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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON AGENDA ITEM 1.7

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).

# ISSUE

Resolution 659 (WRC-15) invites ITU-R

1. to study the spectrum requirements for telemetry, tracking and command in the space operation service for the growing number of non-GSO satellites with short duration missions, taking into account No 1.23;
2. to assess the suitability of existing allocations to the space operation service in the frequency range below 1 GHz, taking into account recognizing a) and current use;
3. if studies of the current allocations to the space operations service indicate that requirements cannot be met under invites ITU-R 1 and 2, to 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.

# Preliminary CEPT position

CEPT supports additional allocations or upgrades of existing allocations to the space operation service for short duration mission satellites provided that:

Studies of spectrum requirements are based on satellite missions planned and constellation development.

Studies of spectrum requirements show the need for additional allocations or upgrades of existing allocations.

Studies show compatibility with existing services.

CEPT recognises that studies with regard to the bands 399.9-400.05 MHz and 401-403 MHz, if any, will have to take into account the considerations under Agenda item 1.2. In addition, CEPT is of the view that co-channel sharing between Earth-to-space links of non-GSO short duration missions and GSO Data Collection Systems is not feasible in the band 401-403 MHz.

CEPT recognises that all allocations to the space operation service in the Earth-to-space direction below 1 GHz are subject to coordination under No 9.21. The application of this provision is not suitable for short duration non-GSO satellites. Therefore, CEPT is of the view that, in addition to considering additional allocations to the space operation service in the Earth-to-space direction, there may be a need to consider modifying the current regulatory situation in the existing allocations.

CEPT is of the view that consideration of the frequency band 154-156 MHz as candidate for operation of non-GSO satellites with short duration missions is not feasible due to difficulties in sharing with the incumbent services (the radiolocation service).

CEPT is of the view that any consideration of bands for use under this agenda item must exclude the 406-406.1 MHz COSPAS-SARSAT band as well as its adjacent 405.9-406 MHz and 406.1-406.2 MHz bands (see resolves 1 of Resolution 205 (WRC-15)).

CEPT is of the view that sharing between non-GSO satellites with short duration missions and the radio astronomy service in the frequency bands 150.05-153 MHz and 406.1-410 MHz is not feasible in the Earth-to-space direction as well as the space-to-Earth direction.

# Background

Agenda Item 1.7 addresses the growing spectrum needs for telemetry, tracking and command for satellites with short duration missions. A short duration mission is a satellite mission for which the associated filing has a period of validity of less than 3 years. These short duration missions are typically composed of small non-GSO satellites which are launched as single units but also as part of larger constellations. The issues concerning filing of small satellites with short operational lifetime and using non-GSO in ITU-R were addressed under WRC-15 Agenda item 9.1.8. The study results on this issue are presented in Report ITU-R SA.2312 and Report ITU-R SA.2348.

Subsequently, Agenda item 1.7 was proposed by CEPT at WRC-15 to cater for the growing number of non-GSO satellites, in particular those referred to as “small” satellites. This growth has been a major contributing factor to the growth in numbers of satellites recently launched in general. Some developers and commercial operators are planning to launch as many as 100 on a single launch for a single application. The applications of these small satellites vary widely, but all of these satellites have one common need which is Telemetry, Tracking and Command (TT&C). Providing for proper TT&C will allow positive satellite control at all times, and, when combined with a ranging capability, may in addition provide for orbit determination, which in turn can aid in the tracking of space objects.

## Consideration of Technical characteristics of Short duration NGSO satellites

ITU Working Party 7B which is responsible for this agenda item, is developing a PDNR ITU-R [SHORT DURATION NGSO – CHARACTERISTICS]. This document contains technical characteristics for telemetry, tracking and command in the space operation service below 1 GHz for non-GSO satellites with short duration missions. The Report provides the characteristics which are necessary in order to perform sharing and compatibility studies.

## Consideration of spectrum requirements

Invites 1 of Resolution 659 (WRC-15) calls for studying the spectrum requirements for telemetry, tracking and command for such satellites, taking into account No 1.23.Simulations have been performed in order to determine the spectrum requirements, based on an assumed number of 300 satellites operating at any given time. The results of these simulations are contained in the Preliminary draft new Report ITU-R SA.[SHORT DURATION NGSO - REQUIREMENTS] which is under development by ITU Working Party 7B. This Report concludes that 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.

## Considerations on the suitability of existing allocations to the space operation service

Invites 2 of Resolution 659 (WRC-15) calls for assessing the suitability of existing allocations to the space operation service in the frequency range below 1 GHz, taking into account that the existing allocations to the space operation service below 1 GHz where No 9.21 applies are not suitable for short duration mission NGSO satellites. This is because the timeline for coordination under No 9.21 is usually significantly longer than the time to develop and launch these short duration non-GSO missions. Taking into account that there are no allocations in the Earth-to-space direction below 1 GHz which are not subject to coordination under No 9.21, before considering additional allocations to the space operation service in the Earth-to-space direction, there may be a need to consider modifying the current regulatory situation in these bands.

## Considerations on new allocations or upgrades of allocations to the space operation service

Invites 3 of Resolution 659 (WRC-15) calls for sharing and compatibility studies as well as studies of 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 existing allocations to the space operation service within the frequency ranges 150.05-174 MHz and 400.15-420 MHz, in case the studies of the current allocations to the space operation service indicate that requirements cannot be met under invites ITU-R 1 and 2.

It should be noted that there are many services allocated in the frequency bands under consideration. In this context, Resolution 659 (WRC-15) recognizes the special requirements for the protection of GMDSS and COSPAS-SARSAT (Resolution 205 (WRC-15)).

ITU Working Party 7B is developing a preliminary draft new report ITU-R SA.[ SHORT DURATION NGSO - SHARING STUDIES] which contains the results of sharing and compatibility studies between short duration non-GSO satellites and incumbent services in the frequency ranges of 150.05-174 MHz and 400.15-420 MHz.

While considering the GMDSS frequency bands 156.000-157.450 MHz, 160.600-160.975 MHz, 161.475-162.050 MHz and 405.9-406.2 MHz it is required to take into account Nos 5.226, 5.267, Article 31, Article 52, Appendix 15 and Appendix 18. In accordance with No 5.225A the frequency band 154-156 MHz is allocated to the radiolocation service on a primary basis in several countries of Region 1. Studies have shown that the space surveillance radars operating in the frequency band 154-156 MHz can cause unacceptable interference to systems in SOS (Earth-to-space) for operation of non-GSO satellites with short duration missions and it can lead to control loss of such satellites. In addition, it was shown that the space surveillance radars operating in the frequency band 154-156 MHz can suffer unacceptable interference caused by such systems in 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 unfeasible.

The studies relating to the frequency bands 399.9-400.05 MHz and 401-403 MHz, if any, will have to take into account the considerations under Agenda item 1.2. In addition, the parts of the frequency bands 150.05-174 MHz and 400.15-420 MHz are considered under the studies on Agenda items 1.11, 1.9.1 and 1.9.2.

The frequency band 162-174 MHz is heavily used by public safety agencies, utilities and transportation companies including railway companies. The studies contained in the PDNR ITU-R [SHORT DURATION NGSO – SHARING STUDIES] showed that co-channel sharing of non-GSO satellites with short duration missions downlink with the stations in the land mobile service is unfeasible in the frequency band 162-174 MHz due to the excess of the protection threshold value for the land mobile service. In addition, co-channel sharing of non-GSO satellites with short duration missions uplink with the stations in the land mobile service is also unfeasible in the frequency band 162-174 MHz due to considerably large separation distances required for protection of the stations in the land mobile service.

The PDNR ITU-R [SHORT DURATION NGSO – SHARING STUDIES] indicates that dynamic studies conducted between SOS uplink signals from Earth stations of NGSO satellites of short duration missions and GSO space stations operating under the MetSat service in the band 401-403 MHz, show that the GSO space station receivers suffer from the harmful interference of about 30 dB above the interference threshold. Therefore, co-channel sharing between Earth-to-space links of non-GSO short duration missions and GSO Data Collection Systems is not feasible in the band 401-403 MHz.

Furthermore, according to the PDNR ITU-R [SHORT DURATION NGSO – SHARING STUDIES], the levels of interference from SOS Space to Earth transmissions to GSO Data collection systems space station receivers in the frequency band 401-403 MHz exceeds the relevant ITU-R interference thresholds by about 10 dB.

Therefore, co-channel sharing is not feasible between short duration NGSO SOS systems (Earth-to-space and space-to-Earth) with GSO MetSat Data collection systems in the frequency band 401-403 MHz.

A preliminary study performed within CEPT indicates that there is scope for a new allocation to the space operation service in the frequency band 403-406 MHz in the Earth-to-space direction, coexisting with the MetAids service. However, there is a need for additional studies, in particular a short term interference analysis as well as studies regarding dropsondes and rocketsondes.

Any allocation to the space operation service in the space-to-Earth direction in the band 403-406 MHz will require further study.

A preliminary study performed within CEPT indicates that sharing between non-GSO satellites with short duration missions in the space-to-Earth direction and the Earth-to-space direction with the radio astronomy service in the frequency bands of 150.05-153 MHz and 406.1-410 MHz bands is not feasible.

# List of relevant documents

ITU-Documentation (Recommendations, Reports, other)

* Report ITU-R SA.2271 - Sharing conditions between space research service proximity operations links and fixed and mobile service links in the 410-420 MHz band
* Report ITU-R SA.2312 - Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites
* Report ITU-R SA.2348 - Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites
* Recommendation ITU-R M.478 – Technical characteristics of equipment and principles governing the allocation of frequency channels between 25 and 3 000 MHz for the FM land mobile service
* Recommendation ITU-R M.1808 - 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 M.489 - Technical characteristics of VHF radiotelephone equipment operating in the maritime mobile service in channels spaced by 25 kHz
* Recommendation ITU-R M.825 - Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification
* Recommendation ITU-R M.1371 - Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band
* Recommendation ITU-R M.1842 - Characteristics of VHF radio systems and equipment for the exchange of data and electronic mail in the maritime mobile service RR Appendix 18 channels
* Recommendation ITU-R M. 2092 - Technical characteristics for a VHF data exchange system in the VHF maritime mobile band
* Recommendation ITU-R M.1085 - Technical and operational characteristics of wind profiler radars for bands in the vicinity of 400 MHz
* Recommendation ITU-R M.1462 -  Characteristics of and protection criteria for radars operating in the radiolocation service in the frequency range 420-450 MHz
* Recommendation ITU-R M.1802 - Characteristics and protection criteria for radars operating in the radiolocation service in the frequency band 30-300 MHz
* Recommendation ITU-R M.1808 – 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 F.699 – 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.755 – Point-to-multipoint systems in the fixed service
* Recommendation ITU-R F.758 - 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 RA.769-2 – Protection criteria used for radio astronomical measurements
* Recommendation ITU-R RA.1513-1 – Level 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 on a primary basis
* Annex 5 to document 7B/170 - Draft CPM test on WRC-19 agenda item 1.7
* Annex 6 to document 7B/170 - Work plan for studies required for WRC-19 agenda item 1.7
* Annex 7 to document 7B/170 - Preliminary draft new Report ITU-R SA.[SHORT DURATION NGSO - CHARACTERISTICS] - Technical characteristics for telemetry, tracking and command in the space operation service below 1 GHz for non-GSO satellites with short duration missions
* Annex 8 to document 7B/170 - Preliminary draft new Report ITU-R SA.[SHORT DURATION NGSO - REQUIREMENTS] - Studies to accommodate spectrum requirements in the space operation service for non-geostationary satellites with short duration missions
* Annex 9 to document 7B/170 - Working document towards a preliminary draft new report ITU-R SA.[short duration NGSO - SHARING STUDIES] - Studies on the suitability of existing allocations to the space operation service below 1 GHz and additional sharing studies on possible new and/or upgraded allocations
* Annex 20 to document 7B/170 - Working document towards a preliminary draft new Report ITU-R SA.[SHORT DURATION NGSO - SHARING] - Compatibility between Radiosonde systems and NGSO short duration-satellite systems, operating in the 400.15 to 406 MHz Frequency band

CEPT and/or ECC Documentation (Decisions, Recommendations, Reports)

* ECC Decision EEC/DEC/(16)02 – Harmonised technical conditions and frequency bands for the implementation of (BB-PPDR) systems
* ECC Decision EEC/DEC/(08)05 – Harmonisation of frequency bands for the implementation of digital PPDR radio applications in 380-470 MHz range
* ECC Decision EEC/DEC/(06)06 – Narrow Band Digital Land Mobile PMR/PAMR in the 80 MHz, 160 MHz and 400 MHz bands
* ECC Decision EEC/DEC/(04)06 – Wide Band Digital PMR/PAMR in the 400 MHz and 800/900 MHz
* ECC Report 240 – Studies for BB PPDR and other applications in 410-430 and 450-470 MHz and adjacent bands
* ECC Report 218 – Harmonised conditions and spectrum bands for the implementation of future European BB-PPDR systems
* ECC Decision ERC/DEC/(99)17 - Automatic Identification and Surveillance system (AIS) channels in the maritime VHF band
* ECC Decision ECC/DEC/(05)02 - Use of the frequency band 169.4-169.8125 MHz.

EU Documentation (Directives, Decisions, Recommendations, other), if applicable

* N/A

# Actions to be taken

Determine suitability of the existing allocations to the space operation service in the frequency range below 1 GHz.

Determine technical and operational characteristics of systems operating below 1 GHz and specifically systems within or adjacent to the 150.05-174 MHz and 400.15-420 MHz bands.

Conduct sharing and compatibility analyses between the NGSO short duration missions using the space operation service and systems of other services within or adjacent to the frequency ranges 150.05-174 MHz and 400.15-420 MHz if studies of the suitability of current allocations to the space operation service indicate that the spectrum requirements cannot be met.

Continue sharing studies between NGSO short duration satellites operating under the space operation service and the Meteorological Aids service in the band 403-406 MHz.

Examine possible regulatory actions to satisfy the spectrum requirements of non-GSO satellites with short duration missions.

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

## European Union (date of proposal)

## Regional telecommunication organisations

APT (July 2017)

Preliminary view(s)

APT Members are of the view that:

* ITU-R studies should be continued in accordance with Resolution 659 (WRC-15).
* Protection of existing services is necessary and any new allocations or upgrades of existing allocations to the space operation service could be applied without any constraint to the incumbent services and their future development.
* The following frequency ranges should not be considered:

Maritime mobile VHF radiocommunication in the frequency ranges 156-157.45 MHz, 160.6-160.975 MHz and 161.475-162.05 MHz, in accordance with RR No. 5.226 and Appendix 18 (Rev. WRC-15).

The frequency range 406-406.1 MHz that is dedicated for satellite emergency position-indicating radio beacons, in accordance with Resolution 205 (Rev. WRC-15); and

Frequency bands used by Global Maritime Distress and Safety System (GMDSS) included in Appendix 15 of RR.

ATU (September 2017)

The APM19-2 Outcome:

Support the ongoing studies and to urge ATU administrations to contribute and actively participate in the studies with a goal of ensuring protection of incumbent services, including the safety of life COSPAS – SARSAT system operating in the 406 ‒ 406.1 MHz band.

Arab Group (April 2017)

Some administrations within the ASMG support the usage of non-geostationary short-term satellite (Pico/Nano satellites) to be used in universities and scientific institutes.

Follow up the studies in the ITU-R, also support the results of these studies ensuring the protection of the existing services.

CITEL (September 2017)

Preliminary view

Canada

Subject to the outcome of the compatibility studies, Canada will consider supporting new allocations and an upgrade of the existing allocations to the space operation service within the frequency ranges 150.05‑174 MHz and 400.15‑420 MHz. Canada is of the view that frequency bands subject to No. 9.21 are not suitable for space operation service for satellites with small duration missions.

RCC (April 2017)

The RCC Administrations consider that spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions should be based on real plans for satellite constellation development, taking into account to be able to meet these needs by existing allocations to the space operation service and to the services where a space station is operated in the frequency bands below 1 GHz.

The RCC Administrations consider that when using existing or new frequency allocations to the space operation service below 1 GHz (including frequency bands 150.05–174 MHz and 400.15−420 MHz) for the purpose to command non-GSO satellites with short duration missions, the protection shall be ensured to the incumbent services in the same and adjacent frequency bands.

The RCC Administrations oppose using the frequency bands 150.05-174.0 MHz and 405.9-406.2 to command non-GSO satellites with short duration missions, since according to No 5.225А some countries of Region 1 have allocated the frequency band 154-156 MHz on a primary basis to the radiolocation service, and the frequency bands 156.000 -157.450 MHz, 160.600 -160.975 MHz, 161.475-162.050 MHz and 405.9-406.2 MHz are required for operation and protection of the GMDSS, and separate parts of the frequency band 150.05-174.0 MHz are intensively used in the territory of RCC Administrations for fixed and mobile services.

## International organisations

IARU (June 2017)

The IARU supports satisfying the spectrum requirements for non-GSO satellites with short duration missions within the existing allocations for the space operation service or the frequency ranges identified in invites ITU-R 3 of Resolution 659 (WRC-15), unless the satellites are amateur satellites as defined in RR Nos. 1.56 and 1.57.

IATA (date of proposal)

ICAO (September 2016)

To oppose consideration of possible allocation to the space operation service in the frequency range 405.9-406.2 MHz unless agreed ITU-R studies have proven aviation use of the EPIRBs operating in the frequency band 406-406.1 MHz is protected in accordance with Resolution 205 (Rev. WRC-15) and No 5.267.

To oppose any new allocations to the space operations service in other frequency bands/ranges that could impact aviation systems unless agreed ITU-R studies have proven sharing and compatibility with those systems.

To ensure that any change to the regulatory provisions and spectrum allocations resulting from this agenda item do not preclude the use of SOS allocations for space planes if this service is deemed appropriate for such use.

IMO (July 2017)

The integrity of GMDSS should be protected, and the following frequency bands should not be included in the study:

* 156.000-157.450 MHz, 160.600-160.975 MHz and 161.475-162.050 MHz; and
* 405.900-406.200 MHz.

Taking account of the relevance on the frequency bands with agenda items 1.9.1 and 1.9.2 the coordination with these Agenda items need to be considered.

SFCG (September 2017)

SFCG recognizes the growing number of short duration non-geostationary orbit satellite missions and the associated spectrum requirements resulting from this activity. Therefore, SFCG supports studies and analyses under Agenda Item 1.7 in order to satisfy the invites of Resolution 659 (WRC-15).

SFCG is of the view that new SOS allocations or updates to existing SOS allocations are favourable to accommodate the growing number of short duration non-GSO satellites. However, any new regulatory measures under this AI should assure three key elements:

* An unambiguous definition must be given about what constitutes a “satellite with short duration mission”:

A system with a period of validity of not more than three years.

A system consisting of one or multiple spacecraft where at any time only one spacecraft is transmitting.

The case of a (or multiple) spacecraft with a lifetime of not more than three years, where the operator launches a (or multiple) replenishment/replacement spacecraft(s) such that the operator has persistent frequency and orbital characteristics and capabilities longer than three years, is not a short duration mission.

* The solution shall not have negative impacts on science services already operating in the frequency bands proposed. Due to the importance of the frequency band 401-403 MHz for Data Collection Systems (GSO and non-GSO), any potential new allocation to SOS in this band added under this Agenda Item would have to be consistent with those limits established under Agenda Item 1.2.
* Any consideration of bands for use under this agenda item must exclude the 406-406.1 COSPAS-SARSAT band as well as appropriate guard bands (see resolves 1, Resolution 205 (WRC-15) and Working Party 7B studies).

EUMETNET (November 2016)

Support to specific SOS allocations for non-GSO satellites with short duration missions provided it does not impair the current and future use of METAIDS, METSAT and EESS (Earth-to-space) services in the 400.15-406 MHz band.

WMO (February 2017)

WMO emphasises that the frequency band 400.15-406 MHz is the key band for radiosondes and DCS worldwide operations and is concerned about its consideration under this agenda item.

## Regional organisations

ESA (October 2016)

See SFCG position

Eurocontrol (date of proposal)

EUMETSAT (October 2016)

EUMETSAT supports the SFCG position on this WRC-19 agenda item and would particularly highlight the need for protecting meteorological satellite (Data Collection System) operations the band 401-403 MHz. It is of paramount importance to preserve the usability of this frequency band 401-403 MHz for DCS systems in the long term."

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)

CRAF (June 2017)

CRAF supports the protection of existing RAS allocations in the 150.05-153.0 MHz and 406.1-410.0 MHz bands. No changes should be made to the RR unless acceptable sharing and compatibility criteria are developed with the RAS.

NATO (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 1.7. It does not constitute a common position of the NATO Nations.

From a military perspective, there are no suitable existing space operations service (SOS) allocations below 1 GHz for this application. Sharing and compatibility studies conducted in accordance with invites 3 of ITU-R Resolution 659 (WRC-15) should take into account the military tactical, mobile, and radiolocation systems operating in and adjacent to the frequency bands 150.05-174 MHz and 400.15-420 MHz.