

Key Spectrum and Regulatory Issues of NGSO/LEO

IAFI National Workshop on Spectrum and regulatory issues in preparation for WRC-23

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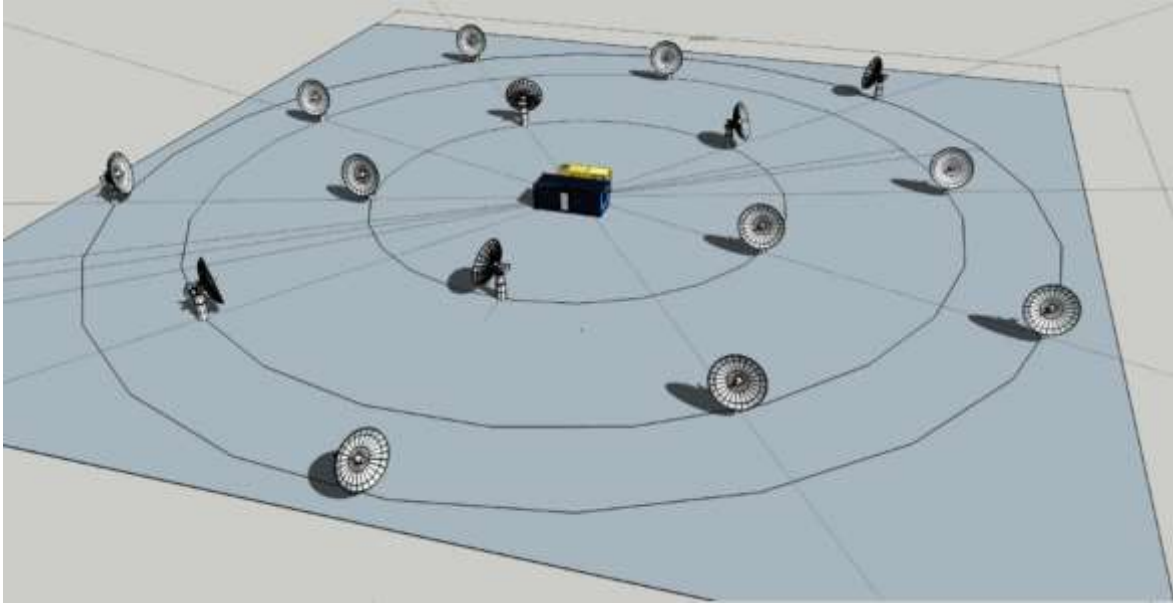
Spectrum and Market Access, Director

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NGSO Gateways (1/2)

- ▲ Feeder link connectivity for NGSO systems is ensured via “landing stations/antenna farms” consisting of sites with multiple identical full motion antennas



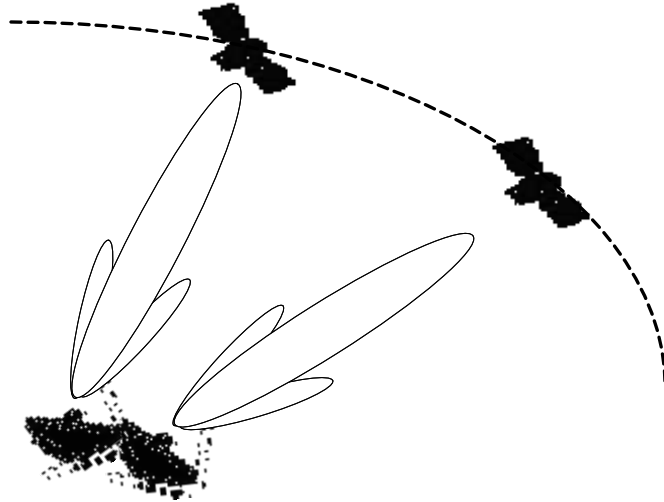
- ▲ As it is the custom elsewhere, for the gateway landing station license is normally separate from the service provision license
 - gateway license does not confer any right for the provision of services
 - level playing field for service providers
- ▲ Possible for the satellite operator or the teleport operator or a service provider to acquire it
- ▲ Deployment of NGSO gateways can be optimised

NGSO Gateways (2/2)

- ▲ While each antenna will be tracking a different satellite at any one time, the overall range of pointing angles, power and frequencies will be within the same envelope (i.e. the interference scenario and spectrum use is not different from a single antenna)
 - no multiple fees should be imposed for each additional antenna on the same “antenna farm”
 - principle already adopted by Australia, Italy, Portugal, UK, US, Colombia, Canada, etc
- ▲ Novel satellite systems in Ka-band use ~4GHz of spectrum
 - the existing fee spectrum formula involving the Royalty R would need revising as, if applied, it would lead to disproportionate amounts
- ▲ Gateways are typically considered as infrastructure: a revenue related formula, while suitable for service providers, is not applicable
- ▲ In line with international practices, there are typically no applicable technical standards for gateway earth stations (while standards exist for the user terminals)
 - the requirement for compliance with a TEC technical standards should be reconsidered for NGSO gateway earth stations
- ▲ No predefined large separation distance required between NGSO antenna farms
 - The distance between NGSO gateways is entirely dependent on the NGSO systems parameters, as well as the methodology and criteria used to assess inter-system interference

Microwave spectrum assignment

- ▲ Microwave spectrum assignment for satellite use should be based on an administrative process, which is standard procedure elsewhere
 - Spectrum assignment by auction is not suitable for spectrum that can be shared between multiple satellite operators (such as in Ku/ Ka band) thanks to the directivity of antennas



- ▲ A satellite microwave spectrum auction would artificially limit the number of satellite operators sharing the spectrum and exclude them from the market, while satellite operators can (differently from terrestrial mobile operators) coexist in the same frequency range.

Protection of GSO networks and NGSO-NGSO coordination

- ▲ In most of the Ka-band (17.7-18.6GHz, 19.7-20.2GHz, 27.5-28.6GHz and 29.5-30GHz) there are equivalent power flux density (epfd) limits on NGSO to protect GSO (RR. **22.2**)
 - **These limits are established by ITU, ensure non-interference and therefore no coordination is required**
- ▲ For the remaining Ka-band spectrum (18.8-19.7 GHz and 28.6-29.1 GHz) coordination between NGSO and GSO systems is required under the relevant ITU provisions
- ▲ Coexistence between NGSO systems can be ensured by complying with the coordination provisions set out in the ITU Radio Regulations
 - Consideration of ITU filing priority allows for a system to be designed by taking into account a defined interference environment, represented by those systems whose with higher priority
- ▲ Analysis is carried out by operators of different NGSO systems in bi-lateral coordination discussions
- ▲ The required simulations take into account deployment information, power levels, the constellation design, etc

Ongoing issues in the AWG

- ▲ Final stages of an APT report on “Ka-band satellite systems for use in the Asia Pacific region and consideration for development of national frequency plans”
 - Information on Ka-band satellite systems in operation and proposed in APT region, including the services and applications provided
 - Information on co-frequency compatibility and sharing issues between satellite services in the Ka-band and other services allocated in the same bands
 - Guidance to assist administrations with the development of national frequency plans for the use of Ka-band frequencies

Members are encouraged to support the finalization of this APT report in AWG-31

- ▲ Collating responses to questionnaire on current status and future plan of usage in the frequency ranges of 7.125 – 24 GHz and 92 – 300 GHz

Members are encouraged to respond to this questionnaire highlighting also the planned and future use of Ku/Ka bands for satellite services



Annex – Status of WRC-23 AIs 1.16 and 1.17

WRC-23 AI 1.16 – NGSO ESIM in Ka-Band

▲ *"... to facilitate the use of the frequency bands*

17.7 – 18.6 GHz and 18.8 – 19.3 GHz and 19.7 – 20.2 GHz (space-to-Earth)

27.5 – 29.1 GHz and 29.5 – 30 GHz (Earth-to-space)

by NGSO FSS ESIM, while ensuring due protection of existing services in those bands..." –

Resolution 173 (WRC-19)

▲ Allowing NGSO ESIM in Ka-band **will provide a much required harmonized international framework also to protect existing services**

▲ Technical and regulatory provisions for the operation of ESIM under this Agenda Item are limited to aeronautical and maritime ESIM

▲ At the May 2022's meeting of WP 4A the membership agreed that only the notifying administration of the NGSO satellite system is responsible for the operation of ESIM

- Further discussion required on the interference management issues (e.g. detection of interference, identification of source, etc.) in the subsequent WP 4A meeting

Progress and Telesat's proposed preliminary position– AI 1.16

- ▲ A compilation of the **Preliminary Draft New Resolution was developed** based on the input documents
- ▲ Sharing studies are confirming that the same conditions **as for GSO ESIM would also protect terrestrial services from non-GSO ESIM**
 - Aeronautical ESIM (A-ESIM): general conclusion that the interference protection criteria is not exceeded for either any altitude/location or deployment scenario/type for A-ESIM and terrestrial service with the PFD limits at the surface of the Earth currently under consideration (**same as GSO ESIM in the same frequency bands**)
 - Maritime ESIM (M-ESIM): results of study shows no exceedance of protection criterion for both FS and MS with the M-ESIM 70km distance from the coast and the power limits under consideration (**same as GSO ESIM in the same frequency bands**)

Proposed preliminary position

- ▲ Supports the adoption of harmonized regulatory framework as well as technical and operational measures that facilitate the use of NGSO ESIMs, while ensuring protection of existing services in-band and adjacent frequency bands.
- ▲ Based on ITU-R studies, aims to **establish technical, operational and regulatory provisions similar to those for GSO ESIMs** - i.e Res 156 (WRC-16) and Res 169 (WRC-19)
- ▲ Supports the development of a methodology regarding examination by the Radiocommunications Bureau of compliance with pfd limits by non-GSO aeronautical ESIM or of adequate transitional measures in case WRC-23 could not finalise the methodology

APG23-4 Preliminary Views – AI 1.16

- To continue studies to develop technical and regulatory solutions for all concerns raised. Completion of studies and decisions shall be made to ensure the protection of existing services.
- Sharing studies should be finalised and results of the studies transferred to the Draft New Resolution
- Regulatory provision and technical and operational measures with appropriate examination methodology by the BR for NGSO ESIM should be established. In the absence of such methodology, transitional measures should be developed and agreed by WRC-23
- The only administration that could notify ESIM is the same administration as the one notifying the non-GSO system to which the ESIM communicate. Notification of any frequency assignment for ESIMs shall only be made by one administration, which will be responsible for ESIM operation
- Interference management mechanism and operation mechanism of ESIMs shall be clearly defined for inclusion in the Draft New Resolution
- Non-GSO FSS ESIM deployment in the bands 17.7 – 18.6 GHz and 18.8 – 19.3 GHz will not result in increased adjacent band interference to EESS (passive) operations in the 18.6 – 18.8 GHz should be finalised
- With respect to the sharing/compatibility studies and PFD examination for aeronautical NGSO ESIM studies, the protection of terrestrial services shall be ensured in accordance with Resolution 173 (WRC-19)
- NGSO ESIM characteristics shall remain under the envelope characteristics of typical NGSO earth stations
- For the protection of GSO FSS networks operating in 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz, the relevant EPFD limits in RR No. 22.5C, 22.5D and 22.5F apply
- There are several issues on the operation of ESIMs operating with NGSO space stations to be clarified and specified in the Draft New resolution

Summary of other Regional Views – AI 1.16 (1 of 2)

<p>ASMG</p>	<ul style="list-style-type: none"> - Follow-up studies, provided that NGSO ESIM would not claim protection from other services and their future developments - for the protection of GSO networks in the FSS operating in the frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5-28.6 GHz and 29.5-30.0 GHz RR Article 22 EPFD limits should be applied - Define the role of the Network Control and Monitoring Center (NCCM), while emphasizing that the notifying administration of the satellite network holds the responsibility for operating NGSO ESIM
<p>ATU</p>	<ul style="list-style-type: none"> - Support studies towards development of regulatory framework for the use of frequency bands by NGSO FSS ESIMs - For the protection of terrestrial services operating in the 27.5-29.1 GHz from non-GSO ESIM, technical conditions similar to Res.169 could be developed based on sharing studies that have been conducted by WP4A (PFD limits for A-ESIM; min distance from the coast and max EIRP spectral density towards the horizon for M-ESIM). - Support that the only administration that could notify the ESIM is the same administration that notified NGSO satellite network with which the ESIM will communicate
<p>CEPT</p>	<ul style="list-style-type: none"> - Support the development of a regulatory framework for NGSO ESIM - Ensure the protection of GSO systems and other services - NGSO ESIM receiving in the 18 GHz band shall not claim protection from terrestrial services - Protection of GSO networks in the frequency bands 17.8-18.6 GHz, 19.7-20.2 GHz, 27.5 – 28.6 GHz and 29.5 – 30 GHz from NGSO ESIM can be achieved by complying with No.22.5C, 22.5D and 22.5F. - Protection of GSO networks and NGSO systems in the frequency band 28.6 – 29.1 GHz shall be achieved on the basis of coordination agreement between administrations and operators in accordance with No.9.11A

Summary of other Regional Views – AI 1.16 (2 of 2)

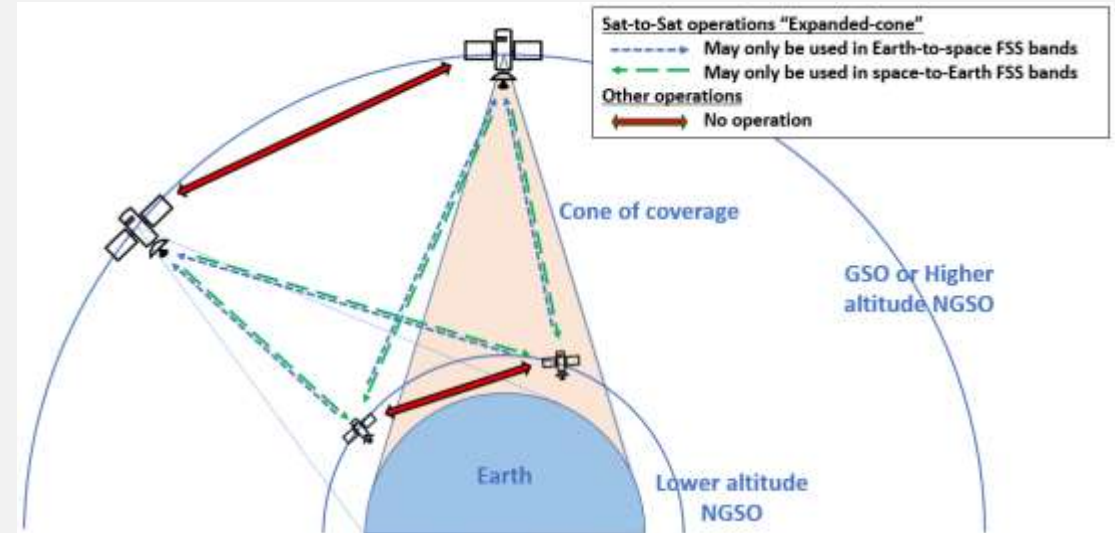
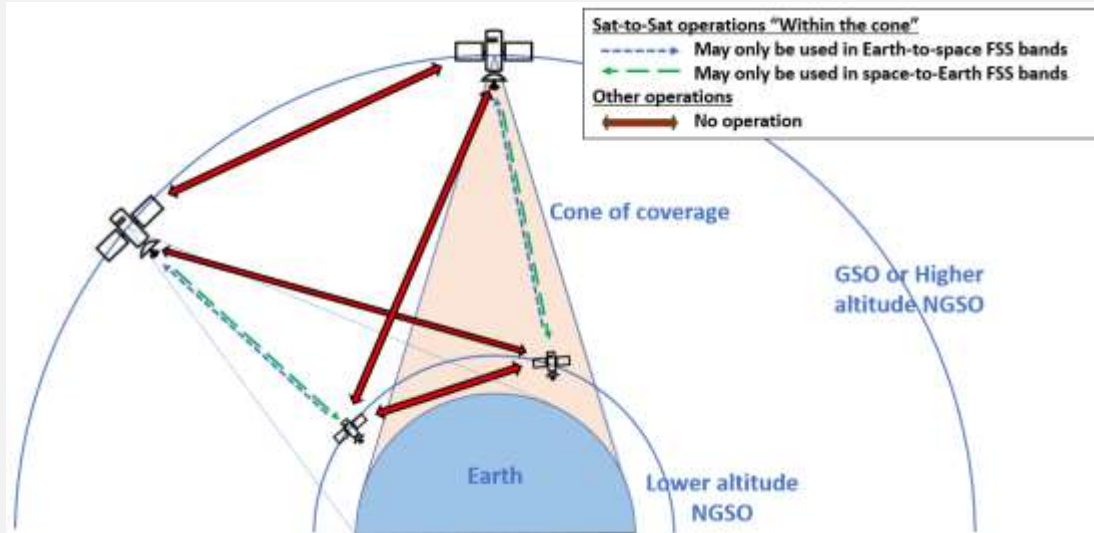
<p style="text-align: center;">RCC</p>	<ul style="list-style-type: none"> - Support development of regulatory provisions and technical requirements for aeronautical and maritime ESIMs in NGSO FSS - NGSO ESIMs could be used only if the following conditions are met: <ul style="list-style-type: none"> • NGSO ESIM in the bands 18/19 GHz shall not claim protection from terrestrial services • Maintain relevant RR provisions for the protection of GSO networks from NGSO FSS systems • NGSO FSS ESIM are within the characteristics for typical ES of NGSO FSS networks as well as comply with agreements between administrations • NGSO FSS ESIM shall not be used for applications related to safety of life; • ESIM shall comply with the efd limits specified in RR No. 22.5C, 22.5D and 22.5F • RR No. 22.2 applies in the band 17.7 – 17.8 GHz; • Unauthorised use of ESIM shall be excluded by the provisions of RR.
<p style="text-align: center;">CITEL</p>	<ul style="list-style-type: none"> - Preliminary Views (GT-CMR23-2022-39-013r2) <ul style="list-style-type: none"> - Support studies on the technical and operational characteristics of ESIM and sharing and compatibility studies to develop technical and regulatory provisions in accordance with Resolution 173 (WRC-19) (Brazil, US, Canada) - Studies that were conducted to support the deployment of GSO ESIM in the Ka-band have many similarities with those that are being carried out under Resolution 173(WRC-19). WRC-23 should aim to establish the same technical, operational and regulatory provisions. (Canada) - EPFD limits should be used to protect ground services from the operation of aeronautical ESIM, consistent with previous WRCs. It is prudent to develop a methodology that can be used by the RRB to verify compliance of NGSO aeronautical with a set of pfd limits prior to WRC-23, but that the absence of said methodology at the end of WRC-23 should not delay the development of a regulatory framework for NGSO ESIMs in this agenda item. (Mexico) - Preliminary Proposal (GT-CMR23-2022-39-033) <ul style="list-style-type: none"> - Add a new footnote to Article 5 of the RR, establishing the conditions for the operation of NGSO ESIM via a new Resolution. (Brazil, Canada) <p><i>No Inter-American proposal on this AI has been finalized yet</i></p>

WRC-23 AI 1.17 – Inter-Satellite Links (ISLs)

- ▲ *"to determine and carry out... the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate"* - **Resolution 773 (WRC-19)**
- ▲ Frequency bands in consideration under this AI:
 - 11.7 – 12.7 GHz
 - 18.1 – 18.6 GHz
 - 18.8 – 20.2 GHz
 - 27.5 – 30 GHz
- ▲ There is a growing interest for utilizing ISLs for a variety of applications, for example
 - As a data transport layer, where there is limited access to Earth stations (e.g. over the oceans)
 - For most Earth observation and space science missions, data-download to the ground is a bottleneck as well as a key design driver. The possibility of relaying data to the ground via satellite-to-satellite links is a possible remedy to the existing limitations
 - Useful also for real or near-real time data applications, such as disaster management

Concept of Operations – AI 1.17

- ▲ Direction of transmission is limited to those of the existing FSS allocation
- ▲ Two Concepts of Operations have been discussed, as illustrated below



Progress and Telesat's proposed preliminary position- AI 1.17

- ▲ Significant progress made to advance work in recent WP4A on preliminary draft CPM text, including the inclusion of methods to satisfy this Agenda Item
- ▲ Some of the issues discussed and that require further work include:
 - The concept of operations for the extended cone concept, including its implications
 - Protection of EESS, GSO FSS and other NGSO systems
 - Organisation of spectrum needs based on future near-term and long-term requirements
 - Suggestions were made to improve the CPM methods to reduce complexity under this Agenda Item in subsequent WP4A
 - Possible introduction of a new ISS allocation

Proposed preliminary position

- ▲ Support on-going studies according to the FSS directionality indicators (i.e. Earth-to-space or space-to-Earth) in accordance to Res 773 (WRC-19).
- ▲ Support the introduction of satellite-to-satellite transmissions and ensuring the same level of protection for FSS GSO networks, NGSO systems and other incumbent services as currently provided in the Radio Regulations in the relevant frequency bands

APG 23-4 Preliminary View – AI 1.17

- Support ITU-R studies on sharing and compatibility as well as to develop technical and regulatory provisions in accordance to Res 773 (WRC-19)
- Use of inter-satellite service needs to fully protect the FSS
- Currently no coordination procedure to protect other services, in particular FSS
- Technical conditions and regulatory provisions developed shall not cause unacceptable interference to the terrestrial services in 27.5 – 29.5 GHz
- Consideration should be given to the operational of secondary terrestrial services currently contained in the RR in order that these terrestrial services should not be adversely affected by the inter-satellite service in the frequency bands
- Support protection of BSS band 11.7 – 12.2 GHz in Region 3 and not impose any additional constraints on future development of the BSS in the same band
- Support NOC for the allocation in the band 11.7 – 12.2 GHz in Region 3
- Support satellite-to-satellite transmissions according to the FFS directionality indicators and “within the cone of coverage” concept of operations

Summary of other Regional Views – AI 1.17

<p>ASMG</p>	<ul style="list-style-type: none"> - Support development of regulatory framework to ensure protection of in-band and adjacent bands services - Define the concept of operation for “within the cone” or “expanded cone” with appropriate constraints - The sharing mechanism with the non-GSO FSS either through coordination or the establishment of hard limits. - Support the allocation of sate-to-sat transmissions within the current FSS allocation with the same directional designators in FSS
<p>ATU</p>	<ul style="list-style-type: none"> - Support the development of a regulatory framework to ensure the protection of the in-band and adjacent bands services - Support setting of hard limits as a way to protect other non-GSO FSS, as a sharing mechanism as opposed to the coordination method (N2). - Support allocation of satellite-to-satellite transmissions within current FSS allocation, with same directional indicators as in FSS - Support the “within the cone of coverage” concept of operations - Support studies on the “augmented cone” concept of operations - Avoid a new ISS allocation in these core FSS bands
<p>CEPT</p>	<ul style="list-style-type: none"> - Support the development of a regulatory framework to enable ISLs - ISLs must ensure the same level of protection for terrestrial services and GSOs/NGSOs as currently provided in the RR and must not impose new constraints
<p>RCC</p>	<ul style="list-style-type: none"> - Support the development of technical and operational conditions, as well as regulatory provisions, including new allocations to inter-satellite service, for the operation of inter-satellite links. - Spectrum requirements should be justified, conditions for the use of inter-satellite links should ensure the protection of existing primary services in the same or neighbouring frequency bands and no additional constraints should be imposed on existing and future stations of these services - Use of inter-satellite links in the current concepts does not meet the definition of FSS and imposes additional constraints on the use of the existing and future systems/networks of FSS, inter alia, over the national territories
<p>CITEL</p>	<p>Preliminary Views GT-CMR23-2022-39-010/22 rev.4</p> <ul style="list-style-type: none"> - Support studies to consider technical and regulatory provisions to allow ISLs (Brazil, Canada, US, Mexico) - Support confining studies to links that operate in the same direction of transmission as provided for in the current allocations and confined to satellite located on different orbits. (Canada, Mexico, US) - ISLs should ensure protection of primary allocated services, Provide the same levels of protection for GSO and non-GSOs currently operating and their future developments, without imposing additional regulatory or technical constraints. ISLs also need to protect incumbent terrestrial services. (Brazil, Canada, US, Mexico) <p><i>No Inter-American proposal on this AI has been finalized yet</i></p>



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