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| Summary:  |
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| Proposal: |
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DRAFT CEPT BRIEF ON AGENDA ITEM 1.15

1.15 to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15);

# ISSUE

Taking into account the results of ITU-R studies according to Resolution 767 (WRC-15) on sharing and compatibility between passive and active services as well as spectrum needs for those services, to consider identification for use by administrations for the land-mobile and fixed service applications operating in the frequency range 275-450 GHz, while maintaining protection of the passive services identified in No 5.565 and take appropriate action.

# Preliminary CEPT position

CEPT supports the identification of frequency bands for land-mobile and fixed services applications in this frequency range notwithstanding the continued protection of the passive services in the frequency range 275-450 GHz as identified in No 5.565.

# Background

In close proximity to radio communication systems huge amount of data is transferred from a stationary terminal to some mobile equipment in less than a few seconds. Wireless links for data centres, which are deployed in addition to fibres, allow for reconfigurable links within a data centre. These links allow for flexibility in routing to cope with peak traffic. In intra-device communications, a wireless link between e.g. microchips within one device is realized.

WP 5A and WP 5C have informed WP 1A (at the June 2017 WP 1A meeting) about the necessary parameters of land-mobile service (LMS) and fixed service (FS) applications to be used for sharing and compatibility studies:

* WP 5A has developed a preliminary draft new Report ITU-R M. [300GHZ\_MS\_CHAR] providing technical and operational characteristics, as well as spectrum needs of LMS applications (Annex 31 to Document [5A/469](https://www.itu.int/md/R15-WP5A-C-0469/en)).
* WP 5C has developed a preliminary draft new Report ITU-R F.[300GHZ\_FS\_CHAR] providing technical and operational characteristics, as well as spectrum needs, of FS applications (Annex 3 to Document [5C/292](https://www.itu.int/md/R15-WP5C-C-0292/en)).

ITU-R on-going studies are considering LMS applications like "close proximity mobile systems (CPMS)", “wireless links for data centres” and “intra-device communications”. All these applications are point-to-point wireless links which will provide high data rates, in the order of 100 Gbit/s, with simple modulation schemes using wide bandwidths of up to 103.68 GHz in the range of 275 to 450 GHz.

The main FS applications considered in the frequency range 275-450 GHz are point-to-point fronthaul and backhaul links for mobile services. The fronthaul is the link connection between the base station’s baseband unit (BBU) and the remote radio head (RRH), while the backhaul is the link between the base station and the higher level network elements. Both links share identical parameters since the difference between both is only the transmitted data. High data rates in the order of 100 Gbit/s are provided by simple modulation schemes using wide bandwidths of about 50 GHz. Due to the longer transmission distances and the atmospheric absorption, fixed point-to-point systems narrow down the frequency range for candidate bands (See section 3.1).

In IEEE 802 a first standard for point-to-point links in the frequency range 252-325 GHz is currently under development and expected to be published in the beginning of 2018.The applications and the technical characteristics of the IEEE standard under development are consistent with the FS and LMS parameters that are provided by 5A and 5C in the preliminary draft new reports ITU-R M.[300GHZ\_MS\_CHAR] and ITU-R F.[300GHZ\_FS\_CHAR] for consideration in the frequency compatibility studies.

## spectrum needs

**LMS Applications:** WP 5A concluded that a total spectrum bandwidth of 50 GHz would be sufficient to provide high-data rate transmissions between CPMS devices for KIOSK applications, as well as, intra device applications and wireless links for data centers. In the case of CPMS application for KIOSK downloading the candidate frequency range to satisfy this spectrum requirement is 275 – 325 GHz. For other CPMS applications, intra-device communications and wireless links for data centers, the candidate frequency band considered by WP 5A is the full range 275 – 450 GHz (Doc. 5A/469 Annex 31, June 2017). The final selection of the bands identified for LMS will depend on the results of the technical studies. A segmentation of these 50 GHz in non-consecutive allocation blocks could provide the solution for this agenda item. Due consideration should also be given to the MS allocations below 275 GHz to be used to satisfy parts of the spectrum requirements identified.

**FS Applications:** WP 5C concluded that a bandwidth of around 25 GHz would be sufficient for initial typical deployments of high-capacity links for fronthaul/backhaul for IMT systems. A total long term spectrum bandwidth of about 50 GHz is considered sufficient to support the evolution of IMT traffic between BBU and RRH. The possible candidate frequency bands identified by WP 5C for fronthaul and backhaul applications are 275–325 GHz and 380–445 GHz (Doc. 5C/292 Annex 3, June 2017). The final selection of the bands identified for FS will depend on the results of the technical studies. A segmentation of these 50 GHz in non- consecutive allocation blocks could provide the solution for this agenda item. Due consideration should also be given to the FS allocations below 275 GHz to be used to satisfy parts of the spectrum requirements identified.

## Sharing with passive services

The frequency range 275-450 GHz is identified by No 5.565 for the use for the radio astronomy service, the Earth exploration-satellite service (passive) and the space research service (passive). An additional identification of this frequency range for land-mobile and fixed services needs to maintain the protection of the passive service as identified in RR No. 5.565 in the frequency range 275-1 000 GHz.

### Radio Astronomy Service

Sharing between the radio astronomy service and active services has been addressed in Report ITU-R RA.2189. The Report takes account of terrestrial, aeronautical and satellite based active transmitters and concludes that sharing with all types of transmitters is, under certain conditions, feasible.

1. to be confirmed at the next PTA meeting

### Earth Exploration-Satellite Service

The EESS (passive) sensing is described in Report ITU-R RS.2194 on a band by band basis. Furthermore, WP 7C has developed a preliminary draft new report ITU-R RS.[275-450 GHz CHARS] describing the technical and operational characteristics of EESS(passive) systems in the frequency range 275-450 GHz and provided this information to WP1A. In carrying out the necessary sharing studies between the EESS (passive) sensing and the FS/MS, account needs to be taken of the different types of sensing modes: Limb Scan Mode, Conical Scan Mode and Nadir scan mode as well as the relevant spectral lines and measurements performed in the various bands. Studies should also take into account existing and planned instruments in the EESS (passive) sensing.

As far as EESS (passive) is concerned, the following bands will need to be considered in the range 275-450 GHz (taking into account the last outcomes of WP 5C stating that the band 325-380 GHz is not assumed relevant for FS applications):

275-286 GHz (sharing with both FS and MS)

296-306 GHz (sharing with both FS and MS)

313-356 GHz (sharing with FS and MS in the 313-325 GHz, with MS only above 325 GHz)

361-365 GHz (sharing with MS only)

369-392 GHz (sharing with MS only in the 369-380 GHz, with FS and MS above 380 GHz)

397-399 GHz (sharing with both FS and MS)

409-411 GHz (sharing with both FS and MS)

416-434 GHz (sharing with both FS and MS)

439-467 GHz (sharing with both FS and MS)

The detailed information of the FS/MS networks in the frequency range 275-450 GHz was made available by WP 5C and WP 5A (June 2017) and therefore the frequency compatibility analysis with the EESS (passive) systems are yet to be performed. Initial sharing studies have been carried out before those characteristics were made available and were based on assumed RF characteristics of FS and MS systems. These preliminary studies provided the maximum emission levels at the ground in a reference area that would be necessary to ensure protection of EESS (passive) sensors in bands above 275 GHz.

Initial studies in the 296-306 GHz presented at the PTA meeting of February 2017 band have shown that the maximum emission levels at the ground would be -12.9 dBW/200 MHz (ref. area of 10/20 km²) for Nadir instruments, -8.9 dBW/200 MHz (ref. area of 10/20 km²) for Conical instruments and 33 to 53 dBW/3 MHz (ref. area of around 30 M km²) Limb instruments.

Under all combinations of the FS characteristics known to date, these studies showed that the FS e.i.r.p. density in 200 MHz is between 7.5 to 22.6 dB (for 24 dBi antenna) and 33.5 to 48.6 dB (for 50 dBi antenna) above the maximum emission level at the ground for Conical instruments (-8.9 dBW/200 MHz) and 11.5 to 26.6 dB (for 24 dBi antenna) and 37.5 to 52.6 dB (for 50 dBi antenna) above the maximum emission level at the ground for Nadir instruments (-12.9 dBW/200 MHz).

Considering the large exceedance up to around 50 dB, interference could also occur for a single FS transmitter in its antenna sidelobe, i.e. pointing at quite large angle from the satellite position. Taking as an example the FS antenna pattern in Recommendation ITU-R F.699 (recognising that it does apply in this frequency range) would show that an FS link could interfere the EESS sensors at an angle up to 24° from its main beam for a 50 dBi antenna and at all angles for a 24 dBi antenna.

The initial studies in the 296-306 GHz band have shown that even not having taken into account any aggregate effects or the case of compatibility in adjacent bands, relevant in particular when considering broadband FS/MS systems, sharing could be critical.

The assessment of potential interference from FS/MS to EESS (passive) sensors will require the consideration of the aggregate effect of a full deployment of FS/MS networks/stations in the corresponding frequency bands, taking into account the FS and MS parameters now considered in WP 1A, i.e. FS/MS deployment scenarios (density of equipment per km², frequency reuse pattern, pointing elevation distributions, …) .

### Space Research Service

Taking into account the specificities of SRS (passive) missions that are not dedicated to measurements on Earth, sharing and compatibility studies with FS/MS in bands above 275 GHz are not required.

# List of relevant documents

ITU-Documentation (Recommendations, Reports, other)

* Recommendation ITU-R RS.2017
* Preliminary draft new Report ITU-R RS.[275-450 GHz CHARS]
* Preliminary draft new Report ITU-R M.[300GHZ\_MS\_CHAR]
* Preliminary draft new Report ITU-R F.[300GHZ\_FS\_CHAR]
* Report ITU-R [SM.2352](http://www.itu.int/pub/R-REP-SM/publications.aspx?lang=en&parent=R-REP-SM.2352) on Technology trends of active services in the frequency range 275 - 3000 GHz
* Report ITU-R RS.2194 on Passive bands of scientific interest to EESS/SRS from 275 - 3000 GHz
* Report ITU-R RA.2189 on Sharing between the radio astronomy service and active services in the frequency range 275-3 000 GHz

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

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

IEEE Documentation

* IEEE Doc. 802.15-14-0304-16-003d Application Requirements Document
(<https://mentor.ieee.org/802.15/dcn/14/15-14-0304-16-003d-applications-requirement-document-ard.docx>)
* IEEE Doc. 802.15-13-0309-20-003d Technical Requirements Document (<https://mentor.ieee.org/802.15/dcn/14/15-14-0309-20-003d-technical-requirements-document.docx>)
* IEEE Doc. 802.15-16-0610-00-003d Final Draft Proposal Explanation (<https://mentor.ieee.org/802.15/dcn/16/15-16-0610-00-003d-proposal-for-ieee802-15-3d-thz-phy-explanations.pptx>)
* IEEE Doc. 802.15-16-0592-00-003d Final Draft Proposal Explanation Channelization (<https://mentor.ieee.org/802.15/dcn/16/15-16-0592-00-003d-proposal-for-ieee802-15-3d-channel-assignment-plans.pdf>)

# Actions to be taken

The following actions need to be taken into account before identifying frequency bands for land-mobile and fixed services applications operating in the frequency range 275-450 GHz:

to confirm technical and operational characteristics of systems in the land-mobile and fixed services operating at frequencies above 275 GHz, including the description of:

link elevation distribution expected in the band above 275 GHz

antenna pattern(s)

deployment scenarios (densities of equipment per km²) in various environments (rural, suburban and urban)

emission masks including out of band emission and spurious emissions

to confirm spectrum needs of systems in the land-mobile and fixed services, taking into account the results of the above studies;

to develop propagation models within the frequency range 275-450 GHz so as to enable sharing and compatibility studies between the land-mobile, fixed and passive services in this frequency range;

to conduct sharing and compatibility studies between the land-mobile, fixed and passive services operating in the frequency range 275-450 GHz, including single entry and aggregate scenarios.

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

## European Union (date of proposal)

## Regional telecommunication organisations

APT (July 2017)

APT Members support the ITU-R studies to consider identification of frequency bands for use by the land-mobile and fixed service applications operating in the frequency range 275-450 GHz, provided that the protection on passive services identified in No.5.565 is ensured.

ATU (September 2017)

APM19-2 Outcomes

Encourage administrations to closely follow the ongoing studies on the identification of frequency bands in the range 275-450 GHz for Land Mobile and Fixed Service applications to ensure the protection of passive services identified in No 5.565.

Arab Group (20 April 2017)

Follow up and support the current studies to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, while ensuring the protection of passive services identified in No 5.565, and not adding any additional constraints on these services.

CITEL (September 2017)

USA:

The United States is of the view that it may be possible to develop a similar footnote to that in No. 5.565 for land-mobile and fixed services, identifying bands for terrestrial active service use. To this end, the United States supports studies in the ITU-R on sharing and compatibility between passive and active services as well as spectrum needs for the land-mobile and fixed services for WRC-19 agenda item 1.15 under the terms of Resolution 767 (WRC-15).

RCC (16 September 2016)

The RCC Administrations consider it reasonable that identification of frequency bands for land-mobile and fixed services applications in 275-450 GHz band in the RR No. 5.565 will facilitate global harmonization of radio frequencies for development and introduction of land mobile and fixed service applications above 275 GHz.

The RCC Administrations consider that when identifying frequency bands for active services in 275-450 GHz range, a balance of interests has to be observed in the use of this frequency range by both active and passive services, ensuring possibility for future development of new active service applications while excluding interferences to the passive services in the frequency bands already identified in No 5.565 for passive services and effect of active applications in the main and adjacent frequency bands.

## International organisations

IARU (April 2017)

Resolution 767 (WRC-15) recognizes that the amateur service is developing and demonstrating applications above 275 GHz. As studies proceed to identify candidate frequency bands for the land-mobile and fixed services in the frequency range 275-450 GHz, the IARU supports maintaining access for non-commercial experimentation by stations in the amateur service to as much of the frequency range as possible, consistent with the protection of the passive and other active services.

IATA (date of proposal)

ICAO (date of proposal)

IMO (date of proposal)

SFCG (September 2017)

Space Frequency Coordination Group (SFCG) supports the identification of frequency bands for use by systems operating in the land-mobile and fixed services, as long as these applications are compatible with passive sensors and do not cause interference to the passive use of the bands identified in RR No. **5.565**. SFCG supports the concept that no allocations will be made to any service above 275 GHz at WRC-19.

With a view to support the process of identifying appropriate spectrum for FS and LMS under this agenda item, space agencies in the framework of the SFCG considered these spectrum needs in light of compatibility with passive sensors and its current and planned use as well as the scientific spectrum requirements for atmospheric profiling and atmospheric chemistry measurements,

According to this preliminary assessment, which has to be further consolidated and confirmed by WP 7C, the frequency bands below 313 GHz are currently predominantly considered and planned for use by limb sounding instruments. Corresponding preliminary sharing studies have shown that limb sounding instruments should be able to share frequencies with FS and LMS systems, while vertical sounding instruments using the band 313-356 GHz could not share with FS and LMS systems. The band 313-356 GHz is a band of high interest for meteorology (water vapour vertical sounding) and needs to be protected.

Considering this, SFCG discussed the possibility of sharing the range 275-310 GHz with FS and LMS, while avoiding FS/LMS identification in the 310-359 GHz range (3 GHz guard band). Together with FS/MS allocations in the adjacent band below 275 GHz this range could more than satisfy the identified spectrum requirement for FS and LMS. However, this initial assessment will have to be discussed and reviewed in depth by WP 7C before a conclusion can be drawn on this option.

EUMETNET (21 November 2016)

No opposition to FS/MS identification in the 275-450 GHz band provided that protection of EESS (passive) is ensured

WMO (February 2017)

WMO does not oppose the identification of land-mobile and fixed services in the 275-450 GHz band provided that protection of EESS (passive) is ensured and the identification is consistent with footnote No 5.565.

If allocations for active service are envisaged, the same approach would have to be applied to passive service.

IEEE 802 (date of proposal)

## Regional organisations

ESA (October 2017)

Supports the SFCG position.

Eurocontrol (date of proposal)

EUMETSAT (October 2017)

EUMETSAT supports the SFCG and WMO position.

Since 2006, the European contribution to operational meteorological observations from polar orbit has been provided by the first generation of the EUMETSAT Polar System (EPS) with its 3 Metop satellites. The second generation of this system with 6 Metop satellites (3x Metop-SG-A and 3x Metop-SG-B) will provide continuity and enhancement of these observations in the timeframe of 2020 to 2040. On the three Metop-SG-B satellites, the conical scanning Ice Cloud Imager (ICI) instrument is planned to provide ice cloud and snowfall imaging in 11 channels in the frequency range from 183 to 664 GHz at a spatial resolution of 15 km. These 11 channels are centered at 183 GHz (175-192 GHz), 243 GHz (239-248 GHz), 325 GHz (314-337 GHz), 448 GHz (439-457 GHz) and 664 GHz (657-671 GHz).

Given the importance of the bands above 275 GHz for passive sensing instruments like the ICI on Metop-SG-B satellites, adequate protection of the frequency bands identified in No 5.565 has to be ensured when proposing identifications for use by administrations for the land-mobile and fixed service applications.

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

EBU (date of proposal)

GSMA (date of proposal)

CRAF (29 September 2016)

CRAF supports the protection of existing RAS, SRS, and EESS (passive) frequency allocations. CRAF also supports the development of propagation models for this frequency range. No changes should be made to the Radio Regulations unless acceptable sharing and compatibility criteria are developed to ensure the protection of RAS, SRS, and EESS (passive) from future services and applications above 275 GHz.