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| **Radiocommunication Study Groups** |  |
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| Source:Document [7B/170 Annex 5](https://www.itu.int/dms_ties/itu-r/md/15/wp7b/c/R15-WP7B-C-0170!N05!MSW-E.docx), [7B/189](https://www.itu.int/md/R15-WP7B-C-0189/en), [7B/217](https://www.itu.int/md/R15-WP7B-C-0217/en), [7B/225](https://www.itu.int/md/R15-WP7B-C-0225/en), [7B/232](https://www.itu.int/md/R15-WP7B-C-0232/en)  Subject: WRC-19 AI 1.7 – Draft CPM Text | **Annex 5 to Document 7B/238-E** |
| **6 November 2017** |
| **English only** |
| Annex 5 to Working Party 7B Chairman's Report | |
| Draft CPM Text for WRC-19 AGENDA ITEM 1.7 | |
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*1.7 to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution****659******(WRC‑15)****;*

Resolution **659 (WRC‑15)**: Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions

# 4/1.7/1 Executive summary

Study the spectrum requirements for telemetry, tracking and command in the space operation service for the growing number of non-GSO (NGSO) satellites with short duration missions, taking into account RR No. **1.23** and assess the suitability of existing allocations to the space operation service in the frequency range below 1 GHz, taking into account current use and that the existing allocations to the space operation service below 1 GHz, where RR No. **9.21** applies, are not suitable for NGSO satellites with short duration missions.

If studies of the current allocations to the space operations service indicate that requirements cannot be met in existing space operation service bands below 1 GHz, conduct sharing and compatibility studies, and study mitigation techniques to protect the incumbent services, both in-band as well as in adjacent bands, in order to consider possible new allocations or an upgrade of the existing allocations to the space operation service within the frequency ranges 150.05-174 MHz and 400.15‑420 MHz.

*{Editor’s note: This draft CPM text is based on a limited number of studies and will require further update as more studies are contributed}*

# 4/1.7/2 Background

Agenda item 1.7 invites studies to accommodate spectrum requirements for telemetry, tracking, and telecommand in the space operation service for non-geostationary satellites with short duration missions. These types of missions provide an affordable means to access orbital resources (spectrum and orbit) for new entrants in space. The mass and dimensions of these satellites have been some of the major contributing factors to their success among new spacefaring nations, thus the demand for suitable allocations, in particular, to the space operation service, will likely increase. However, it is important to ensure that any satellite radio-frequency operation avoids harmful interference to other systems and services. The frequency bands below 1 GHz under consideration for new or upgraded allocation -- 150.05-174 MHz and 400.15-420 MHz -- are used for a wide variety of terrestrial and space applications, some of which are heavily used and new allocations to the space operation service in these frequency bands should not put undue constraints on incumbent services.

The term “short duration mission” used in Resolution **659 (WRC-15)** refers to a mission having a limited period of validity of not more than typically three years. Therefore, the term “short duration mission” is not directly tied to the lifetime of the spacecraft. For example, a single spacecraft with a lifetime of less than typically 3 years, where the operator does not launch a replenishment or replacement spacecraft, is a short duration mission. However, in the case of a (or multiple) spacecraft with a lifetime of less than typically 3 years, where the operator launches a (or multiple) replenishment or replacement spacecraft(s) such that the operator has a persistent frequency assignments longer than typically 3 years, is not a short duration mission.

## 4/1.7/2.1 Exclusion of the band 406-406.1 MHz

The frequency band 406–406.1 MHz, allocated exclusively to the mobile satellite service, is within the studied frequency range of 400.15-420 MHz. Resolution **659 (WRC-15)** recognizes the provisions contained in RR No. **5.266**, RR No. **5.267** and Resolution **205 (Rev.WRC-15)**. This band is used by the COSPAS-SARSAT system for safety of life purposes, therefore the 406‑406.1 MHz band should not be considered for an allocation to the space operation service. Protection of safety-of-life systems operating this frequency band is further described in Article **31** and Appendix **15** of the Radio Regulations. Since the frequency bands 403-406 MHz and 406.1‑420 MHz are under consideration for an SOS allocation, adjacent band interference to COSPAS-SARSAT has been studied and is addressed in Section 4/1.7/3.12.

# 4/1.7/3 Summary and Analysis of the results of ITU-R studies

## 4/1.7/3.1 Relevant ITU-R Recommendations

Recommendation ITU-R [SA.363](http://www.itu.int/rec/R-REC-SA.363/en): “Space operation systems”

Recommendation ITU-R [SA.514](http://www.itu.int/rec/R-REC-SA.514/en): “Interference criteria for command and data transmission systems operating in the earth exploration-satellite and meteorological-satellite services”.

Recommendation ITU-R [SA.609](http://www.itu.int/rec/R-REC-SA.609/en): “Protection criteria for radiocommunication links for manned and unmanned near-Earth research satellites”.

Recommendation ITU-R [F.699](http://www.itu.int/rec/R-REC-F.699/en): “Reference radiation patterns for fixed wireless system antennas for use in coordination studies and interference assessment in the frequency range from 100 MHz to about 70 GHz”

Recommendation ITU-R [F.758](http://www.itu.int/rec/R-REC-F.758/en): “System parameters and considerations in the development of criteria for sharing or compatibility between digital fixed wireless systems in the fixed service and systems in other services and other sources of interference”

Recommendation ITU-R [SA.1163](http://www.itu.int/rec/R-REC-SA.1163/en): “Interference criteria for service links in data collection systems in the earth exploration and meteorological-satellite services”.

[Preliminary draft revised] Recommendation ITU-R RS.1165 Technical characteristics and performance criteria for systems in the meteorological aids service in the 403 MHz and 1680 MHz bands

[Preliminary draft revised] Recommendation ITU-R RS.1263 Interference Criteria for Meteorological Aids Operated in the 400.15-406 MHz and 1668.4-1700 MHz Bands

Recommendation ITU-R [F.1336](http://www.itu.int/rec/R-REC-F.1336/en): “Reference radiation patterns of omnidirectional, sectoral and other antennas for the fixed and mobile service for use in sharing studies in the frequency range from 400 MHz to about 70 GHz”

Recommendation ITU-R [M.1478](http://www.itu.int/rec/R-REC-M.1478/en): “Protection criteria for Cospas-Sarsat search and rescue instruments in the band 406-406.1 MHz”.

Recommendation ITU-R [M.1808](http://www.itu.int/rec/R-REC-M.1808/en): “Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies”.

Recommendation ITU-R [SA.2044](http://www.itu.int/rec/R-REC-SA.2044/en): “Protection criteria for non-GSO data collection platforms in the band 401-403 MHz”.

Recommendation ITU-R [M.2046](http://www.itu.int/rec/R-REC-M.2046/en): “Characteristics and protection criteria for non-geostationary mobile-satellite service systems operating in the band 399.9-400.05 MHz”

Recommendation ITU-R [SA.2045](http://www.itu.int/rec/R-REC-SA.2045/en): (12/2013) Basic general partitioning and sharing conditions for the band 401-403 MHz for future long-term coordinated use of data collection systems on geostationary and non-geostationary MetSat and Earth exploration-satellite service systems

Recommendation ITU-R [RA.769-2](http://www.itu.int/rec/R-REC-RA.769/en): “Protection criteria used for radio astronomical measurements”

## 4/1.7/3.2 Results of Spectrum Requirements Studies

This study determined the amount of TT&C spectrum required for short duration NGSO missions, based on the protection criteria as outlined in Recommendation ITU-R SA.363-5.

Simulations have shown that the protection criteria could be exceeded for the case of 2 satellite – earth station pairs, for example in simulation 1 of DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS]. On the other hand, for 8 satellite – earth station pairs in simulation 1 there are still simulation runs showing no violation of the protection criteria, although the vast majority of simulation runs do give a violation of the protection criteria for this number of satellite – earth station pairs. If the visibility cones of the randomly picked earth stations overlap, violation of the protection criteria is almost certain. If the distribution is such that there is little overlap, there can also be cases where the protection criteria are not exceeded. Therefore, in practice, some inter-operator coordination may be necessary. Furthermore such coordination may be necessary to account for the fact the satellite population is dynamic, i.e. satellites are added over time, while other satellites have reached end of mission. Furthermore, it is expected that some of the 300 satellite – earth station combinations will be in centrally-controlled multi-satellite (and earth station) systems, in which spectrum use is coordinated and thus efficiencies are gained.

Taking the above observations into account, the spectrum requirements for short duration NGSO systems range from 0.625 MHz to 2.5 MHz in the space-to-Earth direction, and from 0.682 MHz to 0.938 MHz in the Earth-to-space direction, depending on the operational scenario.

## 4/1.7/3.3 150.05-153 MHz band (Radio Astronomy Service)

Radio astronomy service in the band 150.05-153 MHz:

A study was performed in the Earth-to-space direction to determine compatibility between short duration NGSO earth station transmitters and radio astronomy systems. The results show that, when the NGSO short duration satellite system earth station transmitter is pointed in azimuth towards the RAS receiver with an elevation angle of 5°, a separation distance of at least 200 km is required to ensure that the RA Protection Criteria is met. Therefore, as this would severely limit the locations where earth stations could be located, co-channel co-existence is not feasible in this band.

## 4/1.7/3.4 154-156 MHz band (Space surveillance radars)

Space surveillance radars operating in the frequency band 154-156 MHz can cause unacceptable interference to SOS systems in Earth-to-space direction for command of NGSO satellites with short duration missions. Unacceptable interference could result in satellite control loss. It was also shown that the space surveillance radars operating in the frequency bands 154-156 MHz can suffer unacceptable interference from such systems in the space-to-Earth direction. Therefore sharing of SOS systems (Earth-to-space and space-to-Earth) with the radiolocation systems in the frequency band 154-156 MHz is not feasible.

## 4/1.7/3.5 156-162.0375 MHz band (GMDSS)

NGSO SOS space and earth stations can cause interference to GMDSS receiving stations in the following scenarios:

1. Interference to ship station is caused by SOS space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz, 162.025 MHz.
2. Interference to coast station is caused by SOS space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.650 MHz, 156.8 MHz, 161.975 MHz, 162.025 MHz.
3. Interference to space station is caused by SOS space and earth stations on the frequencies 161.975 MHz, 162.025 MHz.
4. Interference to aircraft station is caused by SOS space and earth stations on the frequencies 156.3 MHz, 156.525 MHz, 156.8 MHz, 161.975 MHz, 162.025 MHz.
5. It is noted that for each frequency given above, the channel bandwidth is the center frequency ±12.5kHz.

## 4/1.7/3.6 150.05-174 MHz band (Land Mobile Service)

Sharing studies with land-mobile systems in the frequency band 150.05-174 MHz:

1 Sharing between short duration NGSO satellites and land-mobile stations in the 150.05-174 MHz frequency band is not feasible.

2 Sharing between short duration NGSO earth-stations and land-mobile stations in the 150.05‑174 MHz frequency band is not feasible.

## 4/1.7/3.7 400.15-401 MHz band

Based on the simulation studies, it is seen that the levels of mutual interference between SRS s-E transmissions and SOS s-E transmissions in the band 400.15-401 MHz would exceed the relevant ITU-R thresholds by large amounts for single-entry cases. Aggregate interference would increase these levels of exceedance. Therefore, sharing between SOS and SRS in this band is not feasible.

Studies performed on sharing between MetSat s-E transmissions and SOS s-E transmissions from NGSO short duration satellites in the 400.15-401 MHz band show that the relevant ITU-R allowable interference thresholds are exceeded by 23 dB. Therefore the results of the studies show that an upgrade of the SOS (s-E) allocation from secondary to primary as per invites 3 of Resolution 659 cannot be made.

## 4/1.7/3.8 401-402 MHz band

{*Editor’s note: Also refer to section 4/1.7/3.11 for a discussion applicable to the frequency band 401-406 MHz*}

### 4/1.7/3.8.1 401-402 MHz SOS (space-to-Earth)

The following scenarios for the interference from SOS space-to-Earth direction to GSO spacecraft DCS receivers were analyzed: static single-entry interferer, static aggregate interferers, dynamic single-entry interferer, and dynamic aggregate interferers. Studies concluded that transmissions to earth stations associated with short-duration NGSO satellites would cause harmful interference to the uplink DCS signals received at GSO spacecraft receiver.

Therefore, NGSO satellites short duration systems with SOS (s-E) characteristics as described in DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] and GSO and NGSO DCS E-S networks in the 401-402 MHz frequency band are not compatible unless technical and/or operational mitigation measures are developed to sufficiently mitigate interference. No mitigation techniques have been identified.

### 4/1.7/3.8.2 401-402 MHz SOS (Earth-to-space)

The following scenarios for the interference from SOS Earth-to-space direction to GSO and NGSO spacecraft DCS receivers were analyzed: static single-entry interferer, static aggregate interferers, dynamic single-entry interferer, and dynamic aggregate interferers. The results of the studies using characteristics of the NGSO SD systems specified in DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] show that the levels of interference from NGSO SD SOS Earth-to-space transmissions to the GSO and NGSO DCS receivers in the frequency band 401-402 MHz would exceed the relevant ITU-R thresholds and are therefore not compatible.

Sharing will not be feasible unless mitigation techniques are developed. No mitigation techniques have been identified.

## 4/1.7/3.9 402-403 MHz band

Based on the studies conducted for the 401-402 MHz band above it is concluded that the sharing scenario between NGSO SD and MetSat systems and conclusions would be identical in the 402-403 MHz band. Therefore sharing between NGSO SD SOS and MetSat in this band is not feasible unless mitigation techniques are developed. No mitigation techniques have been identified.

## 4/1.7/3.10 403-406 MHz band (NGSO SD Earth-space)

[A study was performed in the Earth-to-space direction in order to determine the separation distance required to protect radiosondes operating under the MetAids service from short duration NGSO earth station transmitters.

This study has focussed on interference from the SOS Earth-to-space transmissions in the UK. Due to recent developments in Radiosonde technology, it is unlikely that some MetAid systems will require the whole band in the future.

This study has shown that there is scope for [spectrum allocations and] coexistence between the SOS (E-s) service and the balloon-borne radiosondes in the MetAid service in the 403-406 MHz band.]

{Editor’s note: The notes below are based on input received from 7C-1 in October 2017 during a joint session with the 7B-1 AI 1.7 Drafting Group. These editor’s notes are provided as suggestions for revisions to the studies and CPM text related to compatibility with radiosondes in 403-406 MHz in contributions to the next meeting of WP 7B}

**{General Notes}**

{Editor’s note: Operational perspectives of and including frequency requirements, needs to be considered.}

{Editor’s note: One study indicates (regarding the long-term protection criteria) smaller required separation distances to protect radiosonde receivers compared to the other studies on this issue. The cause for the difference needs to be further investigated since the input parameters seem to be mostly consistent across all 3 studies.}

{Editor’s note: In order to compare the results of studies, the same propagation models and the associated parameters should be used.}

{Editor’s note: The differences in studies (regarding the long-term protection criteria) must be resolved through additional study work before final conclusions are derived from studies.}

{Editor’s note: Sharing studies with dropsondes and rocketsondes have not been studied.}

{Editor’s note: Radiosonde characteristics and protection criteria from the draft revisions to ITU-R RS.1165 and ITU-R RS.1263, respectively, needs to be taken into account.}

{Editor’s note: This study uses terrain profiles applicable to specific radiosonde locations in the U.K. Since radiosondes are operated globally, the analysis should also consider a more generic terrain and sharing conditions that would ensure protection of radiosonde receivers from NGSO SD on a global basis.}

{Editor’s note: Many WP 7C participants are unfamiliar of the propagation model ITU-R P.1812. Much work in WP 7C uses the propagation model ITU-R P.452. It is recommended that a propagation model be agreed by WP 7B to be used for updates to these studies. NOTE: UK indicated that they will research applicable recommendation to see if they can agree to P.452}

{Editor’s note: The radiosonde short-term interference criteria needs to be considered}

{Editor’s note: The notes above also apply to the section 3.11 below}

## 4/1.7/3.11 401-406 MHz band (NGSO SD space-Earth path)

[Based on the results of PDN Report ITU-R SA.[SHORT DURATION NGSO - SHARING] of existing radiosondes system in this frequency band it indicate that co-channel operation between radiosondes operating in the meteorological aids service and NGSO SD satellite downlinks using characteristics in DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] operating in the Space Operations Service may not be possible in the same geographic location and at the same time. Furthermore, result of studies using new radiosonde system characteristics, showed that the long term (20% of the time) protection criteria are exceeded by 8.7-19.2 dB and for the short term (0.2% of the time) protection criteria are exceeded by 15.5-20.2 dB radiosondes across a number of orbital heights and latitudes. Studies were performed on impact from radiosondes into the NGSO SD satellite systems. The results of studies indicate that co-channel operation between radiosondes operating in the meteorological aids service and NGSO SD satellite downlinks using characteristics in DN Report ITU-R SA.[SHORT DURATION NGSO – CHARACTERISTICS] operating in the Space Operations Service may not be possible in the same geographic area and at the same time.]

{Editor’s note: USA to provide updated text at next meeting in May 2018}

## 4/1.7/3.12 406-406.1 MHz band

As noted in section 4/1.7/2.1 the frequency band 406-406.1 MHz should not be considered for an allocation to the space operation service. However, the protection provided by RR **5.267** (any emission capable of causing harmful interference to the authorized uses of the band 406-406.1 MHz is prohibited) also includes protection from out-of-band emissions from services which might operate in frequencies adjacent to 406-406.1 MHz.

Analysis of proposed NGSO SD satellite systems operating in frequencies adjacent to 406‑406.1 MHz concluded that transmissions would exceed the emergency position indicating radio beacon (EPIRB) maximum permissible level of interference. However, the implementation of guard bands of 100 kHz above 406.1 MHz and below 406 MHz would protect the spaceborne COSPAS-SARSAT receivers operating in the 406-406.1 MHz frequency band from NGSO SD space-to-Earth transmissions. Additionally, the implementation of guard bands of 1 MHz below 406 MHz and 900 kHz above 406.1 MHz applied to the NGSO SD satellite earth stations would protect the spaceborne COSPAS-SARSAT receivers.

## 4/1.7/3.13 406.1-410 MHz band

Analysis of sharing between NGSO SD satellites and land-mobile and fixed stations in the 406.1‑410 MHz frequency band showed that sharing is not feasible. The analysis also showed that sharing between NGSO SD earth-stations and land-mobile and fixed stations in the 406.1-410 MHz frequency band is not feasible.

## 4/1.7/3.14 410-420 MHz band

Eight scenarios were studied for the compatibility of the command system for NGSO satellites with short duration missions with Space to Space Communication System (SSCS) in the space research service from the International Space Station (ISS) for frequencies 414.2 MHz (Primary) and 417.1 MHz (Backup). The results from the eight different scenarios indicate that sharing is not feasible.

Analysis of sharing between short duration NGSO satellites and land-mobile and fixed stations in the 410-420 MHz frequency band showed that sharing is not feasible. The analysis also showed that sharing between short duration NGSO earth-stations and land-mobile and fixed stations in the 410‑420 MHz frequency band is not feasible.

## 4/1.7/3.15 Summary of Studies

Table 1 and Table 2 below are excerpted from the preliminary draft new Report ITU-R SA.[short duration NGSO – SHARING STUDIES], and summarize the results of studies done with regard to the study of the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution **659** **(WRC‑15)**.

{Editor’s note: the bands 148-149.9 MHz and 449.75-450.25 (E-s) are not covered in table 1 below as it was not agreed that these bands fall into the scope of potential upgrades under Res. **659** (further discussion on this topic is required at the next meeting in May 2018)}

Table 1

Potential for Upgrade of Existing worldwide harmonized allocations to the space operation service

| Frequency band [MHz] | Status | Direction | Allocated bandwidth [MHz] | Upgrade Possible? | Study Reference/ Remarks |
| --- | --- | --- | --- | --- | --- |
| 30.005-30.010 | Primary | N/A | 0.005 | N/A | Satellite identification |
| 137-137.025 | Primary | space-to-Earth | 0.025 | N/A |  |
| 137.025-137.175 | Primary | space-to-Earth | 0.15 | N/A |  |
| 137.175-137.825 | Primary | space-to-Earth | 0.65 | N/A |  |
| 137.825-138 | Primary | space-to-Earth | 0.175 | N/A |  |
| 267-272 | Secondary | space-to-Earth | 5 | Not Studied Yet | **5.257** states that “The band 267-272 MHz may be used by administrations for space telemetry in their countries on a primary basis, subject to agreement obtained under No. **9.21**” |
| 272-273 | Primary | space-to-Earth | 1 | N/A |  |
| 400.15-401 | Secondary | space-to-Earth | 0.85 | No | Refer Study 8.1 (SOS s-E to MetSat s-E ground receivers)  Note: Upgrade May not be feasible. |
| No | Refer Study 8.2 (SOS s-E to SRS s-E receivers)  Note: allocation (upgrade) cannot be made |
| 401-402 | Primary | space-to-Earth | 1 | N/A | **s-E** - Refer Study 9.7 (SOS s-E to GSO & NGSO MetSat receivers)  Note: May not be compatible unless technical and/or operating mitigation  Note: Primary allocation to SOS s-E already exists |

Table 2

Potential for new allocations to the space operation service

| Frequency band [MHz] | Bandwidth [MHz] | Sharing possible?  E-s | Sharing possible?  s-E | Remarks |
| --- | --- | --- | --- | --- |
| VHF |  |  |  |  |
| 150.05-153 | 2.95 | No | No | Refer Study 9.11 (RAS) |
| 150.05-174 | 23.95 | No | No | Refer Study 9.3.1 & 9.3.2 (LMS) |
| 154-156 | 2.0 | No | No | Refer Study 9.1 (Surveillance Radar to NGSO sat receivers) and (NGSO sat emissions to radar ops) |
| 156.2875-156.3125 | 0.025 | No | No | Refer Table 5 & Study 9.2 (GMDSS freq 156.3 & 156.2875-156.3125)(VHF-CH06) |
| 156.5125-156.5375 | 0.025 | No | No | Refer Table 5 & Study 9.2 (GMDSS freq 156.525 & 156.5125-156.5375)(VHF-CH70) |
| 156.6375-156.6625 | 0.025 | No | No | Refer Table 5 & Study 9.2 (GMDSS freq 156.650 & 156.6375-156.6625)(VHF-CH13) |
| 156.7875-156.8125 | 0.025 | No | No | Refer Table 5 & Study 9.2 (GMDSS freq 156.8 & 156.7875-156.8125) (VHF-CH16) |
| 161.9625-161.9875 | 0.025 | No | No | Refer Table 5 & Study 9.2 (interference to GMDSS – AIS-SART VHF CH AIS 1) |
| 162.0125-162.0375 | 0.025 | No | No | Refer Table 5 & Study 9.2 (interference to GMDSS – AIS-SART VHF CH AIS 2) |
| 162.0375-174 | 11.9625 | No | No | Refer Study 9.3.3 & 9.3.4 (LMS) |
|  |  |  |  |  |
| **UHF** |  |  |  |  |
| 400.05-400.15 | 0.1 |  |  | No studies conducted. |
| 400.15-401 | 0.85 | N/A? | No | Refer Study 8.1 (SOS s-E to MetSat s-E ground receivers)  Note: Upgrade May not be feasible. |
| No | Refer Study 8.2 (SOS s-E to SRS s-E receivers)  Note: cannot be made |
| 401-402 | 1.0 | No | No1 | **s-E** - Refer Study 9.7 (SOS s-E to GSO MetSat & NGSO EESS receivers)  Note: May not be compatible unless technical and/or operating mitigation  Note: Primary allocation to SOS s-E already exists |
| **E-s** - Refer Study 9.6. (SOS E-s to GSO MetSat & NGSO EESS E-s receivers, not feasible) |
| 402-403 | 1.0 | No | No | **s-E** - Refer Study 9.9 (SOS s-E to GSO MetSat & NGSO EESS E-s receivers)  Note: No allocation to SOS. |
| **E-s** - Refer Study 9.8 (SOS E-s to GSO MetSat & NGSO EESS E-s receivers, not feasible) |
| 403-406 | 3.0 | No | No | Refer Study 9.12 |
| Possible Scope For | - | Refer Study 9.13 |
| No | No | Refer Study 9.14 |
| 405-406 | 1.0 | No | No | Section 7: Avoid 405-405.9 (COSPAS-SARSAT)  Note 2: 405.9-406 (guard band for COSPAS-SARSAT) |
| 406-406.1 | 0.1 | No | No | Section 7 (exclusion of 406-406.1 (COSPAS-SARSAT) |
| 406.1-420 | 13.9 | No | No | Section 7: 406.1-406.2 (guard band for COSPAS-SARSAT)  Section 7: Avoid 406.2-407 (COSPAS-SARSAT) |
| (406.1-410) Refer Study 9.11 (RAS) |
| (406.1-420) Refer Study 9.4 (LMS) |
| (406.1-420) Refer Study 9.5.1 (FS) & 9.5.2 (FS) |
|  |  |  |  | (414.2 & 417.1) Refer Study 9.10 (ISS Study) |

# 1- The entry of No in this cell relates specifically to incompatibility between incumbent services (including incumbent SOS applications) and NGSO SD satellites that have characteristics defined in DN Report ITU-R SA.[SHORT DURATION NGSO - CHARACTERISTICS] (refer Res.659 WRC-15). It should not be interpreted that other applications operating under the existing SOS allocation are incompatible.

# 4/1.7/4 Methods to satisfy the agenda item

*[This section should contain the brief description of the Method or Methods to satisfy the agenda item as per section 4 of Annex 2 to Resolution ITU-R 2-7]*

## 4/1.7/4.1 Method A: NOC

There would be no new allocations or an upgrade of the existing allocations to the space operation service and, therefore, no change to the RR.

**Advantages:**

– No impact to existing services

**Disadvantages:**

– The demand for spectrum for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions may not be met.

Satellites with missions of short duration may continue to operate in inappropriate allocations causing interference to incumbent services.

## [4/1.7/4.1 Method B

An allocation to the space operation service, limited to non-GSO satellite systems, in the lower end of the 403-406 MHz allocation which is not subject to coordination under section II of Article **9** of the Radio Regulations. The worst case spectrum requirement in the Earth-to-space direction is given in the DN Report ITU-R SA.[SHORT DURATION NGSO – REQUIREMENTS] as 0.938 MHz. Therefore, a 1 MHz wide allocation in the frequency range of 403-404 MHz would accommodate the worst case spectrum requirement.

Advantages

– An allocation to the space operation service in the Earth-to-space direction would fulfil the spectrum requirements of short duration NGSO satellites in the Earth-to-space direction.

– An allocation to the space operation service in the Earth-to-space direction would provide a regulatory compliant alternative to the current and foreseen use of the bands under consideration under WRC-19 agenda item 1.2 for telemetry, tracking and command in the Earth-to-space direction, for which WRC-19 agenda item 1.2 trying to establish e.i.r.p. limits.

Disadvantages

None.]

# 4/1.7/5 Regulatory and procedural considerations

TBD