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| Subject:  | Draft CEPT Brief on WRC-19 Agenda Item 1.6 |
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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON AGENDA ITEM 1.6

1.6 to consider the development of a regulatory framework for non-GSO FSS satellite systems that may operate in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space), in accordance with Resolution 159 (WRC-15).

# ISSUE

According to Resolution 159 (WRC‑15) “Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)” to conduct:

1. studies of technical and operational issues and regulatory provisions for the operation of non-GSO FSS satellite systems in the frequency bands 37.5-42.5 GHz (space-to-Earth) and 47.2-48.9 GHz (limited to feeder links only), 48.9-50.2 GHz and 50.4-51.4 GHz (all Earth-to-space), while ensuring protection of GSO satellite networks in the FSS, MSS and BSS, without limiting or unduly constraining the future development of GSO networks across those bands, and without modifying the provisions of RR Article 21;
2. studies carried out under resolves to invite ITU-R 1 shall focus exclusively on the development of equivalent power flux-density limits produced at any point in the GSO by emissions from all the earth stations of a non-GSO system in the fixed-satellite service or into any geostationary FSS earth station, as appropriate;
3. studies and development of sharing conditions between non-GSO FSS systems operating in the frequency bands listed in resolves to invite ITU-R 1 above;
4. studies of possible necessary revisions to Resolution 750 (Rev.WRC-15) to ensure protection of the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz from non-GSO FSS transmission, taking into account recognizing i) above, including study of aggregate FSS interference effects from networks and systems operating or planned to operate in the frequency bands described in resolves to invite ITU-R 1 above;
5. studies towards ensuring protection of the radio astronomy frequency bands 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz from non-GSO FSS transmissions, taking into account recognizing i) above, including study of aggregate FSS interference effects from networks and systems operating or planned to operate in the frequency bands described in resolves to invite ITU-R 1 above.

# Preliminary CEPT position

CEPT considers that studies for the development of regulatory provisions and technical and operational conditions shall ensure protection for GSO satellite networks and stations of other existing services including passive services in the adjacent frequency bands. To ensure the protection of the EESS (passive) and RAS CEPT supports to study the effects of aggregate FSS interference from GSO satellite networks and NGSO systems operating in the relevant bands.

CEPT considers that the criteria based on a new ITU-R Recommendation under development shall be used while developing the aggregate epfd limits for protection of GSO networks. CEPT supports a methodology of interference assessment that takes into account the correlation between a fading event attenuating both the wanted signal and interfering signals in the frequency bands 40/50 GHz.

CEPT supports further studies on the methodology of interference assessment applicable to frequency bands above 30 GHz.

# Background

Article 22 of the Radio Regulations contains provisions to ensure compatibility of non-GSO FSS operations with GSO networks for the 14/11 GHz and 30/20 GHz bands. Among these provisions there are uplink and downlink equivalent power flux density (epfd↑ and epfd↓) limits to protect GSO networks from unacceptable interference pursuant to RR No. 22.2. There are currently no regulatory provisions for sharing between non-GSO systems and GSO networks in the 50/40 GHz frequency bands. Furthermore, there are currently no ITU-R defined protection requirements for 50/40 GHz band GSO networks.

Latest WP 4A meeting (17 – 27 October 2017, Geneva) received a number of contributions, which included some proposals on GSO FSS and NGSO FSS, NGSO FSS and EESS (passive) and RAS, NGSO FSS and NGSO FSS studies.

NGSO FSS and GSO FSS studies

WP 4A considered the results of 6 technical studies relating to sharing between non-GSO FSS satellite systems using circular orbits and GSO networks in the 50/40 GHz bands.

Study 1 points to the need to develop regulations that facilitate maximizing the spectral efficiency of use of the 50/40 GHz bands and presents sharing considerations that should be taken into account, including technology and natural considerations such as propagation losses. The study presents an analysis of the generation of a EPFD profile masks based on generic LEO constellations of 2 000 and 4 000 service vehicles. The analysis presents a background on the methodology for deriving aggregate EPFD limits based on procedures carried out in lower frequency using Recommendations ITU-R S.1503, ITU-R P.618 and the sharing considerations given in Recommendation ITU-R S.1323. The analysis of this procedure on a representative LEO constellation shows that potential EPFD↓ masks are very system specific and variable, depending on the particular operations of the NGSO constellation chosen for defining a particular mask. The result of this study shows that there can be significant operational margin available to the GSO when propagation impairments are taken into account.

Study 2 provides a simulation and results of a study of the sharing between a non-GSO FSS satellite system in a circular equatorial orbit and a GSO system in the 48/38 GHz frequency bands. The results are shown in both EPFD and I/N statistics. The C/N and C/(N+I) curves of the GSO system and the effect on availability due to interference from the non-GSO system are also provided. Based on the input assumptions, the results show that the unavailability targets in Recommendation ITU-R S.1323 and preliminary draft new Recommendation ITU-R S.[50/40 GHz FSS Sharing Methodology] of 10% increase are met.

Study 3 presents a comparison of the LEO system presented in Study 1 and the MEO system presented in Study 2. The purpose of the comparison in this study is to present an assessment of potential sharing of these two systems, with a view to maximize spectral efficiency in the 50/40 GHz band. The analysis provides a comparison of the representative interference profiles derived in Study 1 and Study 2 relating to non-GSO constellations in LEO and MEO orbits. The analysis shows that the methodology to determine the interference profiles is extremely dependent on the characteristics of the systems being evaluated. While EPFD masks can be developed for a particular system, it is very difficult to define EPFD masks that would allow all non-GSO systems to operate and provide for maximum spectrum efficiency, while still assuring that GSO protection criteria will always be observed. The analysis also shows that if masks are developed for the operation of one particular non-GSO system, a separate non-GSO system may not be able to meet the requirements from that mask. However, each system independently, and even in composite form, might be able to meet the protection criteria given in Recommendation ITU-R S.1323 and Preliminary Draft New Recommendation ITU-R S.[50/40 GHz FSS Sharing Methodology] with some margin.

Study 4 considers both the uplink and downlink interference from two different NGSO systems into a GSO network at varying elevation angles. The two NGSO systems modelled were a LEO system at 1 200 km and a MEO system at 8 062 km. The results of the study provide levels of interference into a GSO system from two different NGSO systems, and should be considered when examining the co-existence between these two types of implementations of the FSS. It was also noted that this study did not include any propagation impairments other than free space path loss, although it was recognized that at these frequencies, rain and cloud attenuation have a significant impact on both, the wanted and interfering signals. If other attenuation losses are taken into account, it is expected that the resulting I/N ratios would be lower.

Study 5 is an analysis with a typical constellation deployment circular orbit LEO NGSO FSS system consisting of 12 orbits with 28 satellites in each orbit, which provides a total of 336 satellites in the system. Assuming that the protection criterion for GSO FSS networks is a 10% increase to unavailability caused by the interference, the criterion was not exceeded for GSO beams from both low latitude and medium latitude scenarios in this study. The levels of emissions from the NGSO system depicted in Study 5 were acceptable based on the assumptions in this study. Although the downlink pfd values of NGSO system exceeded the pfd requirement in RR Table 21-4, this study concluded that the compatibility was achieved. Given that the NGSO FSS system downlink transmitting power would need to be decreased to meet the RR Table 21-4 pfd limits, this lower power would further aid the sharing of NGSO and GSO systems. It is worth to note that the proponents of this study should further clarify some questions raised by the meeting and currently reflected as editor's note.

Study 6 is an analysis regarding interference by a NGSO system to a GSO system in the 50/40 GHz bands under different conditions in two operational scenarios for tracking the NGSO satellites. Based on criterion of 10% increase in the unavailability caused by interference it was shown in this study that by the change in some of the parameters in tracking strategy, it is possible to decrease interference from a non-GSO system. It is concluded in Study 6 that frequency sharing between GSO and non-GSO satellite networks is possible using appropriate tracking strategy.

Thus, the results of the studies carried out in ITU-R showed that compatibility between non-GSO FSS satellite systems using circular orbits and GSO networks in the 50/40 GHz bands is achievable taking into account the operational scenarios for tracking the NGSO satellites (GSO avoidance angle, minimum elevation angle etc.)

WP 4A stated that it is important that each study clearly states the assumptions made, especially regarding deployments and propagation models.

Based on information on propagation models from SG 3, and two input contributions, work progressed on the development of a new Recommendation for a 50/40 GHz sharing methodology. Considering the results of the studies conducted in ITU-R (both in WP 4A and WP 3M) it was agreed that the method, specifically dedicated to the 50/40 frequency band in this proposed new Recommendation, gives more realistic evaluations of the link degradation caused by interference while in Recommendation ITU-R S.1323-2 the attenuation of the interfering link is not taken into account leading to a pessimistic evaluation of the link budget degradation caused by interference.

NGSO FSS and NGSO FSS studies

WP 4A considered one study, which was developed to describe mitigation techniques, such as orbital avoidance angles and earth station diversity, to allow for sharing between co-frequency non-GSO FSS systems. The objective of this study is to determine the effectiveness of such techniques for sharing between next-generation non-GSO FSS constellations. This study examines the effectiveness of orbital separation angles and earth station site diversity in mitigating interference events between non-GSO FSS systems.

NGSO FSS and RAS studies

The previous meeting of WP 4A had sent an LS to WP 7D seeking clarification of protection criteria for RAS. There has not been any meeting of WP 7D since then. However, the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) responded to the questions directly to WP 4A.

WP 4A considered two studies on compatibility with RAS.

Study 1 relates to the protection of the RAS in the 42.5-43.5 GHz frequency band from interference caused by transmissions from space stations of non-GSO satellite systems. It is noted that RR No. 5.551H establishes equivalent power flux density (epfd) limits that shall not be exceeded by all space stations in any non-GSO satellite system for more than 2% of the time. As far as non-GSO satellite systems are concerned, therefore, it appears that there are already mandatory provisions in the Radio Regulations to adequately protect the RAS in the frequency band 42.5-43.5 GHz. This study describes a methodology that can be used to ensure conformance to the limits in RR No. 5.551H of a hypothetical non-GSO satellite system operating in the 42.45.5 GHz frequency band. Study 1 computes the aggregate unwanted emission levels produced by a non-GSO FSS system at the radio astronomy site using the procedure described in Recommendation ITU-R S.1586.

Study 2 relates to the protection of RAS systems from non-GSO satellite systems operating in the 47.2‑50.2 GHz and 50.4-51.4 GHz frequency bands. The results of the performed static analysis showed that coordination/ separation distances could be used to protect RAS stations in the frequency band 48.94-49.04 GHz, 51.4-54.25 GHz from the in band, out-of-band and spurious emissions of non-GSO FSS ES. The resulting coordination zones correspond to the values described in Recommendation ITU-R RA.1031.The studies are being carried out for the RAS in the frequency bands 48.94-49.04 and 51.4-54.25 GHz using protection criteria received from WP 7D.

It was noted during the WP 4A meetings that the 51.4-54.25 GHz frequency band is the subject of RR No. 5.556 “In the bands 51.4-54.25 GHz, 58.2-59 GHz and 64-65 GHz, radio astronomy observations may be carried out under national arrangements” and does not constitute an allocation.

NGSO FSS and EESS (passive) studies

The EESS (passive) frequency bands mentioned in Resolution 159 (WRC-15) are 36-37 GHz and 50.2-50.4 GHz. Both frequency bands are allocated worldwide to the EESS (passive) on a primary basis in the Table of Frequency Allocations of RR Article 5.

WP 4A considered four studies for the EESS (passive) in the PDNR. In the discussions of the studies, it was noted that a NGSO earth station deployment model is essential to determine the amount of interference that an EESS (passive) sensor may receive.

Study 1 considers protection of EESS (passive) in the 36-37 GHz and 50.2-50.4 GHz bands from non-GSO FSS transmission. It is noted in this study that the limits for FSS operating in the 49.7-50.2 GHz frequency band were derived following the results of Report ITU-R SM.2092, which assumed both GSO and non-GSO FSS satellite systems operating in the band. For the non-GSO part of the analysis, only one system was assumed. Based on this it is concluded that the aggregation of interference from earth stations operating with new non-GSO FSS satellite systems in the 50 GHz frequency band may no longer adequately protect EESS (passive) systems, in which case the single entry power density limits of Resolution 750 (Rev.WRC-15) would need to be updated. The frequency band from 36 to 37 GHz is 500 MHz away from the 37.5-42.5 GHz frequency band allocated to the FSS in the space-to-Earth direction. Under the assumptions of Study 1, the probability of exceeding the acceptable EESS interference level (-166 dB(W/100MHz) not to be exceeded for more than 0.1% of the time) is at least two orders of magnitude lower than the 0.1% criterion. These results suggest that the interference from LEO satellite systems into higher orbit EESS (passive) satellite systems operating in the 36-37 GHz band might be acceptable.

Study 2 notes the FSS allocations in the bands (47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space)) are adjacent to the EESS (passive) allocation in the 50.2-50.4 GHz band, which is critical for passive remote sensing. This band for EESS (passive) which is used as a reference window for atmospheric temperature profiling (in the lower troposphere) is also important for cloud detection and measurement as well as for surface parameters. The dynamic analyses shown in Study 2 are limited in the fact that they only consider the case of a single GSO FSS system, but they demonstrate that the power limitations in Resolution 750, when applied to GSO FSS systems operating in the 49.7-50.2 GHz and 50.4-50.9 GHz bands, may not be adequate to ensure protection to the EESS (passive) sensors in the 50.2-50.4 GHz band. The exceedance of ITU-R RS.2017 protection criteria are 2 dB, 3 dB and 14 dB for three study cases and interference from a single GSO FSS earth station within or close to the measurement area. Study 2 also notes that non-GSO FSS systems can operate today in these frequency bands in accordance with the Radio Regulations (including Resolution 750 for the 49.7-50.2 GHz and 50.4-50.9 GHz bands). ITU-R studies leading to limits in Resolution 750 on FSS earth stations in the 49.7-50.2 GHz and 50.4-50.9 GHz bands were done using both GSO and non-GSO FSS earth stations, however, on-going studies have not yet been able to reproduce these results. For this study WP 4A noted that additional studies are needed to accurately determine the aggregate interference potential considering the presence of both GSO and non-GSO FSS systems, and the results of those studies should provide the basis for potential actions in accordance with Res. 159 (WRC-15).

Study 3 was performed to determine whether the protection criteria for EESS (passive) systems operating in the bands 36-37 GHz and 50.2‑50.4 GHz are exceeded when three different non-GSO FSS systems are deployed. Three different constellations were simulated to determine their impact on EESS (passive) operations in the 36-37 GHz and 50.2-50.4 GHz bands. These constellations are representative of filings to the ITU: 1) a LEO at 1200 km; 2) a LEO at 600 km; and 3) a MEO at 8,062 km. Constellations orbiting at different altitudes (above and below the sensors) were chosen to evaluate possible differences in impact to the sensors. These studies showed that when using a worst-case OOBE mask, the interference criteria are not exceeded for the EESS sensors studied in the 36-37 GHz band and for the non-GSO FSS systems modelled. As such, a more refined study to better model OOBE into the EESS (passive) systems was not undertaken. These results suggest that non-GSO FSS systems and EESS (passive) systems in the 37 GHz range are compatible. When considering the aggregate impact of service links and gateways on those systems modelled in the 50.2-50.4 GHz band, neither the out-of-band emission mask provided in Recommendation ITU-R SM.1541 nor the limits provided in Resolution 750 were sufficient to meet the interference criteria provided in Recommendation ITU‑R RS.2017 when considering the combined impact of service links and gateways. Mitigation measures such as the implementation of guard bands or filtering could be considered to limit the levels of unwanted emissions in the band 50.2-50.4 GHz. As demonstrated in Study 3, a guard band of 100 MHz reduced the amount of time the protection criteria was exceeded and the maximum level of unwanted emission for each scenario.

Study 4 provides an analysis of the impact of unwanted emissions from NGSO FSS systems into EESS (passive) systems operating in the band 50.2-50.4 GHz. One constellation of LEO satellites at 1 200 km altitude was considered in this study. A simulation tool was developed to assess the level of interference produced in EESS sensors I1 to I4 by NGSO FSS feeder link earth stations. These simulations have shown that:

* From Study 4, the worst case is given by the nadir scanning sensors and push broom sensor, due to the fact that the gateway earth stations would point at high elevation angles.
* The protection criterion would be exceeded by up to 33 dB when considering a large number of gateway sites within the measurement area, or at least 9 dB when the number of gateway sites is limited to two. This shows that the value of -20 dBW/200 MHz currently in Resolution 750 is not sufficient.

CEPT considered two studies for the protection of the EESS (passive).

A study provided to CEPT ([PTB(17)061](https://cept.org/Documents/cpg-pt-b/39750/ptb-17-061_ai-16-and-eess-passive)) considered a 720 satellites constellation at 1200 km altitude, and a deployment of 2 gateway sites with 18 antennas tracking the 18 satellites at highest elevations above 16°, and 15 user equipment within 2 000 000 km2 around 50 degrees latitude. This study indicates that the unwanted emission limits currently in Resolution 750 for the band 50.2-50.4 GHz for GSO satellites would not be sufficient to cover the case of NGSO satellites. Based on these assumptions, this study shows that an unwanted emission limit of -50.6 dBW/200 MHz for user equipment and -53.5 dBW/200 MHz for gateways would be required to meet the EESS (passive) protection criteria in Recommendation ITU-R RS.2017, taking into account an apportionment of 3 dB. Further work is needed to consider other measurement area latitudes and the aggregate effect of GSO and NGSO FSS systems, as well as other tracking strategies.

A study provided to CEPT ([PTB(17)070](https://cept.org/Documents/cpg-pt-b/39848/ptb-17-070_ngso-eess-aggregation-ai-16)) aims to reproduce the simulation of NGSO FSS systems towards the EESS sensor as performed in 2007 with a view to re-validate the adequacy of the limits of the unwanted emission power in Resolution 750 for FSS NGSO to protect the push-broom EESS sensor in the frequency band 50.2-50.4 GHz. This study considers as a deployment model 6 Earth stations within an area of 2 000 000 km2 similar to the model that was used in Report ITU-R SM.2092 at the time to determine the limits of unwanted emission power in Resolution 750. In addition, this study also proposes to consider the longest hold for elevation angles above 20° as the tracking strategy for simulations. The study also considers the impact of four NGSO-FSS systems (24 earth stations) on a push-broom EESS sensor. The study shows that in the frequency band 50.2-50.4 GHz, the aggregate power calculated for no more than 0.01% of the time over an area of 2 000 000 km2 considering 4 NGSO system is 0.1 dB higher than what would be expected for a single NGSO system and still respects the EESS protection level.

As a result WP 4A updated:

* Working Document towards a Preliminary Draft New Report ITU-R S.[50/40 GSO-NGSO SHARING] on sharing between 50/40 GHz GSO FSS networks and non-GSO FSS systems;
* Working Document towards a Preliminary Draft New Report ITU-R S.[ 50/40 GHz ADJACENT BAND STUDIES] on the protection of EESS (passive) and RAS systems from non-GSO fixed satellite systems operating in the 37.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz frequency bands;
* Working document towards a Preliminary Draft New Report ITU-R S.[50/40 NGSO-NGSO SHARING] on study of mitigation techniques between non-GSO FSS systems;
* Work plan for WRC-19 Agenda item 1.6;
* Working document towards draft CPM Text for WRC-19 agenda item 1.6;
* Preliminary draft new Recommendation ITU-R S.[50/40 GHZ FSS SHARING METHODOLOGY] - Maximum permissible levels of interference in a satellite network (GSO and non-GSO) in the fixed-satellite service caused by other co-directional FSS networks operating in the 50/40 GHz frequency bands.

# List of relevant documents

ITU-Documentation:

* Annex 14 to Document 4A/519 – Working Document towards a preliminary draft new Report ITU-R S.[50/40 GSO-NGSO SHARING] on sharing between 50/40 GHz GSO FSS networks and non-GSO FSS systems
* Annex 16 to Document 4A/519 – Working document towards a preliminary draft new Report ITU-R S.[ 50/40 GHz ADJACENT BAND STUDIES] on the protection of EESS (passive) and RAS systems from non‑GSO fixed satellite systems operating in the 37.5-42.5 GHz, 47.2‑50.2 GHz and 50.4-51.4 GHz frequency bands under WRC-19 agenda Item 1.6
* Annex 15 to Document 4A/519 - Working document towards a preliminary draft new Report ITU-R S.[50/40 NGSO-NGSO SHARING] on study of mitigation techniques between non-GSO FSS systems
* Annex 1 to Document 4A/519 – Preliminary draft new Recommendation ITU-R S. [50/40 GHZ FSS SHARING METHODOLOGY] - Maximum permissible levels of interference in a satellite network (GSO and non-GSO) in the fixed-satellite service caused by other co-directional FSS networks operating in 50/40 GHz frequency bands
* Annex 31 to Document 4A/519 –Working document towards draft CPM Text for WRC-19 agenda item 1.6
* Annex 30 to Document 4A/519 – Work plan for WRC-19 agenda item 1.6
* Recommendation ITU-R S.1323 – Maximum permissible levels of interference in a satellite network (GSO/FSS; non-GSO/FSS; non-GSO/MSS feeder links) in the fixed-satellite service caused by other codirectional FSS networks below 30 GHz
* Recommendation ITU-R S.1325 – Simulation methodologies for determining statistics of short-term interference between co-frequency, codirectional non-geostationary-satellite orbit fixed-satellite service systems in circular orbits and other non-geostationary fixed-satellite service systems in circular orbits or geostationary-satellite orbit fixed-satellite service networks;
* Recommendation ITU-R S.1328 – Satellite system characteristics to be considered in frequency sharing analyses within the fixed-satellite service
* Recommendation ITU-R S.1529 – Frequency sharing of the bands 19.7-20.2 GHz and 29.5-30.0 GHz between systems in the mobile-satellite service and systems in the fixed-satellite service
* Recommendation ITU-R S.1557 – Operational requirements and characteristics of fixed-satellite service systems operating in the 50/40 GHz bands for use in sharing studies between the fixed-satellite service and the fixed service
* Recommendation ITU-R RS.515 – Frequency bands and bandwidths used for satellite passive remote sensing
* Recommendation ITU-R RS.1259 – Feasibility of sharing between space borne passive sensors and the fixed service from 50 to 60 GHz
* Recommendation ITU-R RS.1803 – Technical and operational characteristics for passive sensors in the Earth exploration-satellite (passive) service to facilitate sharing of the 10.6-10.68 GHz and 36-37 GHz bands with the fixed and mobile services
* Recommendation ITU-R RS.1813 – Reference antenna pattern for passive sensors operating in the Earth exploration-satellite service (passive) to be used in compatibility analyses in the frequency range 1.4-100 GHz
* Recommendation ITU-R RS.1861 – Typical technical and operational characteristics of Earth exploration-satellite service (passive) systems using allocations between 1.4 and 275 GHz
* Recommendation ITU-R RS.2017 – Performance and interference criteria for satellite passive remote sensing
* Recommendation ITU-R RS.2064 – Typical technical and operating characteristics and frequency bands used by space research service (passive) observation systems
* Recommendation ITU-R SM.1542– The protection of passive services from unwanted emissions
* Recommendation ITU-R SM.1633 – Compatibility analysis between a passive service and an active service allocated in adjacent and nearby bands
* Report ITU-R SM.2092 – Studies related to the impact of active services allocated in adjacent or nearby bands on Earth exploration-satellite service (passive)
* Report ITU-R SM.2091 – Studies related to the impact of active services allocated in adjacent or nearby bands on radio astronomy service
* Report ITU-R RS.2095 – Sharing of the 36-37 GHz band by the fixed and mobile services and the Earth exploration-satellite service (passive)
* Recommendation [ITU-R RA.314](http://www.itu.int/rec/R-REC-RA.1513/en) – Preferred frequency bands for radio astronomical measurements
* Recommendation [ITU-R RA.517](http://www.itu.int/rec/R-REC-RA.1513/en) – Protection of the radio astronomy service from transmitters operating in adjacent bands
* Recommendation [ITU-R RA.611](http://www.itu.int/rec/R-REC-RA.1513/en) – Protection of the radio astronomy service from spurious emissions
* Recommendation [ITU-R RA.769-2](http://www.itu.int/rec/R-REC-RA.769/en) – Protection criteria used for radio astronomical measurements
* Recommendation [ITU-R RA.1031](http://www.itu.int/rec/R-REC-RA.1513/en) – Protection of the radio astronomy service in frequency bands shared with other services
* Recommendation [ITU-R RA.1513](http://www.itu.int/rec/R-REC-RA.1513/en) – Levels of data loss to radio astronomy observations and percentage-of-time criteria resulting from degradation by interference for frequency bands allocated to the radio astronomy service on a primary basis
* Recommendation [ITU-R RA.1631](http://www.itu.int/rec/R-REC-RA.1513/en) – Reference radio astronomy antenna pattern to be used for compatibility analyses between non-GSO systems and radio astronomy service stations based on the epfd concept
* Recommendation [ITU-R S.1586-1](http://www.itu.int/rec/R-REC-S.1586/en) – Calculation of unwanted emission levels produced by a non-geostationary fixed-satellite service system at radio astronomy sites
* Recommendation ITU-R SA.1396 – Protection criteria for the space research service in the 37-38 and 40-40.5 GHz bands
* Recommendation ITU-R SA.2079 – Frequency sharing between SRS and FSS (space-to-Earth) systems in the 37.5-38 GHz band Report ITU-R RA.2126 – Techniques for mitigation of radio frequency interference in radio astronomy
* Report ITU-R RA.2131 – Supplementary information on the detrimental threshold levels of interference to radio astronomy observations in Recommendation ITU-R RA.769
* Report ITU-R RA.2188 – Power flux-density and e.i.r.p. levels potentially damaging to radio astronomy receivers

CEPT and/or ECC Documentation:

* ERC/DEC/(00)02 ERC Decision of 27 March 2000 on the use of the band 37.5 - 40.5 GHz by the fixed service and Earth stations of the fixed - satellite service (space-to-Earth)
* ECC/DEC/(05)08 The availability of frequency bands for high density applications in the Fixed-Satellite Service (space-to-Earth and Earth-to-space). Approved 24 June 2005/ Amended 8 March 2013
* [ECC/DEC/(02)04 The use of the band 40.5 – 42.5 GHz by terrestrial (fixed service/ broadcasting service) systems and uncoordinated Earth stations in the fixed satellite service and broadcasting-satellite service (space to Earth)](http://www.efis.dk/documents/15427)
* ERC/REC 12-11 Radio frequency channel arrangements for Fixed Service systems operation in the bands 48.5-50.2 / 50.9-52.6 GHz

# Actions to be taken

Finalize technical characteristics of potential non-GSO and GSO FSS systems, which may operate in the frequency bands 37.5‑39.5 GHz, 39.5‑42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz and to encourage contributions relating to services in the bands and adjacent bands to facilitate the studies toward coexistence of services

To identify deployment model(s), GSO arc avoidance and tracking strategy for potential non-GSO systems, which may operate in the frequency bands 37.5‑39.5 GHz, 39.5‑42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz with particular attention to frequency bands close to the EESS passive band 50.2-50.4 GHz

To prepare proposals to preliminary draft new Report ITU-R S.[NGSO 50/40 GHz SHARING]

To consider aggregate interference effect on EESS (passive) from FSS GSO satellite networks and NGSO systems operating in the adjacent bands

To consider aggregate interference effect on RAS from FSS GSO satellite networks and NGSO systems operating in the relevant bands

To consider technical, operational and regulatory provisions that would take into account the effect of aggregate interference into incumbent services

To prepare proposals to preliminary draft new Report on protection of EESS (passive) and RAS systems from non‑GSO fixed satellite systems operating in the 37.5-42.5 GHz, 47.2‑50.2 GHz and 50.4-51.4 GHz frequency bands

To prepare proposals to revise, if and as appropriate, Resolution 750 (Rev.WRC-15) for NGSO systems, based on studies of aggregate FSS interference effects from GSO satellite networks and NGSO systems operating in the adjacent bands

Update a preliminary draft new Recommendation ITU-R S. [50/40 GHZ FSS SHARING METHODOLOGY] - Maximum permissible levels of interference in a satellite network (GSO and non-GSO) in the fixed-satellite service caused by other co-directional FSS networks operating in the 50/40 GHz frequency bands

Continue sharing and compatibility studies and development of sharing conditions between non-GSO FSS systems operating in the frequency bands 37.5-42.5 GHz (space-to-Earth) and 47.2-48.9 GHz (limited to feeder links only), 48.9-50.2 GHz and 50.4-51.4 GHz (all Earth-to-space)

To carry out studies towards ensuring protection of the Space research service in the frequency band 37/38 GHz (space-to-Earth) from non-GSO FSS LEO and MEO transmissions;

To prepare proposals to the draft CPM Report

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations

APT (July 2017)

APT Members support studies on technical and operational issues and regulatory provisions of non-GSO FSS satellite systems in the frequency bands 37.5- 39.5 GHz (space-to-Earth), 39.5 - 42.5 GHz (space to Earth), 47.2 - 50.2 GHz (Earth-to-space) and 50.4 - 51.4 GHz (Earth-to-space) while ensuring protection to GSO satellite networks in FSS, MSS and BSS, and other existing services in the same bands as well as protection of the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz and the radio astronomy in the frequency bands 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz.

ATU (September 2017)

The APM19-2 agreed to:

Support the studies under Resolution 159 (WRC-15) which aim at developing a regulatory framework for new non-GSO FSS satellite systems, while protecting GSO FSS systems in the frequency bands above 30 GHz.

Encourage administrations to contribute towards further development of the three working documents in WP4A.

Note that the overlap in frequency bands with other AIs should not be an issue because this AI does not involve spectrum allocation/identification but rather regulatory framework for non-GSO FSS satellite systems in the stated four bands.

Arab Group (April 2017)

Protect the fixed-satellite service systems in GSO either by adequate epfd levels or any other methodologies or according to wave propagation models in the frequency bands above 30 GHz.

Consult the satellite operators of the team to determine the epfd value that ensures the protection of the satellite networks in the geostationary orbital positions and the opinion for the proposed mechanism.

CITEL (December 2017)

Canada supports the studies under Resolution 159 (WRC-15) to develop a regulatory framework for new non-GSO FSS satellite systems. For the band 36-37 GHz: Canada is of the view that based on the results of studies, EESS (passive) systems operating in the 36- 37 GHz band and non-GSO FSS systems are compatible and no regulatory measures are required to address the compatibility between these two services. For the band 50.2-50.4 GHz: Canada is of the view that based on the results of studies, mitigation techniques and/or regulatory measures may be required to ensure compatibility between EESS (passive) systems operating in the band 50.2-50.4 GHz and non-GSO FSS systems. Canada is of the view that the use of the bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) by non-GSO FSS systems should be subject to coordination procedures under No. 9.12.

The United States supports studies under WRC-19 Agenda Item 1.6 regarding the development of a regulatory framework for non-GSO satellite systems in the existing FSS allocations in the 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) frequency bands under the terms of Resolution 159 (WRC-15) and to take appropriate action based on the results of these studies.

RCC (September 2017)

The RCC Administrations consider that studies on technical and operational issues and regulatory provisions in order to ensure operation of non-GSO FSS satellite systems in the frequency bands 37.5-42.5 GHz (space-to-Earth), 47.2-48.9 GHz (limited to feeder links), 48.9-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) shall ensure protection to GSO satellite networks in FSS, MSS and BSS, and also to stations of other existing services in the same and adjacent frequency bands.

The RCC Administrations consider that technical conditions and regulatory provisions should be developed to ensure sharing of the considered frequency bands between non-GSO FSS systems.

The RCC Administrations consider that when conducting studies, protection shall be ensured to EESS (passive) in the frequency bands 36-37 GHz, 47.5-48.5 GHz and 50.2-50.4 GHz, and also to the radio astronomy service in the frequency bands 42.5-43.5 GHz, 48.94-49.04 GHz and 51.4-54.25 GHz from non-GSO FSS transmissions.

The RCC Administrations find it reasonable to study the impact of aggregate interference from non-GSO FSS networks and systems operated or planned to be operated in the frequency bands 37.5-42.5 GHz (space-to-Earth), 47.2-48.9 GHz (limited to feeder links), 48.9-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) with the purpose of possible revision of Resolution 750 (Rev. WRC-15) "Compatibility between the Earth exploration-satellite service (passive) and relevant active services".

The RCC Administrations consider it reasonable to study modification of interference assessment methodology specified in the Recommendation ITU-R S.1323 (Methodology A) with the purpose to broaden applicability of the methodology in the frequency bands above 30 GHz, including through the development of a new Recommendation ITU-R considering a correlation between hydrometeor fading both for wanted and interference signals taking into account statistical e.i.r.p. variations in systems with the power control in the frequency bands 40/50 GHz.

## International organisations

IATA (date of proposal)

ICAO (date of proposal)

IMO (date of proposal)

SFCG, ESA (June, 2016)

SFCG supports studies to consider a review of the regulatory framework for non-GSO FSS satellites systems addressed under WRC-19 AI 1.6. However, SFCG does not support revisions to the existing regulatory framework for non-GSO FSS systems unless studies conclude the existing protection of space science services, including passive sensing, will be preserved. This may result in possible necessary revisions to Resolution 750 (Rev.WRC-15) to ensure protection of the EESS (passive) in the frequency bands 36-37 GHz and 50.2-50.4 GHz from non-GSO FSS transmissions.

WMO and EUMETNET (February 2017)

EUMETNET

No opposition to the development of a regulatory framework for non-GSO FSS satellite systems in the 37.5-51.4 GHz range provided that protection of EESS (Earth-to-space), EESS (passive) and ground-based radiometers is ensured.

WMO

WMO supports the development of a regulatory framework (including revisions to Resolution 750 (Rev.WRC-15) for non-GSO FSS satellite systems in the 37.5-51.4 GHz range provided that protection of EESS (Earth-to-space) in the band 40-40.5 GHz and EESS (passive) in the bands 36-37 GHz and 50.2-50.4 GHz is ensured by including appropriate unwanted emission limits in Resolution 750 (rev. WRC-15).

WMO would appreciate the development of a solution to ensure the effective operation of the ground-based radiometers in the 50.4-51.4 GHz frequency band.

## Regional organisations

Eurocontrol (date of proposal)

NATO (23 June, 2017)

This NATO military assessment summary is a common military assessment of the NATO Nations on the potential impacts and benefits of Agenda Item 1.6. It does not constitute a common position of the NATO Nations.

There does not seem to be any impact on military capabilities at this stage.

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)

CRAF (March 2017)

CRAF supports the protection of existing RAS and EESS (passive) allocations in the 42.5 - 43.5 GHz, 48.94 - 49.04 GHz, and 50.2 - 50.4 GHz. No changes should be made to the RR unless acceptable sharing and compatibility criteria are developed with the RAS and EESS (passive).