NATIONAL PREPARATORY COMMITTEE TOWARDS WRC-27 AGENDA ITEM BRIEF

Chapter: *3*
Service: *Mobile-satellite issues*
Agenda Item: *1.12*

Description of Agenda Item: *This Agenda Item invites Administrations to consider studies on possible new allocations to, and regulatory actions for, the mobile-satellite service (MSS) in the frequency bands 1 427-1 432 MHz (space-to-Earth), 1645.5 - 1646.5 MHz (space-to-Earth) (Earth-to-space), 1880-1 920 MHz (space-to-Earth) (Earth-to-space) and 2 010-2 025 MHz (space-to-Earth) (Earth-to-space) required for the future development of low-data-rate non-geostationary (NGSO) mobile-satellite systems, in accordance with Resolution 252 (WRC-23)*

Focus: *Is the future development of low-data-rate (LDR) non-geostationary (non-GSO) mobile-satellite service (MSS) systems.*

Status of Studies

Studies supporting WRC-27 Agenda Item 1.12 are still in progress and have not yet been finalized. Technical and regulatory analyses across the candidate frequency bands are advancing at different levels of maturity, and several important issues remain under examination.
Key developments at this stage include:

i. Three potential methods for addressing the agenda item have been identified, although they remain under discussion.
ii. Given the complexity of the subject, a new draft **Resolution** is expected to provide the technical and operational framework.
iii. Discussions are continuing on specific parameter values, including e.i.r.p. and traffic limits.

Objective of the Studies

The primary objective of the studies under WRC-27 Agenda Item 1.12 is to assess the feasibility of establishing a regulatory framework that supports the future development and deployment of low-data-rate (LDR) non-geostationary (non-GSO) mobile-satellite service (MSS) systems.
To meet this objective, the studies focus on four main areas:

i. Potential new allocations: The studies examine possible MSS allocations and related regulatory measures in four candidate frequency bands: **1 427-1 432** MHz, **1 645.5-1 646.5 MHz, 1 880-1 920** MHz, and **2 010-2 025** MHz.
ii. Protection of existing services: A central focus is identifying the technical and regulatory conditions, such as power flux-density (pfd) limits, needed to ensure that new LDR MSS systems can coexist with incumbent services, including fixed, mobile, and IMT systems, in both co-channel and adjacent bands.
iii. Regulatory certainty: The studies seek to provide a clear regulatory basis for the design, authorization, and deployment of satellites and earth stations.

iv. Addressing spectrum scarcity: Recognizing the limited availability of suitable MSS spectrum below 5 GHz, the agenda item explores opportunities to identify harmonized spectrum that can support emerging applications such as satellite-based Internet of Things (IoT).

Overall, the studies aim to enable future LDR MSS applications such as asset tracking and sensor networks while ensuring that these systems do not cause harmful interference to established primary services.

What Are LDR MSS Systems?

Low-data-rate (LDR) non-geostationary (non-GSO) mobile-satellite service (MSS) systems are satellite communication platforms designed for small, intermittent data transmissions rather than continuous connectivity. Operating in non-GSO orbits within MSS allocations, they use burst-mode communications to support lightweight exchanges and can continue functioning even when some packets are lost. Their main characteristics include:

i. **Limited-service scope:** These systems do not support voice services or real-time, high-bandwidth applications such as internet browsing or remote control.
ii. **IoT-focused applications:** They are intended for low-throughput uses such as asset tracking, environmental sensing, remote monitoring, and alerting.
iii. **Low technical demand:** They typically involve very low traffic volumes, modest terminal transmission power, and intermittent rather than continuous connectivity.

Overall, LDR non-GSO MSS systems are a specialized but increasingly important solution for extending scalable, energy-efficient connectivity to IoT and other low-data applications, particularly in areas where terrestrial networks are unavailable or impractical.

Studied Frequency Bands

The frequency bands being studied under this agenda item for the development of **low-data-rate (LDR) non-geostationary mobile-satellite systems** are summarized in the table below:

Frequency band (MHz)	Direction of operation
1 427-1 432 MHz	Space-to-Earth
1 645.5-1 646.5 MHz	Space-to-Earth and Earth-to-space
1 880-1 920 MHz	Space-to-Earth and Earth-to-space
2 010-2 025 MHz	Space-to-Earth and Earth-to-space

These studies aim to identify potential new **mobile-satellite service (MSS)** allocations and determine the technical conditions required to protect existing primary services such as fixed, mobile, and IMT currently operating within or adjacent to these bands.

Methods to Satisfy the Agenda Item

To satisfy this agenda item, three potential methods have been identified to address the future development of low-data-rate (LDR) non-geostationary (non-GSO) mobile-satellite service (MSS) systems. These methods summarised below range from maintaining the current Regulations to establishing new primary or secondary allocations.

Method A: No Change

i. This method proposes **no changes** to the Radio Regulations for any of the frequency bands identified in the agenda item.
ii. It assumes that the current regulatory framework is sufficient or that the proposed new allocations are not feasible without compromising incumbent services.

Method B: New Primary MSS Allocations involves introducing **new primary allocations** to the mobile-satellite service specifically for non-GSO LDR systems. Key features include:

i. **Regulatory Framework:** Implementation would be governed by a new **Resolution** which would define the technical and operational framework.
ii. **Technical Constraints:** Allocations would include strict conditions to protect incumbent services, such as **power flux-density (pfd) limits** for space-to-Earth transmissions and **e.i.r.p. density limits** for user terminals (Earth-to-space).
iii. **Band-Specific Application:** The method is structured band-by-band, specifying the direction of operation (uplink or downlink) for each of the four studied frequency ranges based on compatibility results.

Method C: New Secondary MSS Allocations

This method proposes introducing **secondary allocations** to the MSS in the Table of Frequency Allocations. Its implementation involves:

i. **Limitation Footnotes:** New footnotes would be added to the Table of Allocations to limit use to non-GSO MSS systems operating below specific power thresholds developed during preparatory studies.
ii. **Separation Requirements:** For Earth-to-space operations, it may include required **separation distances** from the borders of countries using the bands for specific services like SAP/SAB.
iii. **Region 2 Special Provision:** In the 2 010 - 2 025 MHz band, the existing primary MSS (Earth-to-space) allocation in Region 2 would be retained, but a footnote would be added to allow non-GSO LDR use provided it does not cause harmful interference to, or claim protection from, existing primary services.

Common Element for All Methods

Regardless of the chosen method, it is proposed to **suppress Resolution 252 (WRC-23)**, as the adoption of any of these proposals would signify that the studies requested by that resolution have been completed

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Interference Protection Mechanisms

To protect existing services from potential interference from low-data-rate (LDR) non-geostationary (non-GSO) mobile-satellite service (MSS) systems, the sources identify several technical and regulatory mechanisms. These range from specific power limits to geographic separation requirements.

Technical Protection Mechanisms

i. **Power Flux-Density (pfd) Masks (Downlink):** For space-to-Earth transmissions, the study proposes pfd masks to limit the signal strength reaching the Earth's surface at various elevation angles. These masks are designed to protect:
    - **Fixed Service Stations:** Particularly at lower elevation angles.
    - **HIBS and IMT AAS Rural/Suburban Macro:** Particularly at higher elevation angles.
    - Specific pfd limits are also being considered for inclusion in **Article 21, Table 21-4** of the Radio Regulations.
ii. **equivalent isotropically radiated power Density Limits (Uplink):** For Earth-to-space transmissions, the study suggests limiting the **equivalent isotropically radiated power (e.i.r.p.)** of user terminals. A maximum e.i.r.p. of **1 W per MHz** is frequently cited as a threshold that could allow sharing with existing services like fixed and mobile stations.
iii. **Out-of-Band Emission Limits:** To protect passive services like the **Earth exploration-satellite service (EESS)** in adjacent bands (specifically 1 400-1 427 MHz), a mandatory out-of-band power limit of **–60.2 dBW/27 MHz** is proposed for LDR MSS systems operating in the 1 427-1 432 MHz band.

iv. **Separation Distances and Exclusion Zones:** To protect terrestrial receivers from interference caused by LDR MSS user terminals (Earth-to-space), the study calculates necessary separation distances:
    - **General Services:** Distances typically range from **2.5 km to 90 km** depending on the band and station type.
    - **HIBS Base Stations:** Require significantly larger exclusion zones, estimated up to **380 km or 425 km**.
    - **SAP/SAB (PMSE) Stations:** Require separation distances between **48 km and 90 km**.

Regulatory and Procedural Mechanisms

i. **Non-Interference/Non-Protection Footnotes:** Proposed regulatory provisions include footnotes highlighting that the use of these bands by non-GSO LDR MSS **shall not cause harmful interference to**, and **shall not claim protection from**, existing fixed and mobile services.
ii. **RR No. 9.21 Agreement:** Some proposed methods specify that the use of these bands is subject to obtaining agreement from other administrations under **Radio Regulation No. 9.21**.
iii. **Cross-Border Protection:** For SAP/SAB services, the study proposes **exclusion zones** within an MSS-operating country measured from the border of a neighbouring country that still uses the band for SAP/SAB.
iv. **Operational Constraints:** A new **Resolution** would formally define LDR systems as those that transmit in bursts, do not support telephony, and operate with low traffic volumes (e.g., 0.001 to 10,000 kbytes per month), effectively limiting the overall interference environment.

Technical and Regulatory Challenges

Four key technical and regulatory challenges associated with WRC-27 agenda item 1.12 have been identified:

1. **Protection of Incumbent Primary and Passive Services**

   A primary challenge is ensuring that new LDR MSS allocations do not cause harmful interference to established services. These include **fixed, mobile, and IMT systems**, as well as **passive services** like the Earth exploration-satellite service (EESS). For example, in the 1 427-1 432 MHz band, studies indicate a strict out-of-band power limit (–60.2 dBW/27 MHz) is required to protect sensitive EESS sensors in the adjacent band.

2. **Risk to Distress and Safety Communications**

   Technical assessments for the **1 645.5-1 646.5 MHz band** have identified a critical regulatory hurdle: LDR non-GSO systems are projected to cause **excessive interference** to existing geostationary (GSO) systems. Because this band is specifically limited to **distress, urgency, and safety communications**, current findings suggest that allowing LDR MSS operations there would lead to harmful interference to life-safety services.

3. **Management of Large Geographic Separation Distances**

   Protecting certain specialized incumbent technologies requires massive exclusion zones that complicate the deployment of MSS earth stations. While typical separation distances range from 2.5 km to 90 km, protecting **High-Altitude IMT Base Stations (HIBS)** and **SAP/SAB (mobile video links)** can require separation distances of **380 km to 425 km**. Managing these large zones, especially in cross-border situations, presents a significant regulatory coordination challenge.

4. **Lack of Technical Consensus and Incomplete Data**

The studies are currently a **"work in progress"** and have not yet been agreed upon by the relevant ITU-R Working Party. Many critical technical parameters such as the specific **pfd (power flux-density) masks** for protecting terrestrial services and elevation angle thresholds are still listed as **"To Be Determined"**

(TBD). Providing "regulatory certainty" is difficult while the technical conditions for sharing and compatibility remain finalized and unconfirmed.

Conclusion

It is noted that, while there is significant interest in establishing a global regulatory framework for **low-data-rate (LDR) non-geostationary mobile-satellite systems** to support the growing **Internet of Things (IoT)**, the technical feasibility remains **unproven and lacks international consensus**.

The status of the studies leads to several key conclusions:

- **Incomplete Technical Foundation:** As of to-date, the technical documentation is explicitly categorized as a **"work in progress"** and reflects input contributions that were **not agreed upon** by the affected parties. Numerous critical parameters, such as the power flux-density (pfd) masks required to protect terrestrial services, remain **undetermined yet.**
- **Serious Interference Risks:** Preliminary findings suggest that operation in certain bands, particularly **1 645.5-1 646.5 MHz**, is highly problematic because it would likely cause **harmful interference to distress, urgency, and safety communications**. Furthermore, current studies have not yet accounted for the **aggregate interference** from multiple satellites, which could worsen these impacts.
- **Complex Coexistence Requirements:** Protecting incumbent services (like HIBS, fixed service stations, and EESS) would require **stringent technical limits** and **massive geographic exclusion zones**. For instance, protecting HIBS base stations could require separation distances of up to **425 km**, creating significant operational and cross-border regulatory challenges.
- **Uncertain Regulatory Path:** Because the compatibility studies are varied and incomplete, the ITU-R continues to maintain **three divergent methods** (ranging from "No Change" to new primary or secondary allocations). The final decision will depend on whether future studies can establish a framework that provides **regulatory certainty** without compromising the primary and life-safety services already occupying these bands