

ADD EUR/XXXXA24/19

DRAFT NEW RESOLUTION [EUR-Q10-17] (WRC-19)

New allocations for the radiolocation service in the frequency band 231.5-275 GHz, and new identification for radiolocation service applications of frequency bands in the range 275-700 GHz

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a)* that millimeter and sub-millimeter wave frequencies have been recognized by the scientific communities and governmental organizations as well suited for stand-off detection of concealed objects;
- b)* that millimeter and sub-millimeter wave imaging systems will provide a significant contribute to public safety, counter-terrorism and the security of high risk/high value assets or areas;
- c)* that millimeter and sub-millimeter wave imaging systems are typically designed in two main configurations: active (radars) and receive-only (radiometers);
- d)* that active millimeter and sub-millimeter wave imaging systems require a frequency bandwidth wider than 30 GHz to achieve range resolutions in the order of a one centimeter;
- e)* that receive-only millimeter and sub-millimeter wave imaging systems detect the extremely weak power that is naturally radiated by objects and require much wider frequency bandwidth than active systems to collect enough power for detection;
- f)* that globally harmonized spectrum for the millimeter and sub-millimeter wave imaging systems is required;
- g)* that the optimal frequency range for the operation of the active millimeter and sub-millimeter wave imaging systems is between 231.5 GHz and 320 GHz. In this frequency range the atmospheric absorption is relatively low;
- h)* that there are some narrower existing allocations to the radiolocation service in the frequency range 217-275 GHz in the three ITU Regions which however do not support the bandwidth required for these systems;
- i)* that for the receive-only millimeter and sub-millimeter wave imagers an identification in the range 275-700 GHz is envisaged;
- j)* that a number of frequency bands in the range 275-1 000 GHz are identified for use by passive services, such as the radio astronomy service, the Earth exploration satellite service (passive) and the space research service (passive);
- k)* that RR No. **5.565** states that the use of the frequency range 275-1 000 GHz by the passive services does not preclude use of this frequency range by active services;
- l)* that administrations wishing to make available frequencies in the 275-1 000 GHz frequency range for active service applications are urged to take all practicable steps to protect these passive services from harmful interference until the date when the Table of Frequency Allocations is established for the relevant frequencies,

recognizing

that there is no service identified in the radio regulation for use by receive-only millimetre and sub-millimetre wave imaging systems,

noting

- a) that active millimeter and sub-millimeter wave imaging systems operate at very low transmit power (a few milliwatts typically) and short ranges (up to 300 m);
- b) that millimeter and sub-millimeter wave imaging systems may be severely affected by other power sources operating in the same frequency band;
- c) that the technical and operational characteristics for millimeter and sub-millimeter wave imaging systems need to be defined, including protection criteria in particular for receive-only systems,

resolves to invite ITU-R

- 1 to study the future requirements for globally harmonized spectrum for the radiolocation service, in particular for millimeter and sub-millimeter wave imaging applications above 231.5 GHz;
- 2 to define technical and operational characteristics including required protection criteria for millimeter and sub-millimeter wave imaging systems;
- 3 to study sharing and compatibility of active millimeter and sub-millimeter wave imaging applications with other systems in the frequency range between 231.5 GHz and 700 GHz;
- 4 to study sharing and compatibility of receive-only millimeter and sub-millimeter wave imaging applications with other systems in the frequency range between 275 GHz and 700 GHz;
- 5 to study possible new allocations to the radiolocation service on a co-primary basis, in the frequency range between 231.5 GHz and 275 GHz, while ensuring the protection of existing services in the considered frequency bands and, as appropriate, adjacent frequency bands;
- 6 to study a possible identification of frequency bands in the range 275-700 GHz for use by radiolocation service applications;
- 7 to review studies in *resolves to invite ITU-R* 1 to 6 and elaborate regulatory measures for the possible introduction of millimeter and sub-millimeter wave imaging systems;
- 8 to complete studies in time for WRC-23,

invites the 2023 World Radiocommunication Conference

to review the results of these studies and take appropriate actions,

invites administrations

to participate actively in the studies by submitting contributions to ITU-R.

ADD EUR/XXXXA24/20

DRAFT NEW RESOLUTION [EUR-R10-18] (WRC-19)

Review of frequency allocations for EESS(passive) in the 231.5-252 GHz frequency range and consider possible adjustment according to observation requirements of passive microwave sensors

The World Radiocommunication Conference (Sharm el-Sheikh, 2019),

considering

- a) that, within the frequency range 231.5-252 GHz, the frequency bands 235–238 GHz and 250 – 252 GHz are allocated to the earth observation satellite service EESS (passive) for the use of passive microwave remote sensing systems;
- b) that these allocations were agreed at the WRC-2000, under agenda item 1.16, Resolution **723 (WRC-97)**;
- c) that the scientific and technology developments for passive microwave sensor measurements have evolved for the last twenty years;
- d) that it is appropriate to ensure that the frequency allocations to EESS (passive) agreed in 2000 correspond to the up-to-date observation requirements for passive microwave sensing,

recognizing

- a) that some passive sensor systems under development plan to operate some channel(s) in the frequency range 239 – 248 GHz given the specific characteristics of this frequency band for ice cloud analysis;
- b) that, as a result, it may be necessary to consider some adjustment/extension of the EESS (passive) allocations within the frequency range 231.5-252 GHz;
- c) that the effect on the other primary services in the frequency range 231.5-252 GHz would have to be studied and, the EESS(passive) allocations possibly adjusted,

resolves to invite ITU-R

- 1 to review the existing primary allocations to the EESS(passive) in the frequency range 231.5–252 GHz, in order to analyze if these allocations are aligned with the spectral needs defined by more recent passive microwave sensors;
- 2 to identify, as appropriate, possible adjustments to the EESS (passive) allocations in the frequency range, taking into account the results under *resolves to invite ITU-R* 1 above;
- 3 to study the impact that any change to the EESS(passive) allocations in the frequency range 231.5–252 GHz might have on the other primary services in these frequency bands,

invites the 2023 World Radiocommunication Conference

to review the results of these studies with a view to adjust existing or adding possible new allocations, as appropriate, to EESS (passive) in the frequency range 231.5-252 GHz without unduly constraining the other primary services currently allocated in this frequency range,

invites administrations

to participate actively in the studies by submitting contributions to ITU-R,

instructs the Secretary-General

to bring this Resolution to the attention of the international and regional organizations concerned.

Proposals on an agenda item for WRC-23

Subject: Consideration of specific spectrum usage of millimeter and sub-millimeter frequency ranges:

- 1 new allocations for future imaging systems in the frequency band 231.5–275 GHz, and identification of frequency bands in the frequency range 275-700 GHz**
- 2 review of existing or possible new allocations for passive remote sensing systems in the 231.5-252 GHz frequency range**

Origin: CEPT

Proposal:

To address the following two issues to accommodate requirements for spectrum usage above 231.5 GHz:

Issue 1: to consider, in accordance with Resolution **[EUR-Q10-17](WRC-19)** additional spectrum allocations to the radiolocation service on a co-primary basis in the frequency band 231.5-275 GHz and identification for radiolocation applications in frequency bands in the frequency range 275 - 700 GHz for millimeter and sub-millimeter wave imaging systems.

Issue 2: to review and consider possible adjustments of the existing or possible new primary frequency allocations to EESS (passive) in the frequency range 231.5–252 GHz, to ensure alignment with more up-to-date remote sensing observation requirements in accordance with Resolution **[EUR-R10-18](WRC-19)**.

Background/reason:

Issue 1: Millimeter and sub-millimeter wave imagers (Radiolocation Service)

Millimeter and sub-millimeter wave frequencies have been recognized by the scientific communities and governmental organizations as well suited for stand-off detection of concealed objects [1][2]. The radiated energy at these frequencies has good penetration through optically opaque media such as clothing, foliage, a truck with soft top, etc. Stand-off systems working at these frequencies have the advantage to allow good cross-range resolution with reasonably small aperture size compared to microwave (used for portal-like systems). Moreover, this radiation is non-ionizing, and therefore preferable to x-rays which can be harmful for living beings.

Millimeter and sub-millimeter wave imagers are typically designed in two main configurations: active (radars) and passive (radiometers) systems. Both types of imagers require wide bandwidth operation. Active millimeter and sub-millimeter wave imagers require a bandwidth wider than 30 GHz to achieve range resolutions in the order of a few millimeters. The latter is required, for example, to detect weapons concealed under clothing. Passive imagers detect the extremely weak power that is naturally radiated by objects and require much wider bandwidth than active systems, in the order of 100 to 200 GHz, to collect enough power for detection. An optimal frequency band, selected for the operation of these technologies, is in the frequency range between 231.5 GHz and 320 GHz. In this frequency range the atmospheric absorption is reasonably low, as shown in Figure 1.

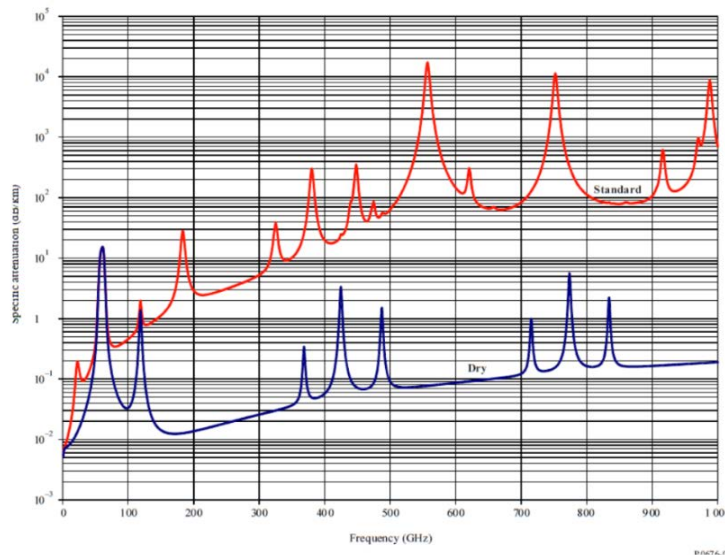


Figure 1: Atmospheric absorption at sub-THz frequency range
 (source: Recommendation ITU-R P.676-11, 9-2016, Attenuation by atmospheric gases)

In the frequency ranges that are considered suitable for millimeter and sub-millimeter wave imaging, or THz imaging, (231.5-320 GHz) allocations to other radio services exist (below 275 GHz) or spectrum has not been allocated yet (above 275 GHz), as shown in the Table below, extracted from the RR.

| Allocation to services | | |
|------------------------|--|----------|
| Region 1 | Region 2 | Region 3 |
| 217-226 | FIXED FIXED-SATELLITE (Earth-to-space) MOBILE RADIO ASTRONOMY SPACE RESEARCH (passive) 5.562B 5.149 5.341 | |
| 226-231.5 | EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 5.340 | |
| 231.5-232 | FIXED MOBILE Radiolocation | |
| 232-235 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE Radiolocation | |
| 235-238 | EARTH EXPLORATION-SATELLITE (passive) FIXED-SATELLITE (space-to-Earth) SPACE RESEARCH (passive) 5.563A 5.563B | |
| 238-240 | FIXED FIXED-SATELLITE (space-to-Earth) MOBILE RADIOLOCATION RADIONAVIGATION RADIONAVIGATION-SATELLITE | |
| 240-241 | FIXED MOBILE RADIOLOCATION | |
| 241-248 | RADIO ASTRONOMY RADIOLOCATION Amateur Amateur-satellite 5.138 5.149 | |
| 248-250 | AMATEUR AMATEUR-SATELLITE Radio astronomy 5.149 | |
| 250-252 | EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 5.340 5.563A | |
| 252-265 | FIXED MOBILE MOBILE-SATELLITE (Earth-to-space) RADIO ASTRONOMY RADIONAVIGATION RADIONAVIGATION-SATELLITE 5.149 5.554 | |
| 265-275 | FIXED FIXED-SATELLITE (Earth-to-space) MOBILE RADIO ASTRONOMY 5.149 5.563A | |
| 275-3 000 | (Not allocated) 5.565 | |

Table: Spectrum allocation in the frequency range 217-3000 GHz

The operation of millimeter and sub-millimeter wave imaging systems will be limited in space and time: the systems can be employed for public safety purposes during events, i.e. screening people participating to a demonstration, a concert or a sportive activity. These situations require the use of the systems in a specific location and for a limited amount of time.

Active millimeter and sub-millimeter wave imaging systems operate at very low transmit power (a few milliwatts typically) and short ranges (up to 300 m). Passive systems, as mentioned before, rely on extremely weak signals. Therefore, both kinds of imagers can be severely affected by other power sources operating at the same frequency band. In view of this, passive imagers need to be very sensitive, although the sensitivity is lower than the required for satellite passive remote sensing and therefore can withstand more interference than passive remote sensing systems. To avoid confusions, these passive imaging systems could be referred to as receive-only imaging systems.

Given this high sensitivity for interference, co-existence with other systems shall be considered in the identification of suitable spectrum for this radiolocation application in the mentioned frequency range. This is a topic for study under the proposed agenda item, together with the co-existence with other radio services in the band.

Operational benefits

Millimeter and sub-millimeter wave imaging, as a radiolocation service, can provide the following major operational benefits:

1. Detection of concealed objects such as weapons, munitions and explosives can be enhanced;
2. Detection of objects is significantly less harmful for humans compared to the X-ray technology that is currently commonly used;
3. Detection can be done from a stand-off distance which is significantly larger than for X-ray technology, which makes it less intrusive for people;
4. This technology will provide a significant contribute to public safety, counter-terrorism and the security of high risk/high value assets or areas.

The foreseen end users are, amongst others, border police, armed forces, special forces, airports, harbors and security forces.

Issue 2: Passive microwave remote sensors (EESS(passive))

WRC-2000 agreed, under its agenda item 1.16, on a number of allocations, including to the Earth exploration-satellite passive service, EESS (passive), above 71 GHz.

Currently there is a need to review the allocations at higher frequencies, specifically in the 231.5 -252 GHz frequency range, taking into account the scientific and technology developments for passive microwave sensor measurements, as is the case in Europe with the development of the Ice Cloud Imager (ICI) instrument of the second generation of the EUMETSAT Polar System (EPS-SG)).

The objective of this new agenda item is to ensure that the allocations to EESS (passive) within this frequency range considered correspond to the observation requirements for satellite passive microwave sensing. For potential adjustments/extension/shifting of the EESS (passive) allocations in this frequency range, the effect on the other primary services would have to be addressed.

Recommendation

This agenda item has a dual objective related to two different types of services operating in frequency ranges above 231.5 GHz.

1) Radiolocation service: The issue proposed in this agenda item is intended to address and estimate the future requirements for globally harmonized spectrum for the radiolocation service.

The agenda item will have to address the allocation and identification on a co-primary basis of a sufficiently wide frequency band, whilst also investigating regulations to guarantee coexistence with existing services in these frequency bands. It is recommended to allocate a sufficiently large frequency band in the frequency range 231.5–275 GHz to the radiolocation service on a co-primary basis for the active part of millimeter and sub-millimeter wave imagers. For this, compatibility with the existing services would have to be assessed as well as with an adjusted/extended/shifted EESS (passive) service (under issue 2 of this proposed agenda item) in case of frequency overlap.

For the active and passive millimeter and sub-millimeter wave imagers, it is recommended to identify a sufficiently large frequency band in the frequency range 275-700 GHz.

2) Earth Exploration Satellite Service (passive): The issue proposed in this agenda item is intended to review the existing primary allocations to the EESS(passive) in the frequency range 231.5–252 GHz, to analyze if these allocations are aligned with the spectral needs defined by more recent passive microwave sensors, and to propose necessary adjustments in the Table of Frequency Allocations. An important aspect will be the study of the potential impact that any changes could have on the other primary services.

Radiocommunication services concerned:

Mobile service, fixed service, amateur service, amateur-satellite service and radionavigation-satellite service

Indication of possible difficulties:

Currently there is no allocation in the frequency band above 275 GHz.

There are already requests for identification in this frequency band for photonic communication (WRC-19 agenda item 1.15).

Previous/ongoing studies on the issue:

To date there are no preceding studies for this topic in this frequency band for Radiolocation.

Consider the analysis for EESS(passive) compatibility conducted for WRC-2000

| | |
|---|--|
| <i>Studies to be carried out by:</i> | <i>with the participation of:</i> |
| ITU-R WP 1A | ... |

ITU-R Study Groups concerned:

SG 4, 5 (WP 5C WP 5B), 7 (WP 7C)

ITU resource implications, including financial implications (refer to CV126):

This proposed agenda item will be studied within the normal ITU-R procedures and planned budget.

Common regional proposal: Yes

Multicountry proposal: No

Number of countries:

Remarks

Recommendation

- [1] TIPPSI THz Imaging Phenomenology Platforms for Stand-off IED Detection, EDA, 2016
- [2] CONSORTIS, Concealed Object Stand-Off Real-Time Imaging for Security, EU FP7, 2017.