

CPG PTA-8**Hybrid meeting, 02 – 05 May 2023****Date issued: 26th April 2023****Source: Georgia and Lithuania****Subject: WRC-27 agenda item to review and update regulatory provisions for sharing between non GSO systems and GSO networks in the portions of 14/11 GHz and 30/20 GHz frequency bands in which No. 22 epfd limits apply****Summary:**

Non-geostationary-satellite (“non-GSO”) systems in the Ka- and Ku-bands have developed into a critically important and game-changing tool for connectivity across the globe. They are capable of providing high speed, low latency broadband connectivity worldwide, including to locations where access to the internet was previously unreliable, or entirely unavailable. Publicly available data shows that non-GSO fixed-satellite service (“FSS”) systems serve well over one million users worldwide as of 2022 and are projected to serve at least tens of millions of users by 2030, resulting in enormous benefits to the global community. These unprecedented developments have dramatically changed the paradigm in satellite telecommunications.

Satellite technology and our knowledge about how non-GSO systems and GSO networks operate in practice has advanced significantly since that time. Technological progress in radio communication enables satellite systems such as smaller spot beams, adaptive modulation, and frequency re-use allow satellite systems to utilize spectrum efficiently and in a manner that is more robust to interference than satellite systems from two decades ago. This is true for fixed-satellite service whether operating in the geostationary or non-geostationary orbits.

The Article 22 epfd limits in the 14/11 GHz and 30/20 GHz, derived 25 years ago, are spectrally inefficient as demonstrated during the work under WRC-19 AI 1.6 and included in ITU-R Report [S.2462-0 \(07/2019\)](#). Equally important, the epfd limits were developed without taking into account long-term GSO protection criteria, and thereby overestimating long-term GSO protections.

After a quarter of century, the time has come to revisit those limits. The goal is to maximise efficient use of spectrum resources between GSO and non-GSO operations while respecting the regulatory regime and ensuring adequate protection of GSO networks from non-GSO systems. Such a proposal is not only in the interest of end-users worldwide (which would receive a cheaper and better service) but would also be consistent with new Plenipot Resolution 219 (Bucharest, 2022).

Proposal:

To adopt a proposal for a WRC-27 FAI to review and update regulatory provisions for sharing between non GSO systems and GSO networks in the portions of 14/11 GHz and 30/20 GHz frequency bands in which No. 22 epfd limits apply.

1. BACKGROUND

Non-geostationary-satellite (“non-GSO”) systems in the Ka- and Ku-bands have developed into a critically important and game-changing tool for connectivity across the globe. They are capable of providing high speed, low latency broadband connectivity worldwide, including to locations where access to the internet was previously unreliable, or entirely unavailable. Publicly available data shows that non-GSO fixed-satellite service (“FSS”) systems serve well over one million users worldwide as of 2022 and are projected to serve at least tens of millions of users by 2030, resulting in enormous benefits to the global community. These unprecedented developments have dramatically changed the paradigm in satellite telecommunications.

Non-GSO systems rely entirely on shared spectrum to provide service, and efficient use of shared spectrum resources is one of the ITU pillars. To realize the full benefits and potential of non-GSO FSS systems, the ITU must ensure equitable access to co-frequency spectrum resources for non-GSO systems and GSO networks while also increasing the efficiency of intra-service spectrum sharing through careful consideration of the ITU’s regulatory provisions.

Article 22 of the Radio Regulations (RR) and Resolution 76 (Rev. WRC-15) contains provisions that aim, in principle, to ensure the compatibility of non-GSO FSS operations with GSO networks in the 14/11 GHz and 30/20 GHz frequency bands. Among these provisions are the uplink and downlink equivalent power flux-density (epfd_↑ and epfd_↓) limits developed in 1997 and 2000. Yet non-GSO systems and GSO networks today are vastly different in design and operational capabilities than the systems that were considered when developing the Article 22 epfd limits nearly twenty-five years ago. Satellite technology and our knowledge about how NGSO systems and GSO networks operate in practice has advanced significantly since that time. Technological progress in radio communication enables satellite systems such as smaller spot beams, adaptive modulation, and frequency re-use allow satellite systems to utilize spectrum efficiently and in a manner that is more robust to interference than satellite systems from two decades ago. This is true for fixed-satellite service whether operating in the geostationary or non-geostationary orbits.

The Article 22 epfd limits in the 14/11 GHz and 30/20 GHz are spectrally inefficient as demonstrated during the work under WRC-19 AI 1.6 and included in ITU-R Report [S.2462-0 \(07/2019\)](#). Equally important, the epfd limits were developed without taking into account long-term GSO protection criteria, and thereby overestimating long-term GSO protections. The EPFD limits were developed by considering an short-term aggregate protection criteria contained in Recommends 3.1 of Recommendation ITU-R S.1323, i.e. 10% decrease in unavailability, derived using anomalous assumptions, and then subdividing these limits by a presumed notional 3.5 operational non-GSO systems. Consequently, because the sharing and regulatory provisions of Article 22 in the portions of 14/11 GHz and 30/20 GHz frequency bands in which epfd limits have been demonstrated to be inefficient and present clear issues with the lack of consideration of long-term protection thresholds limits, it is urgent and necessary to review and update them.

This creates multifold inefficiencies. The current Article 22 provisions allow for a particular aggregate set of non-GSO satellites to exceed the aggregate epfd limits even though it passes the GSO protection criteria outlined in Recommendation ITU-R S.1323 when applied against each reference GSO link. Likewise, scenarios can arise in which a particular non-GSO system will meet a particular epfd limit mask but will not pass the sharing criteria outlined in Recommendation ITU-R S.1323. Notably, these issues were identified and addressed in WRC-19 for the Q/V bands, leading to a new and more efficient sharing framework for those bands and the entry into force of Resolutions 770 and 769.

In addition to the spectrum inefficiency that results from the methodology used to derive the aggregate epfd limits in the Ka- and Ku-bands, long-term epfd limits for non-GSO system protection of GSO networks have the potential to be overly conservative and therefore overly protective. Recommendation ITU-R S.1323, the basis for the aggregate epfd limits developed in 1997 and 2000, does not contain any long-term protection threshold (Methodology A). The following scenario demonstrates the overly conservative and therefore overly protective nature of these limits. Based on the apportionment of the allowable error performance degradations to the FSS hypothetical digital paths arising from time invariant interference for systems below 30 GHz, ITU-R S.1432-1 calculates an -12.2 dB I/N, corresponding to 6% increase in $\Delta T/T$. Figures 1-3 below show the Article 22 epfd limits in the Ka- and Ku-band translated into I/N by using a noise temperature of 195 K and using a reference frequency of 17.8 GHz, 19.7 GHz and 10.7 GHz, respectively. All I/N curves, corresponding to the epfd limits for different diameter GSO receive antennas, have I/N well below -12.2 dB I/N at long-term percentages of time.

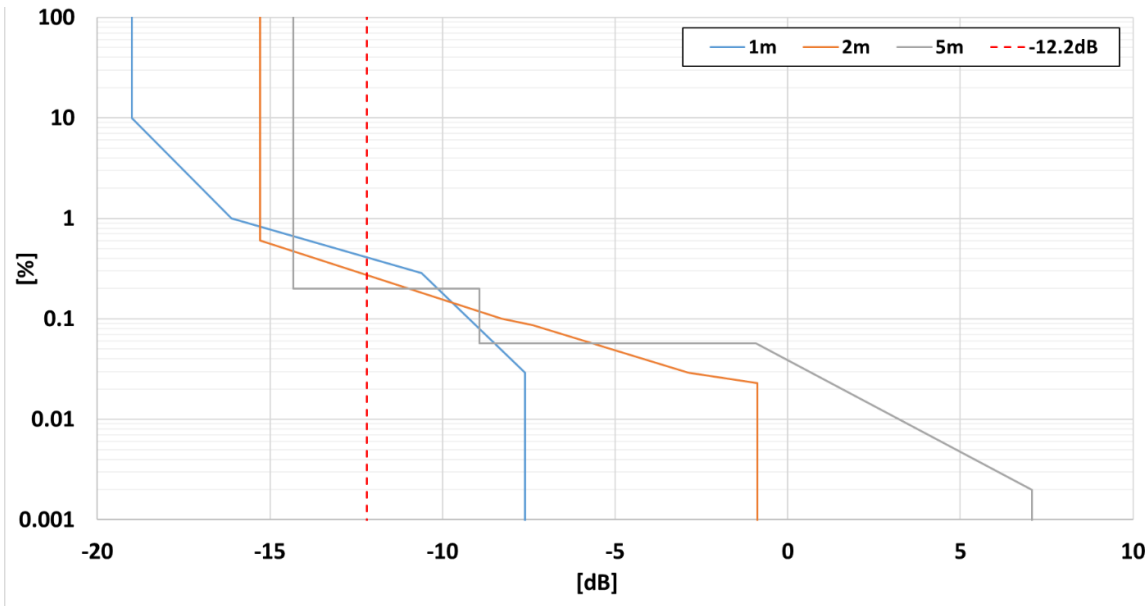


Figure 1: EPFD limits in the Ka band (17.8- 18.6 GHz) translated into I/N curves by assuming a noise temperature of 195 K

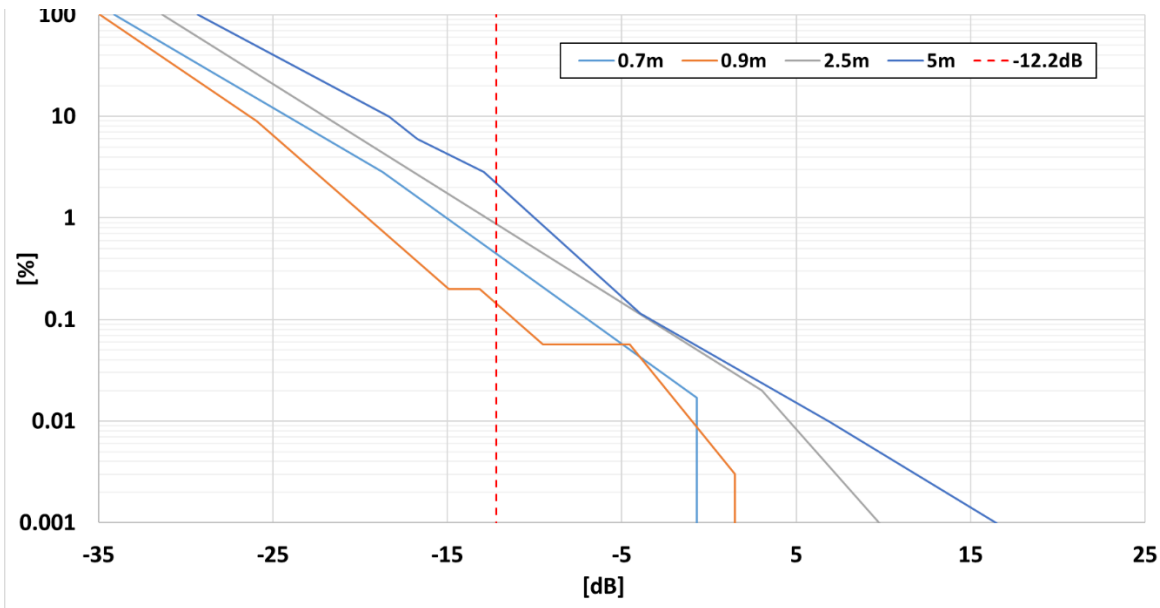


Figure 2: EPFD limits in the Ka band (19.7-20.2 GHz) translated into I/N curves by assuming a noise temperature of 195 K

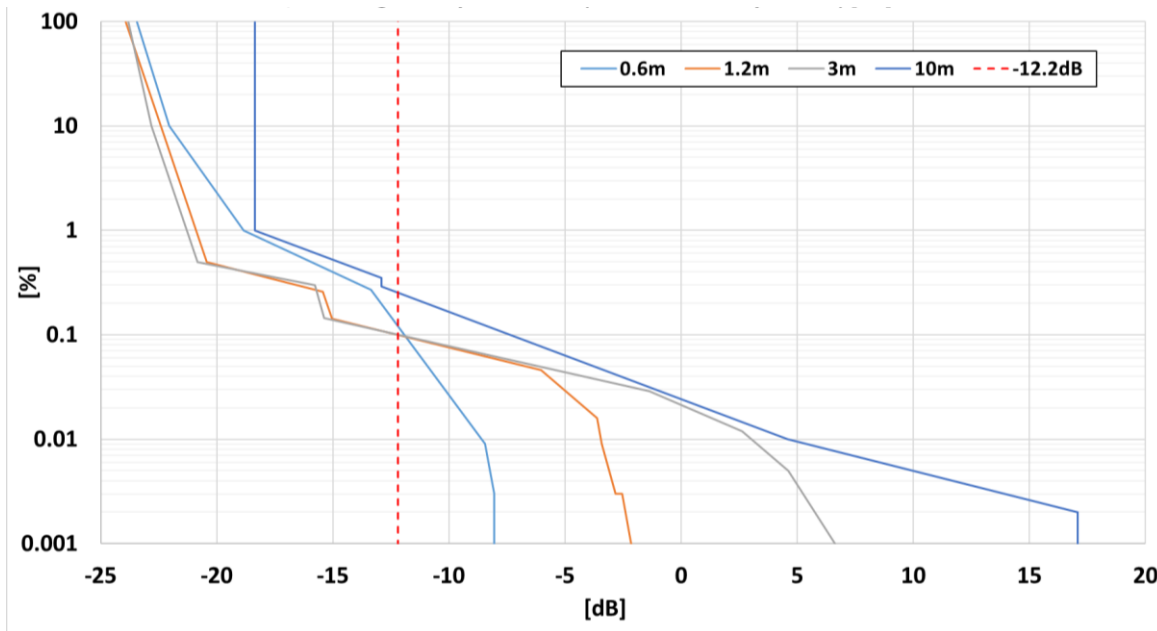


Figure 3: EPFD limits in the Ku band (10.7-12.7 GHz) translated into I/N curves by assuming a noise temperature of 195 K

In short, the Article 22 epfd limits were derived in a manner that has resulted in spectrum inefficiencies. Equally important, the long-term epfd limits were developed without taking into account long-term GSO protection criteria, thereby overestimating long-term GSO protection criteria. Consequently, because the sharing and regulatory provisions of Article 22 in the portions of 14/11 GHz and 30/20 GHz frequency bands in which epfd limits apply are known to be inefficient and present clear issues with long-term epfd limits, it is urgent and necessary to review and update them. Considering the fact that the ITU framework does not result in spectrally efficient operation of modern satellite networks in the assumptions that led to the aggregate epfd limits to protect GSO networks, and from there, to the derivation of the single-entry limits, it is clear that the time has come to revisit those limits. The goal is to achieve a more efficient and rational balancing of the equities between GSO and non-GSO operations while respecting the regulatory regime.

Such an examination would be consistent with new Plenipot Resolution 219 (Bucharest, 2022), which recognizes the need to review technologies used in GSO networks and the increased number of satellites in non-GSO systems, “with a view to addressing them, if necessary, in the Radio Regulations in the processing of frequency assignments by the [BR].”¹ The same resolution calls for ITU-R studies “on the issue of the increasing use of radio-frequency spectrum and associated orbit resources in non-GSO orbits and the long-term sustainability of these resources, as well as on equitable access to, and rational and compatible use of, the GSO and non-GSO orbit and spectrum resources.”

In the proposal below, Georgia and Lithuania seek to start the review process contemplated by PP-22 and improve the ability of non-GSO FSS systems to use the Ku-band and Ka-band frequencies subject to No. 22 epfd limits (including the aggregate limits in Resolution 76 (Rev.WRC-15)). It is acknowledged that this effort will overlap to some degree with the consideration of revisions to Resolution 76 (Rev.WRC-15) to consider the establishment of a consultation process for assuring conformity with and rectifying potential exceedances of the aggregate epfd limits in that resolution and No. 22.5K and proposes to include those discussions as part of the work under this proposed Agenda Item.

¹ The new PP-22 resolution (Resolution 219 (Bucharest, 2022)) goes on to call for ITU-R studies “on the issue of the increasing use of radio-frequency spectrum and associated orbit resources in non-GSO orbits and the long-term sustainability of these resources, as well as on equitable access to, and rational and compatible use of, the GSO and non-GSO orbit and spectrum resources,” and to bring the matter to “the subsequent” WRC for consideration and necessary action.

ANNEX 1: PROPOSAL



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