

# ITU-R

Radiocommunication Sector of ITU

## Recommendation ITU-R M.2082-0 (11/2015)

# Methodology and technical example to assist coordination of the mobile-satellite service and the radiodetermination-satellite service with the fixed service based on the power flux-density coordination trigger levels in the 2 483.5-2 500 MHz band

**M Series**  
**Mobile, radiodetermination, amateur  
and related satellite services**



## Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

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### Series of ITU-R Recommendations

(Also available online at <http://www.itu.int/publ/R-REC/en>)

| Series     | Title                                                                                |
|------------|--------------------------------------------------------------------------------------|
| <b>BO</b>  | Satellite delivery                                                                   |
| <b>BR</b>  | Recording for production, archival and play-out; film for television                 |
| <b>BS</b>  | Broadcasting service (sound)                                                         |
| <b>BT</b>  | Broadcasting service (television)                                                    |
| <b>F</b>   | Fixed service                                                                        |
| <b>M</b>   | <b>Mobile, radiodetermination, amateur and related satellite services</b>            |
| <b>P</b>   | Radiowave propagation                                                                |
| <b>RA</b>  | Radio astronomy                                                                      |
| <b>RS</b>  | Remote sensing systems                                                               |
| <b>S</b>   | Fixed-satellite service                                                              |
| <b>SA</b>  | Space applications and meteorology                                                   |
| <b>SF</b>  | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| <b>SM</b>  | Spectrum management                                                                  |
| <b>SNG</b> | Satellite news gathering                                                             |
| <b>TF</b>  | Time signals and frequency standards emissions                                       |
| <b>V</b>   | Vocabulary and related subjects                                                      |

**Note:** This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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## RECOMMENDATION ITU-R M.2082-0

**Methodology and technical example to assist coordination of the mobile-satellite service and the radiodetermination-satellite service with the fixed service based on the power flux-density coordination trigger levels in the 2 483.5-2 500 MHz band**

(2015)

**Scope**

This Recommendation provides information on coordination of the fixed service with mobile-satellite and radiodetermination-satellite service systems operating in the 2 483.5-2 500 MHz frequency band. An estimation of the level of interference that may be caused by mobile-satellite and radiodetermination-satellite service systems is included. This Recommendation examines the impact of the relaxation of the power flux-density level that triggers coordination with the fixed service that was agreed at WRC-12 under agenda item 1.18.

This Recommendation may assist when performing coordination under Radio Regulations No. **9.14** with administrations requesting to operate their RDSS or MSS systems at pfd levels in excess of the thresholds defined in RR Appendix 5.

**Keywords**

RDSS, MSS, FS, MS, coordination trigger

**Abbreviations/Glossary**

FDP fractional degradation of performance

pfd power flux-density

**Related ITU Recommendations, Reports**

- |                               |                                                                                                                                                                                                                                                           |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recommendation ITU-R F.758-6  | 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 F.1108-4 | Determination of the criteria to protect fixed service receivers from the emissions of space stations operating in non-geostationary orbits in shared frequency bands                                                                                     |
| Recommendation ITU-R M.1143-3 | System specific methodology for coordination of non-geostationary space stations (space-to-Earth) operating in the mobile-satellite service with the fixed service                                                                                        |
| Recommendation ITU-R M.1787-2 | Description of systems and networks in the radionavigation-satellite service (space-to-Earth and space-to-space) and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz |

The ITU Radiocommunication Assembly,

*considering*

- a) that the band 2 483.5-2 500 MHz is allocated to the mobile-satellite service (MSS), the radiodetermination-satellite service (RDSS), the fixed service (FS) and the mobile service (MS) on a worldwide co-primary basis;
- b) that the use of this band for the MSS is for downlink (space-to-Earth) transmissions to user terminals;
- c) that the necessity to coordinate space systems with administrations using the FS is determined through the use of appropriate power flux-density (pfd) values given in RR Appendix 5;
- d) that the pfd is one of the technical parameters used for the determination of criteria which facilitate sharing between the MSS and terrestrial services;
- e) that FS networks use digital modulation techniques,

*noting*

- a) that in the frequency band 2 483.5-2 500 MHz shared between systems in the non-geostationary MSS, and systems in the FS, Table 5-2 of RR Appendix 5 establishes the following pfd thresholds:

|                     |                              |                  |
|---------------------|------------------------------|------------------|
| -126                | dB(W/(m <sup>2</sup> · MHz)) | for 0° ≤ θ ≤ 5°  |
| -126 + 0.65 (θ - 5) | dB(W/(m <sup>2</sup> · MHz)) | for 5° ≤ θ ≤ 25° |
| -113                | dB(W/(m <sup>2</sup> · MHz)) | for θ > 25°      |

where θ is the angle of arrival (degrees) on the surface of the Earth of the radio-frequency wave;

- b) that for the countries in Region 2, 43 countries in Region 1, in Australia and in Israel, in the frequency band 2 483.5-2 500 MHz shared between systems in the non-geostationary MSS and systems in the FS, Note 9 to Table 5-2 of RR Appendix 5 establishes the following pfd thresholds:

|                       |                              |                  |
|-----------------------|------------------------------|------------------|
| -124.5                | dB(W/(m <sup>2</sup> · MHz)) | for 0° ≤ θ ≤ 5°  |
| -124.5 + 0.65 (θ - 5) | dB(W/(m <sup>2</sup> · MHz)) | for 5° ≤ θ ≤ 25° |
| -111.5                | dB(W/(m <sup>2</sup> · MHz)) | for θ > 25°      |

- c) that in the frequency band 2 483.5-2 500 MHz shared between systems in the non-geostationary RDSS, and systems in the FS, Table 5-2 of RR Appendix 5 establishes the following pfd threshold:

|      |                              |                  |
|------|------------------------------|------------------|
| -129 | dB(W/(m <sup>2</sup> · MHz)) | for 0° ≤ θ ≤ 90° |
|------|------------------------------|------------------|

- d) that for the countries in Region 2, 43 countries in Region 1, in Australia and in Israel, in the frequency band 2 483.5-2 500 MHz, shared between systems in the non-geostationary RDSS and systems in the FS, Note 9 to Table 5-2 of RR Appendix 5 establishes the following pfd threshold:

|      |                              |                  |
|------|------------------------------|------------------|
| -128 | dB(W/(m <sup>2</sup> · MHz)) | for 0° ≤ θ ≤ 90° |
|------|------------------------------|------------------|

- e) that the above values relate to the pfd and angles of arrival which would be obtained under free-space propagation conditions;
- f) that, in Region 1, the provisions of RR No. 5.398A shall be taken into account,

*recommends*

**1** that, subject to mutual agreement between administrations concerned, the methodology presented in Annex 1 may be used for coordination between FS and MSS and RDSS systems as a means for determining the impact on FS systems when the threshold pfd levels contained in Table 5-2 of RR Appendix 5 are exceeded;

**2** that any ambiguity in specific parameters of the methodology contained in Annex 1 should be resolved through mutual agreement.

NOTE – Annex 2 provides a technical example of application of the methodology contained in Annex 1.

## Annex 1

### **Determining the fractional degradation of performance of fixed service systems due to power flux-density coordination trigger levels in the 2 483.5-2 500 MHz band**

#### **1 Scope**

The methodology described in this Annex draws on existing ITU-R Recommendations and references a general methodology for computing the aggregate interference from RDSS and MSS spacecraft as seen by a terrestrial station in the FS.

Examples of the aggregate level of interference to the FS from the HIBLEO-X/HIBLEO-4 MSS and Galileo RDSS constellations are provided in the Attachment to Annex 2.

#### **2 Methodology<sup>1</sup>**

The methodology used in Recommendation ITU-R F.1108, for digital radio relay systems, is used along with Recommendation ITU-R M.1143. Recommendation ITU-R F.1108 uses the concept of fractional degradation of performance (FDP) for digital FS stations. The FDP is the fractional increase in the percentage of time that the controlling performance criterion will not be met because of the presence of interference. It has been suggested in Recommendation ITU-R F.758-6 that an FDP of 25% is suitable for systems operating in the 2 483.5-2 500 MHz frequency range.

The program simulates the interference into the FS network from the non-GSO satellite constellation(s) as follows.

##### **2.1 Calculation loop**

The program calculates the position and velocity vectors of the satellites of the non-GSO satellite system and stations of FS system at each time instance.

At each time sample the program calculates the total interfering power at each fixed service (FS) station from all active spots from all visible and appropriately selected MSS and RDSS satellites. If the FS receiver bandwidth does not completely overlap the MSS or RDSS signal the interfering

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<sup>1</sup> This text is adapted from Recommendation ITU-R M.1143.

power is then scaled by the bandwidth factor. In the digital case, this interfering power is scaled to 1 MHz.

The aggregate interference power from all active spot beams of all visible satellites visible to the FS station is determined using the following equation:

$$I = \sum_{i=1}^N \sum_{j=1}^S \frac{E_{ij}}{L_i} G^3(\alpha_{ij}) G^4(\theta_i) \frac{B_w}{B_{ij}} \frac{1}{F} \frac{1}{P_{ij}}$$

where:

- $I$  : interference power (W)
- $i$  : 1 of  $N$  satellites being considered in the interference calculation for the FS station
- $j$  : 1 of  $S$  active spot beams on the visible selected MSS (or RDSS) satellite with frequency overlap to the current FS station receiver, taking account of the satellite spot beam frequency reuse pattern
- $E_{ij}$  : maximum e.i.r.p. density per reference bandwidth input to the antenna for the  $j^{\text{th}}$  active spot beam in its boresight direction of the  $i^{\text{th}}$  visible selected satellite (W/reference bandwidth)
- $B_{ij}$  : reference bandwidth for the interfering signal from the  $j^{\text{th}}$  active spot beam of the  $i^{\text{th}}$  visible selected satellite (kHz)
- $G^3(\alpha_{ij})$  : antenna discrimination of the  $j^{\text{th}}$  active spot beam of the  $i^{\text{th}}$  visible selected satellite towards the FS station
- $\alpha_{ij}$  : angle between the boresight pointing vector  $j^{\text{th}}$  active spot beam of the  $i^{\text{th}}$  visible selected satellite to the FS station (degrees)
- $L_i$  : free space loss at the given reference frequency from the  $i^{\text{th}}$  visible selected satellite to the FS station
- $G^4(\theta_i)$  : the FS station's antenna gain in the direction of the  $i^{\text{th}}$  visible selected satellite
- $\theta_{ik}$  : angle between the FS station's antenna pointing vector and the range vector from the FS station and the  $i^{\text{th}}$  visible selected satellite (degrees)
- $B_w$  : receiver bandwidth of the affected FS station (1 MHz)
- $F$  : feed loss for the FS station
- $P_{ij}$  : polarization advantage factor between  $j^{\text{th}}$  spot beam of the  $i^{\text{th}}$  MSS (or RDSS) satellite and the FS station.

The polarization advantage  $P_{ij}$  is to be used only if the  $i^{\text{th}}$  MSS (or RDSS) satellite is within the 3 dB beamwidth of the FS station antenna and the FS station is within the 3 dB beamwidth of the  $j^{\text{th}}$  spot beam of the  $i^{\text{th}}$  MSS (or RDSS) satellite.  $P_{ij}$  can be calculated according to the formula of Note 7 of Recommendation ITU-R F.1245.

## 2.2 Size and number of steps in the calculation loop

It is necessary to have enough samples at appropriate time intervals to have accurate results, taking into account all the interference received at the receiver of the fixed station.