonstrate how efficiently the assigned spectrum is being used and employing **advanced frequency reuse techniques** to maximize utilization.

- **Spectrum Sharing Requirements**: In regions like **Europe**, NGSO operators must coordinate with terrestrial and GSO systems to enable **shared spectrum usage**, minimizing interference and optimizing the use of available frequency bands.

6. Gateway and Ground Infrastructure Requirements

- **Domestic Gateway Establishment**: In countries like **India** and **Australia**, NGSO operators are mandated to establish **domestic gateways** within the country to ensure data localization and regulatory compliance. This also reduces latency and improves service reliability for domestic users.
- **Multiple Gateways for Network Resilience**: The **FCC** in the United States encourages operators to deploy **multiple gateways** across different regions to enhance the robustness of the network. This requirement aims to minimize service disruptions due to technical issues or natural disasters affecting a single gateway.

7. Interference Mitigation and Coordination

- **Coordination with Other Services**: The **International Telecommunication Union (ITU)** requires NGSO operators to coordinate with other satellite and terrestrial operators to prevent interference. Countries like **Canada** and **Australia** adhere strictly to these guidelines, ensuring efficient use of spectrum and avoiding conflicts.

- **Inter-Satellite Coordination**: Obligations are often imposed to ensure that NGSO systems do not interfere with each other. The **FCC** requires NGSO operators to implement interference mitigation strategies, such as **beamforming** and **dynamic power control**, to minimize cross-system interference.

8. Environmental Compliance and Debris Mitigation

- **Orbital Debris Mitigation Plans**: Regulators like the **FCC** (United States) and **Ofcom** (United Kingdom) require NGSO operators to submit and adhere to **orbital debris mitigation plans**. This includes deorbiting satellites at the end of their lifecycle and avoiding the creation of space debris, which is particularly crucial for NGSO constellations due to the large number of satellites involved.
- **Safe Deorbiting Protocols**: The **ITU** encourages NGSO operators to have protocols in place for the **safe deorbiting** of satellites, ensuring the sustainability of space operations and reducing the risks associated with debris collisions.

9. Consumer Protection and Affordability Obligations

- **Affordable Service Requirements**: Regulators in countries like **Australia** and **India** require NGSO operators to provide **affordable pricing plans** for rural and underserved consumers. This is intended to bridge the digital divide and ensure that satellite services are accessible to all socio-economic segments.

- **Service Level Agreements (SLAs)**: The **FCC** mandates that NGSO operators provide **SLAs** that specify minimum performance metrics (such as speed, latency, and availability), and establish compensation mechanisms for consumers if these metrics are not met.

10. Support for Public and Emergency Services

- **Priority Connectivity for Public Institutions**: Many countries, including **Canada** and **Australia**, require NGSO operators to provide connectivity to **public institutions**, such as schools and healthcare facilities, particularly in rural areas.
- **Emergency Response Connectivity**: Regulators like the **FCC** mandate NGSO systems to prioritize **emergency communication** during natural disasters or other crises, ensuring that connectivity is available when most needed.

11. Local Employment and Economic Development Obligations

- **Local Workforce Engagement**: Some countries, such as **India**, require satellite operators to hire and train local talent for the deployment and maintenance of NGSO infrastructure, fostering local economic growth and enhancing technical expertise in the satellite communications sector.
- **Local Manufacturing Support**: In some jurisdictions, NGSO operators are encouraged to **source equipment locally** or collaborate with domestic manufacturers, which supports the local economy and reduces reliance on imported technology.

Summary:

International practices for imposing additional rollout obligations on NGSO-based Fixed Satellite Services typically include:

1. **Coverage obligations** with a focus on underserved areas and specific timelines for reaching coverage targets.
2. **Service availability and reliability requirements** with high availability standards and redundancy measures.
3. **Milestone-based rollout schedules** to ensure timely deployment.
4. **Quality of Service (QoS) standards** including minimum data speeds and latency targets.
5. **Spectrum efficiency and sharing requirements** to optimize the use of assigned frequencies.
6. **Domestic gateway establishment** and multiple gateway deployment for improved service resilience.
7. **Interference mitigation and coordination** with other satellite and terrestrial services.
8. **Environmental compliance and debris mitigation** to ensure sustainable space operations.
9. **Consumer protection and affordability measures** to ensure access for underserved communities.
10. **Support for public institutions and emergency services** to provide connectivity in times of need.
11. **Local workforce and economic development obligations** to promote local participation and support the economy.

These practices help ensure that NGSO-based Fixed Satellite Services are effectively deployed to provide reliable, affordable, and high-quality Internet and data communication services, particularly in underserved areas where traditional telecommunications infrastructure is insufficient.

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

Comments : Yes.

Imposing additional rollout obligations for the assignment of frequency spectrum for Geostationary Orbit (GSO) and Non-Geostationary Orbit (NGSO) based Mobile Satellite Services (MSS) is essential to ensure efficient deployment, service quality, and the expansion of voice, text, data, and Internet services, especially in underserved areas. Below are some additional rollout obligations that could be considered:

1. Minimum Coverage Requirements

- **Nationwide Coverage Obligations**: Operators should be required to ensure nationwide coverage, focusing on remote and underserved areas, as a condition for MSS frequency spectrum assignment. This is especially important for GSO and NGSO systems that are capable of covering large geographical regions.
- **Coverage Targets**: Define specific percentage-based coverage targets (e.g., 95% of the population or geographical area) within specified timelines, ensuring that all regions, including rural and remote locations, are served effectively.

2. Quality of Service (QoS) Standards

- **Minimum Data Rates**: Set obligations for providing minimum data speeds to end-users, ensuring acceptable service levels for voice, text, data, and Internet services, regardless of the satellite constellation used (GSO or NGSO).
- **Latency and Signal Availability Requirements**: MSS operators should be required to meet **maximum latency standards** and ensure high **signal availability** (e.g., 99.9%) to maintain consistent service quality, especially in rural areas.
- **Service Performance Reporting**: Regular reporting on key QoS parameters, such as call drop rates, data throughput, and service latency, to ensure compliance with established quality standards.

3. Deployment Timelines

- **Phased Rollout Obligations**: Operators should adhere to a **phased rollout schedule** that includes specific milestones for the provision of services. These milestones could be set to include population centers and remote locations to ensure balanced and efficient deployment.
- **Penalties for Delay**: Introduce penalties for delays in meeting rollout targets to ensure operators are incentivized to meet their commitments in a timely manner.

4. Service Availability and Reliability

- **High Uptime Requirements**: Operators should be obligated to maintain a minimum **service availability** level, such as 99.5% or higher, to ensure reliable service in both urban and rural settings.
- **Redundancy and Failover Systems**: To ensure continuity of services, operators should implement **redundancy and failover systems**. This is particularly relevant for NGSO constellations, which may experience periodic gaps in coverage without redundancy in place.

5. Spectrum Utilization and Efficiency

- **Spectrum Efficiency Obligations**: Establish obligations that require operators to utilize spectrum efficiently by demonstrating **spectral efficiency** through the use of technologies like adaptive coding and modulation, or frequency reuse.
- **Dynamic Spectrum Sharing**: Encourage **dynamic spectrum access** to make the most efficient use of spectrum resources, particularly in regions where multiple operators are providing MSS services.

6. Gateway and Infrastructure Development

- **Domestic Gateway Requirement**: Operators should be required to establish **domestic gateways** to handle service traffic locally. This ensures compliance with regulatory requirements and minimizes latency for voice and data services.

- **Multiple Gateways for Reliability**: Operators deploying NGSO constellations should be required to deploy **multiple gateways** across different regions to ensure redundancy and enhance service reliability, especially in case of gateway failure.

7. Interference Mitigation and Coordination

- **Interference Management Plans**: Operators should provide detailed **interference mitigation plans**, including coordination with existing satellite and terrestrial services to avoid interference and ensure efficient co-existence of systems.
- **Compliance with ITU Guidelines**: Operators must comply with **International Telecommunication Union (ITU)** guidelines to minimize interference and avoid conflicts between different satellite systems.

8. Public Safety and Emergency Services

- **Prioritization for Emergency Services**: Require operators to **prioritize network access** for emergency services in times of disaster or crisis, ensuring connectivity when other forms of communication are unavailable.
- **Support for Public Institutions**: Obligations to provide **connectivity to public institutions** (such as health centers, schools, and government offices) in rural and underserved areas would ensure MSS services contribute meaningfully to public welfare.

9. Consumer Protection Measures

- **Affordable Service Requirements**: Operators should be required to offer **affordable pricing options** to low-income consumers, especially in rural areas, ensuring universal access to MSS services.
- **Service Level Agreements (SLAs)**: Operators must provide **SLAs** that specify minimum performance metrics (such as speed, latency, and reliability) and the compensation available to consumers if these metrics are not met.

10. Monitoring and Compliance Reporting

- **Regular Rollout and Quality Reporting**: Operators should be obligated to submit regular reports to the regulator on their progress toward meeting rollout and QoS obligations. This includes details on population coverage, infrastructure deployment, and service quality metrics.
- **Regulatory Audits**: Routine audits and site inspections by regulatory authorities to verify compliance with rollout, coverage, and quality of service obligations.

11. Environmental Considerations and Sustainability

- **Orbital Debris Mitigation Plans**: Require satellite operators to implement **orbital debris mitigation measures**, ensuring safe operation of their satellite constellations and minimizing risks associated with space debris.
- **Ground Station Environmental Compliance**: Ground station installations should comply with **environmental impact**

assessment (EIA) requirements, especially in ecologically sensitive areas.

12. Support for Local Economic Development

- **Local Workforce Participation**: Obligations to engage and train the **local workforce** in the deployment and maintenance of satellite and gateway infrastructure would promote local economic development and reduce the operational costs associated with deploying MSS.
- **Promotion of Local Manufacturing**: Where possible, promote the **local production of satellite user terminals** or components to encourage industrial growth and economic participation at the national level.

Summary:

In addition to TRAI's recommended rollout conditions for satellite-based Telecommunication Service Authorization, additional rollout obligations for GSO/NGSO-based Mobile Satellite Services should include:

- **Minimum coverage requirements** with a focus on rural and underserved areas.
- **Quality of Service (QoS) standards** to ensure data speeds, low latency, and service availability.
- **Phased rollout schedules** with penalties for delays in meeting milestones.
- **Service reliability and redundancy measures** for continuous coverage.

- **Efficient spectrum utilization** with dynamic spectrum sharing and coordination.
- **Infrastructure requirements** such as domestic gateways and multiple sites for reliability.
- **Public safety and emergency service support** with priority access during disasters.
- **Consumer protection** to ensure affordability and reliability of service.
- **Monitoring, compliance reporting, and environmental obligations** to ensure sustainable service provision.

These additional obligations are designed to ensure that the assigned spectrum is effectively utilized to provide robust, reliable, and equitable mobile satellite services, particularly for voice, data, and Internet connectivity across the country, benefiting both underserved and general populations.

International practice :

Internationally, regulators have implemented various additional rollout obligations for satellite-based Telecommunication Service Authorization when assigning frequency spectrum for Geostationary Orbit (GSO) and Non-Geostationary Orbit (NGSO) based Mobile Satellite Services (MSS) to provide voice, text, data, and Internet services. These obligations aim to promote universal access, ensure service quality, and prevent misuse of spectrum. Below are some examples of practices adopted by different regions and countries:

1. Coverage Obligations

- **Global and Regional Coverage Requirements**: Regulators in regions like the **United States (FCC)** and **European Union** have set specific requirements for operators to provide a minimum level of coverage, particularly for underserved and remote areas. NGSO systems are often required to provide global or regional coverage to ensure connectivity beyond urban centers.
- **Priority Coverage Areas**: In countries like **Australia** and **Canada**, satellite operators are mandated to prioritize coverage in rural and remote locations, ensuring that MSS is utilized effectively to connect communities that lack traditional telecommunications infrastructure.

2. Quality of Service (QoS) Standards

- **Minimum Data Speeds and Latency Targets**: International practices often require operators to meet specific minimum **data rates** and **latency standards**. For example, the **FCC** in the United States requires satellite services to achieve certain minimum download and upload speeds, ensuring quality service.
- **Performance Benchmarks**: The **International Telecommunication Union (ITU)** encourages countries to adopt QoS benchmarks for satellite services, ensuring consistent service quality across different geographies, regardless of the satellite constellation used.

3. Spectrum Efficiency and Utilization Requirements

- **Spectrum Utilization Reporting**: In regions like **Europe** (under CEPT regulations) and **Asia**, operators are required to demonstrate efficient utilization of the assigned spectrum. They must periodically report to regulatory authorities regarding spectrum usage, ensuring that the frequencies are effectively utilized.
- **Shared Spectrum Policies**: Some countries, including **Japan** and **South Korea**, have adopted policies for **shared spectrum usage** to improve spectral efficiency and accommodate both GSO and NGSO satellite services without interference.

4. Service Availability and Reliability

- **Service Uptime Requirements**: **Canada's Innovation, Science, and Economic Development (ISED)** mandates satellite operators to meet minimum service availability standards, such as 99.9% uptime, to ensure reliable services, particularly for emergency and safety communication.
- **Redundancy and Failover Systems**: Regulators in countries like **Germany** require operators to maintain redundancy and failover systems to ensure continuous coverage in case of satellite or gateway failure, ensuring uninterrupted service delivery.

5. Domestic Gateway Deployment

- **Domestic Gateway Requirement**: In countries like **India** and **Brazil**, operators are required to establish **domestic gateways** to

handle service traffic locally. This helps to comply with data localization requirements and enhances service efficiency.

- **Multiple Gateways for Resilience**: The **FCC** in the United States encourages operators, particularly NGSO systems, to establish multiple gateway locations within the country to improve network resilience and maintain service reliability in case of gateway disruptions.

6. Interference Management and Coordination

- **International Coordination Obligations**: The **ITU** requires operators to comply with international coordination processes to avoid interference with other satellite or terrestrial services. Countries like **Canada** and **Australia** have strict adherence to ITU regulations, ensuring that GSO and NGSO systems coexist effectively.
- **Spectrum Coordination Agreements**: **CEPT** member states in Europe require satellite operators to reach spectrum coordination agreements with neighbouring countries and other satellite operators to prevent harmful interference, particularly in shared spectrum bands.

7. Rollout Timelines and Milestones

- **Phased Rollout Obligations**: In the **European Union**, satellite operators are given **specific milestones** for achieving coverage targets, particularly for underserved areas. They are required to reach certain percentages of coverage within specified timeframes, ensuring timely service deployment.

- **Penalties for Delays**: Countries like **Japan** and **Australia** impose financial penalties or risk revocation of licenses if operators fail to meet the rollout timelines, providing strong incentives for timely deployment.

8. Support for Public and Emergency Services

- **Public and Government Service Provision**: Many countries, including **Canada** and **Australia**, mandate satellite operators to provide connectivity to **public institutions** like schools, health centers, and government offices in underserved areas.
- **Emergency Communication Requirements**: The **United States** requires satellite operators to provide priority access for emergency services. This ensures MSS is available during natural disasters or other crises when traditional communication infrastructure is damaged or overloaded.

9. Environmental and Sustainability Compliance

- **Orbital Debris Mitigation**: The **FCC** in the United States and **Ofcom** in the United Kingdom require satellite operators to submit **orbital debris mitigation plans** to ensure the sustainability of space operations, particularly for NGSO constellations.
- **Compliance with End-of-Life Procedures**: International best practices, such as those outlined by the ITU, require operators to manage the safe deorbiting of satellites at the end of their operational life to reduce space debris.

10. Consumer Protection and Affordable Service Requirements

- **Affordable Services for Rural Areas**: **Australia** and **India** require satellite operators to offer **affordable pricing plans** for services in rural and underserved areas, ensuring that satellite services are accessible to low-income communities.
- **Service Level Agreements (SLAs)**: Regulators like the **FCC** and **ISED** require operators to provide **SLAs** specifying minimum service quality metrics, such as data speed and latency, and stipulate compensation for consumers in case of service failures.

11. Local Economic Development and Employment Support

- **Local Employment and Skills Training**: In countries like **India**, operators are encouraged to hire and train the **local workforce** to manage and maintain satellite infrastructure, promoting skill development and local economic growth.
- **Local Manufacturing and Sourcing Requirements**: Some countries also encourage the **local production of satellite user terminals** and components, promoting domestic industrial development and reducing dependence on imports.

Summary:

Internationally, the rollout obligations for GSO/NGSO-based Mobile Satellite Services typically include:

- **Coverage obligations** focused on underserved areas.

- **Quality of Service (QoS) standards** for reliable voice, data, and Internet services.
- **Spectrum utilization requirements** to ensure efficient spectrum use.
- **Service availability and reliability obligations** like high uptime and redundancy.
- **Domestic gateway requirements** to enhance service efficiency and comply with local regulations.
- **Interference management and international coordination** in line with ITU guidelines.
- **Phased rollout timelines** and penalties for delays to ensure timely deployment.
- **Support for public services** and emergency communication.
- **Environmental compliance** to mitigate orbital debris risks.
- **Consumer protection measures** like affordable pricing and SLAs.
- **Local employment support** to promote economic development.

These international practices highlight the importance of imposing additional obligations on satellite operators to ensure equitable access, high service quality, efficient spectrum use, and sustainable development in the satellite communication sector.

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 - NGSO based Fixed Satellite

Services for providing data communication and Internet services;

(c) GSO/ NGSO based Mobile Satellite Services for providing voice, text, data, 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.

Introducing a provision for surrender of frequency spectrum before the expiry of the period of validity could have several implications for NGSO (Non-Geostationary Satellite Orbit) and GSO (Geostationary Satellite Orbit) satellite services. Here are some reasons why such a provision might be beneficial:

1. **Flexibility for Service Providers**: It allows service providers who no longer need the spectrum or who face changing market conditions to relinquish it, thereby reducing ongoing costs associated with holding the spectrum.
2. **Efficient Spectrum Utilization**: The surrendered spectrum can be quickly reallocated to other entities, ensuring optimal and dynamic use of spectrum resources. With growing demand for satellite-based

communication services, making spectrum available faster could be highly beneficial.

3. **Financial Relief**: For operators struggling financially or no longer needing the spectrum, surrendering it early can offer relief from payment obligations and related fees.
4. **Facilitating Competition**: This could enhance competition by allowing new players or those needing more spectrum to access it without waiting for the original validity period to expire.
5. **Technological Evolution**: Satellite technology is rapidly evolving, and operators may need different frequencies to support new generations of satellites. The provision for surrendering spectrum helps free up resources for emerging technologies and applications.

The provision should also be designed with safeguards, such as requiring advance notice or imposing financial conditions, to prevent strategic misuse or abrupt changes in the availability of critical spectrum.

Process and Associated Terms and Conditions :

For introducing a provision for surrender of frequency spectrum for NGSO-based Fixed Satellite Services, the process and associated terms and conditions should be carefully crafted to balance flexibility for spectrum holders with ensuring efficient spectrum use. Below are some suggestions:

1. Process for Spectrum Surrender:

- **Submission of Application**:

- The spectrum holder must submit a formal request to the relevant regulatory authority, outlining the reasons for surrender and the intended timeline.
- This request must include a detailed spectrum usage report, financial status, and future operational plans, if any.

- **Review by the TRAI** :
  - The TRAI should evaluate the application to ensure it complies with all stipulated conditions. The authority should assess the potential impact on service continuity, competition, and spectrum reuse.
- **Approval and Timeline**:
  - Upon approval, the authority will issue a notice of acceptance. The spectrum will be surrendered after the stipulated notice period.

2. Associated Terms and Conditions:

a. Minimum Period of Spectrum Holding:

- **Minimum Holding Duration**: To avoid misuse, spectrum holders should be required to hold the spectrum for a minimum period (e.g., 3 to 5 years) before being eligible for surrender.
- **Rationale**: This prevents spectrum hoarding or speculative behavior, ensuring only genuine operators enter the market.

b. Notice Period:

- **Notice Period for Surrender**: The operator must provide a notice period of at least 6 to 12 months before the effective surrender date.
- **Rationale**: This ensures adequate time for regulatory bodies to make alternate arrangements for the surrendered spectrum and to minimize potential disruptions in services.

c. Surrender Fee:

- **Fee for Surrender**: A surrender fee should be imposed to discourage arbitrary surrender requests and cover administrative costs associated with spectrum reassignment.
- **Calculation of Fee**: The fee could be based on a percentage of the initial spectrum assignment cost or calculated based on the remaining period of validity (e.g., 5-10% of the remaining value).

d. Financial Settlement:

- **No Refund**: There should be no refund of spectrum auction fees paid upfront, but future spectrum usage charges could be waived post-surrender.
- **Clearing Outstanding Dues**: The spectrum holder must clear all dues related to the spectrum, including any outstanding usage charges, penalties, or other liabilities, prior to surrender.

e. Service Continuity Obligations:

- **Customer Notification**: Operators intending to surrender spectrum must notify customers in advance to ensure service continuity or provide alternate arrangements where possible.
- **Migration Plan**: A clear migration plan should be submitted to minimize disruption for existing customers.

f. Reallocation of Spectrum:

- **Spectrum Reallocation**: Once surrendered, the spectrum must be reassigned through an open, transparent process such as an auction or administrative allocation, based on market needs.
- **Priority for Reuse**: Consideration could be given to allocating surrendered spectrum to new players or those needing additional bandwidth, fostering competition.

g. Restrictions on Future Applications:

- **Moratorium on Reapplication**: The entity surrendering the spectrum may be restricted from applying for similar spectrum in the same band for a defined period (e.g., 1 to 2 years) to discourage speculative actions.

h. Regulatory Oversight:

- **Periodic Audits**: Regulators may conduct audits to ensure operators are adhering to the conditions of spectrum surrender and that there is no anticompetitive impact.

3. Safeguards Against Misuse:

- **Anti-Hoarding Clause**: Conditions should be put in place to prevent operators from hoarding spectrum only to surrender it at strategic times.
- **Operational Review**: Regulators may reserve the right to deny a surrender request if it appears detrimental to market dynamics, consumer interest, or national security.

These processes and conditions aim to balance the flexibility for spectrum holders while safeguarding optimal spectrum utilization and ensuring that market stability and consumer interests are preserved.

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.

Comments : Yes.

It would be beneficial to prescribe timelines for processing applications for the assignment of frequency spectrum for the following reasons:

(c) NGSO-Based Fixed Satellite Services (FSS) for Data Communication and Internet Services:

1. **Fostering Innovation**: NGSO (Non-Geostationary Satellite Orbit) systems are crucial for providing high-speed internet and data communication services, especially in underserved areas. Delays in spectrum assignment can hamper the rollout of such services, impeding technological advancements and investments.
2. **Competition**: Defined timelines ensure a level playing field for service providers, avoiding unnecessary delays that could favor incumbents or well-connected players.
3. **User Benefits**: Timely spectrum allocation helps in the rapid deployment of services, thereby benefiting consumers who are dependent on satellite services for reliable internet access, particularly in remote areas.
4. **Global Coordination**: NGSO satellites often involve cross-border operations. Timely allocation helps coordinate with global spectrum regulators and avoid potential interference issues.

(d) GSO/NGSO-Based Mobile Satellite Services (MSS) for Voice, Text, Data, and Internet:

1. **Critical Communications**: MSS (Mobile Satellite Services) provide essential communication in remote areas, disaster zones, and during emergencies. Delayed spectrum assignment could hinder the deployment of life-saving communication services.

2. **Avoiding Fragmentation**: Prescribed timelines reduce the risk of spectrum fragmentation, where different countries or regions allocate the same spectrum at different times, causing interference and inefficiencies.
3. **Support for 5G Integration**: With emerging technologies like 5G, integrating MSS into broader communications infrastructure is key. Clear timelines can support seamless coordination between terrestrial and satellite services.
4. **Industry Confidence**: Predictable timelines for spectrum allocation encourage investment by providing certainty to operators and reducing the risks of regulatory delays.

In both cases, setting clear timelines for processing applications will ensure regulatory efficiency, transparency, and equitable access, while fostering growth in satellite-based communication services.

International Practice :

International practices for prescribing timelines for the processing of frequency spectrum applications for satellite services, such as NGSO-based Fixed Satellite Services (FSS) and GSO/NGSO-based Mobile Satellite Services (MSS), tend to vary by country and region. However, several general trends and frameworks can be observed globally, influenced by regulatory bodies such as the **International Telecommunication Union (ITU)** and regional/national regulators.

(c) NGSO-Based Fixed Satellite Services (FSS):

1. ITU Framework:

- **Coordination and Registration**: The **ITU Radiocommunication Sector (ITU-R)** prescribes a framework for the allocation and management of frequency spectrum, including satellite services. The ITU allocates specific frequency bands for FSS and provides a timeline for countries to coordinate the use of these frequencies through their **Radio Regulations Board (RRB)**.
- **Bringing into Use (BIU) Process**: The ITU's BIU rules require that satellite networks be brought into use within 7 years of notification. This timeline includes various stages such as international coordination, publication, and final notification by the responsible national authority.
- **National Practices**: Countries such as the **United States (FCC)**, **Canada (ISED)**, and **Europe (CEPT)** often prescribe clear timelines (ranging from 6 to 18 months) for spectrum processing to ensure that the services meet international coordination requirements.

2. United States (FCC):

- The **FCC** regulates spectrum allocation for satellite services, including NGSO-based FSS. They often prescribe a **12–18 month timeframe** for processing applications, including the necessary coordination with the ITU.
- The FCC also issues public notices to provide transparency on processing timelines and encourages public input to expedite the process.

3. European Union (CEPT):

- The **European Conference of Postal and Telecommunications Administrations (CEPT)** coordinates spectrum management in the EU. A specific timeline is set for different stages of satellite service authorization, often including a consultation period of about **6 months**, followed by the spectrum assignment, depending on international coordination.

(d) GSO/NGSO-Based Mobile Satellite Services (MSS):

1. ITU-R Guidelines:

- The **ITU-R** defines similar coordination processes for GSO/NGSO-based MSS as it does for FSS. The ITU framework requires frequency notification, international coordination, and registration within a defined period (usually 7 years from notification).
- The use of MSS frequencies often involves complex coordination due to the mobile nature of services, and timelines for processing applications are influenced by ITU's global regulations.

2. United States (FCC):

- For MSS services, the **FCC** typically follows a **12-month window** for processing spectrum applications, including public consultations and coordination with international bodies like the ITU.

- In certain cases (such as for systems like Iridium and Globalstar), the FCC expedites the process due to the critical nature of MSS for emergency services.

3. Europe (CEPT):

- In the **European Union**, the **CEPT** follows similar timelines to the FCC for MSS applications. The process typically includes consultation, evaluation, and coordination stages that can last from **12 to 18 months**, depending on the complexity and scope of the application.
- **Ofcom** in the UK and **ANFR** in France also prescribe timelines within this range, often synchronized with ITU international coordination procedures.

4. Canada (ISED):

- Canada's **Innovation, Science, and Economic Development (ISED)** requires GSO/NGSO-based MSS services to undergo international coordination under ITU-R rules. Timelines for applications are aligned with these guidelines, typically taking **12–18 months** for final approval.

Summary of International Practices:

1. **ITU Guidelines**: Both NGSO-based FSS and GSO/NGSO-based MSS applications are subject to timelines governed by the ITU, typically requiring coordination within **7 years** but with certain national variations for application processing.

2. **National Regulators**:
    - **FCC (USA)**: Typically **12 to 18 months** for FSS and MSS.
    - **CEPT (Europe)**: Usually **6 to 18 months** depending on complexity.
    - **ISED (Canada)**: Typically **12 to 18 months** for both FSS and MSS.

International practices emphasize predictable timelines to promote regulatory certainty, reduce bottlenecks, and ensure services are brought to market efficiently while adhering to ITU global coordination standards.

Q.13 Whether there are any other suggestions related to assignment of 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 :

For the benefit of consumers in relation to the assignment of spectrum for NGSO-based Fixed Satellite Services (FSS) and GSO/NGSO-based Mobile Satellite Services (MSS), the following suggestions can be considered:

(c) NGSO-Based Fixed Satellite Services (FSS) for Data Communication and Internet Services:

1. **Affordable and Competitive Pricing**:

- **Promote competition** by ensuring that spectrum is allocated fairly among multiple service providers, thereby preventing monopolistic control over satellite services.
- Encourage **open bidding or transparent allocation** processes that help reduce spectrum costs, which can ultimately lower the cost of services for consumers.

2. **Wider Coverage and Access in Remote Areas**:
   - Prioritize spectrum assignments that focus on extending **broadband internet access to rural and underserved areas**. NGSO satellite systems can play a crucial role in bridging the digital divide by delivering reliable internet where terrestrial infrastructure is limited or non-existent.
   - Mandate **universal service obligations** for operators receiving spectrum to ensure equitable distribution of services across geographies.
3. **Improved Quality of Service (QoS)**:
   - Ensure spectrum allocation is tied to commitments for **high-speed and low-latency internet services**, which are essential for modern data usage like video streaming, online education, and telehealth.
   - Introduce **QoS benchmarks** that must be met by satellite service providers in terms of bandwidth, speed, and latency, offering consumers a better experience.
4. **Innovation and Future-Proofing**:

- Encourage the use of spectrum for innovative services such as **IoT (Internet of Things)** and **smart agriculture** applications that are heavily dependent on reliable data communication from satellite networks.
- Promote the allocation of spectrum that is **future-proofed for emerging technologies**, allowing service providers to upgrade to newer, more efficient satellite systems.

(d) GSO/NGSO-Based Mobile Satellite Services (MSS) for Voice, Text, Data, and Internet:

1. **Improved Emergency and Disaster Communication**:
   - Mandate that MSS providers offer **emergency communication services**, especially in disaster-prone and remote areas where terrestrial networks may fail. Reliable satellite communication during emergencies can save lives.
   - Assign spectrum in a way that supports **disaster relief organizations and emergency responders**, giving them access to robust and uninterrupted communication channels during crises.
2. **Enhanced Mobile Connectivity in Remote Areas**:
   - Ensure MSS providers focus on offering **mobile communication services (voice, text, data, and internet)** in areas with little to no cellular network coverage. This will benefit consumers in rural regions, enabling them to stay connected with family, work, and essential services.

- Require operators to **scale coverage** to areas underserved by traditional terrestrial networks, providing seamless global connectivity.

3. **Seamless Roaming and Global Connectivity**:
   - Advocate for **seamless global roaming** services through MSS, ensuring that consumers can access uninterrupted mobile services even while traveling in remote or rural locations where terrestrial networks might not exist.
   - Encourage **interoperability** between MSS providers and terrestrial network operators, allowing for smooth transitions between satellite and cellular networks for voice and data services.
4. **Reliable and Resilient Communication Networks**:
   - Promote the assignment of spectrum to providers that ensure **high-reliability mobile networks**, particularly for mission-critical industries like maritime, aviation, and defense, which require uninterrupted mobile communication services.
   - Ensure MSS systems provide **redundancy** in cases of terrestrial network outages, enhancing communication resiliency for all consumers.
5. **Consumer-Centric Pricing Models**:
   - Encourage operators to offer **flexible pricing models** for MSS, making mobile satellite services affordable for consumers in various economic brackets. This includes both subscription-based models and pay-as-you-go options.

- Consider price caps or regulatory oversight on MSS pricing to avoid excessive charges, especially for basic services like voice and text, which are crucial for consumers in remote areas.

6. **Public Safety and Security**:
   - Ensure that spectrum allocation processes for MSS include provisions for **public safety and national security**, allowing government and law enforcement agencies access to secure and reliable communication networks.
   - Encourage **data protection and privacy safeguards** for consumers using MSS, ensuring that sensitive communication remains secure.

General Consumer Benefits for Both NGSO FSS and GSO/NGSO MSS:

1. **Transparency and Accountability**:
   - Ensure that spectrum allocation processes are **transparent and fair**, allowing consumers to know which companies are assigned spectrum and how this impacts the services available to them.
   - Introduce **consumer feedback mechanisms** that allow individuals to report on the quality of services provided by satellite operators, holding them accountable to regulatory standards.
2. **Environmental Considerations**:

- Encourage operators to adopt environmentally friendly practices by **minimizing space debris** from satellite launches and ensuring sustainable satellite operations.
- Spectrum assignment could be tied to commitments to **minimize environmental impact**, which is becoming an increasingly important factor for many consumers.

By focusing on these consumer-centric suggestions, the assignment of spectrum for satellite services can provide better connectivity, higher-quality service, and more affordable access to communication technologies, especially in underserved regions.

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.

Comments : No Comments on Spectrum

But for the benefits of consumers :

When determining spectrum charges for **NGSO-based Fixed Satellite Services (FSS)** that provide data communication and Internet services, certain precautions should be taken to safeguard consumer interests. These precautions can help balance the need for fair revenue generation by the government while ensuring affordable and reliable services

for consumers, especially in underserved areas. Here are the key precautions:

1. Affordability and Price Control:

- **Cap on Spectrum Charges**: To prevent excessive costs being passed on to consumers, spectrum charges should be capped or regulated, especially for bands that are used for consumer services like internet and data communication. This helps avoid inflated costs that could lead to high service prices for consumers.
- **Sliding Scale Pricing**: Spectrum charges could be based on a **sliding scale**, where operators serving underserved or rural areas receive a discount or reduced charges. This ensures that NGSO operators providing critical internet services in remote areas can maintain affordable pricing for consumers.

2. Encouraging Competition:

- **Competitive Auctions with Safeguards**: While auctions for spectrum allocation should be competitive, safeguards should be put in place to prevent spectrum hoarding or monopolistic behavior. If one or two operators dominate the spectrum, they could raise prices, which would be passed on to consumers.
- **Spectrum Sharing Mechanisms**: Implement spectrum-sharing models that allow multiple operators to use the same frequency band, which promotes competition and encourages operators to keep consumer prices low.

3. Linking Spectrum Charges to Consumer Pricing Models:

- **Conditional Pricing Models**: Operators could be granted spectrum on the condition that their pricing for data communication and internet services is regulated or reviewed to ensure consumer affordability. For example, service providers may be required to submit pricing models and profit margins for approval, ensuring that spectrum charges don't excessively increase consumer costs.
- **Service-Level Guarantees**: Tie spectrum charges to the provision of certain service standards, such as minimum speeds, coverage areas, or data limits. This would ensure that consumers receive adequate value for the fees charged by operators who are using the spectrum.

4. Facilitating Access in Underserved and Rural Areas:

- **Incentivized Spectrum Fees**: Offer lower spectrum charges for operators that commit to providing internet services in rural, remote, or underserved areas. This ensures that the most vulnerable and underserved populations get affordable internet access, and it encourages operators to invest in these regions.
- **Universal Service Obligations**: Spectrum assignments should include obligations for the operator to serve not only urban but also rural or underserved areas. The spectrum charges could be discounted based on the extent of rural coverage, ensuring that consumers in these regions benefit from lower costs.

5. Transparent and Fair Spectrum Pricing:

- **Transparency in Spectrum Fees**: Regulatory bodies should provide full transparency in how spectrum charges are calculated and allocated. Consumers benefit from knowing that the fees are not arbitrary but are based on rational economic principles that balance public interest with the operator's business needs.
- **Periodic Review of Spectrum Fees**: Spectrum charges should be periodically reviewed by regulators to reflect market conditions, technological advancements, and the needs of consumers. This avoids situations where spectrum charges become outdated and burdensome, leading to higher consumer prices.

6. Safeguarding Consumer Interests in the Long-Term:

- **Long-Term Spectrum Assignments**: Assign spectrum for longer periods (e.g., 10-20 years) to give operators financial predictability and reduce the pressure to recover high initial costs in the short term. This ensures that operators can offer more affordable services to consumers without rushing to recoup costs through higher charges.
- **Revenue Sharing Mechanisms**: Instead of upfront or one-time spectrum charges, consider revenue-sharing models where operators pay a percentage of their revenue from the services they provide using the spectrum. This can create a win-win situation where operators are incentivized to grow their consumer base without being burdened by heavy upfront spectrum fees.

7. Consumer Protection Measures:

- **Regulatory Oversight on Service Pricing**: Regulatory bodies should closely monitor how spectrum charges affect the pricing of internet and data services. This can prevent operators from unjustifiably raising consumer prices under the pretext of high spectrum costs.
- **Consumer Grievance Mechanisms**: Create dedicated channels for consumers to report unfair pricing or service quality issues. This ensures that consumers are protected from exploitative pricing models that could arise from high spectrum costs.

8. Fostering Innovation and Efficiency:

- **Incentivize Efficient Spectrum Use**: Spectrum charges should encourage operators to make efficient use of the assigned frequencies, promoting innovation in satellite technology. Efficient spectrum usage can reduce operational costs, which would ultimately benefit consumers in terms of better service at lower costs.
- **Support for Small and Innovative Operators**: Provide favorable spectrum pricing to small or innovative operators entering the market, promoting competition and ensuring a wide range of affordable options for consumers.

9. Global Coordination and Best Practices:

- **Align with Global Best Practices**: Ensure that spectrum charges for NGSO-based FSS align with international best practices to avoid overburdening operators, especially those offering global or cross-

border services. Global alignment can foster competitive pricing, which will benefit consumers with lower costs.

- **Monitoring of International Trends**: Regulatory bodies should monitor trends in other countries and adapt spectrum charges to ensure that consumers do not pay excessively high rates compared to global norms.

By implementing these precautions, the assignment of spectrum for NGSO-based Fixed Satellite Services can strike a balance between fair pricing for operators and affordable, high-quality services for consumers.

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.

Comments : No Comments.

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.

Comments : No Comments.

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.

Comments : No Comments.

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.

Comments : No Comments.

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.

Comments : No Comments.

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.

Comments : No Comments.

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.

Comments : No Comments.

Thanks.

Sincerely Yours,

(Prof. Dr. Kashyapnath)
President