|  |  |
| --- | --- |
| **U.S. Radiocommunications Sector**  **Fact Sheet** | |
| **Working Party:** ITU-R WP 4C | **Document No:**  USWP4C-05R1 |
| **Ref:** Document 4C/445, Annex 4 (from last cycle) | **Date:** 22 March 2024 |
| **Document Title:** Proposed Revision to Working Document Toward a Preliminary Draft Revision of Report ITU-R M.2305-0, Consideration of aggregate radio frequency interference event potentials from multiple Earth exploration-satellite service systems on radionavigation-satellite service receivers operating in the 1 215-1 300 MHz frequency band | |
| **Author(s)/Contributors:**  Rick Merchant  SSC/CGEP USSF  Los Angeles AFB, CA  Tiange (George) Fan, for GPS  The Aerospace Corporation  El Segundo, CA  Tom L. Hayden, for GPS  TLH Consulting  Seattle, WA  Stephen Baruch, for GPSIA  New Wave Spectrum Partners LLC  Dallas, TX  Mark Rentz, for GPSIA  John Deere  Torrance, CA | Phone: (310) 653-1871  Email : [rick.merchant.2@spaceforce.mil](mailto:rick.merchant.2@spaceforce.mil)  Phone : (310) 336-1252  Email : [Tiange.Fan@aero.org](mailto:Tiange.Fan@aero.org)  Phone : (425) 443-1837  Email : [Tom.Hayden@live.com](mailto:Tom.Hayden@comcast.net)  Phone : (240) 476-2600  Email : [sbaruch@newwavespectrum.com](mailto:sbaruch@newwavespectrum.com)  Phone : (310) 381-2607  Email : [RentzMarkL@JohnDeere.com](mailto:RentzMarkL@JohnDeere.com) |
| **Purpose/Objective:** To provide an update to the Working Document toward a Preliminary Draft Revision of Report ITU-R M.2305-0 that was initiated during the June/July 2023 meeting of WP 4C. | |
| **Abstract:** Working Party 4C initiated work on a potential revision to Report ITU-R M.2305 at its June/July 2023 meeting. This contribution is intended to progress that work by proposing updates to the WD toward a PDR of Report ITU-R M.2305-0 on aggregate interference from EESS (active) spaceborne SAR instruments into RNSS earth station receivers operating in the 1 215‑1 300 MHz frequency band. | |
| **Fact Sheet prepared by:** Steve Baruch | |

|  |  |
| --- | --- |
| **Radiocommunication Study Groups** | Logo  Description automatically generated |
|  |  |
| Received: \_\_ April 2024  Source: Document 4C/445, Annex 4 (from last cycle) | **Document 4C/\_\_-E** |
| **\_\_ April 2024** |
| **English only** |
| United States of America | |
| PROPOSED REVSIONS TO WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT REVISION OF REPORT ITU-R M.2305-0 | |

At its June/July 2023 meeting Working Party 4C initiated work on a working document towards a preliminary draft revision of Report ITU-R M.2305-0, on the subject of aggregate radio frequency interference event potentials from multiple Earth exploration-satellite service systems on radionavigation-satellite service receivers operating in the 1 215-1 300 MHz frequency band. *See* Annex 4 to Doc. 4C/445 (2019-2023 ITU-R Study Cycle).

In this contribution, the United States proposes revisions and updates to PDR Report ITU-R M.2305-0. Proposed U.S. changes are highlighted in green.

**Attachments:** 1

|  |
| --- |
| ATTACHMENT |
| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT REVISION OF REPORT ITU-R M.2305-0 |
| Consideration of aggregate radio frequency interference event potentials from multiple Earth exploration-satellite service systems on radionavigation-satellite service receivers operating in the 1 215-1 300 MHz frequency band |

(2014)

TABLE OF CONTENTS

Page

1 Introduction 2

2 Pulsed RFI effects 2

2.1 Effects of pulsed RFI from a single source 2

2.2 Aggregate RFI cases 3

3 EESS (active) sensors in the 1 215-1 300 MHz frequency band 4

3.1 General characteristics 4

3.2 Antenna characteristics 5

4 Aggregate RFI impingement analysis 8

4.1 Satellite models 8

4.2 Single sensor received isotropic power 8

4.3 Receiver models 9

4.4 Single-Sensor interference power into receivers 10

4.5 Aggregate RFI impingement statistics 11

5 Analysis results 14

5.1 Study A 14

5.2 Study B 15

5.3 Discussion 16

6 Summary 17

Annex 1 – Background on choice of time-step value for Scatterometer 2 calculations 18

Annex 2 – Example of evaluating the aggregate pulsed radio frequency interference from multiple EESS (active) spaceborne synthetic aperture radars to RNSS earth station receivers operating in the 1 215-1 300 MHz band 21

# [NOC]

Annex 1

[NOC]

Аnnex 2  
  
Example of evaluating the aggregate pulsed radio frequency interference from multiple EESS (active) spaceborne synthetic aperture radars   
to RNSS earth station receivers operating in the 1 215-1 300 MHz band

# 1 Introduction

This annex provides an example of calculating the aggregate interference from multiple EESS (active) SAR sensors operating simultaneously over the same territory.

# 2 Example of evaluating the aggregate pulsed radio frequency interference from multiple spaceborne synthetic aperture radars

As an example, consider the impact of interference from the SAR1 system from Table 1 of Report ITU‑R RS.2537-0 on an SBAS receiving RNSS earth station from Column 1 to Table 7. The characteristics of SAR1 are presented in Table 2-1 below.

Table 2-1

Technical characteristics of SAR1

| Parameter | Value |
| --- | --- |
| RF centre frequency, MHz | 1 257.5 |
| RF bandwidth, maximum, MHz | 40 |
| RF pulse width, µs | 33.8 |
| Pulse repetition frequency maximum, Hz | 1 736 |

The effective pulsed RFI duty cycle (*PDCLIM*) for SAR 1 is computed as ~~follows :~~follows:

where:

The assumed SBAS receiver recovery time (*τr*) is 1.0 µsec and the SBAS receiver pre-correlator filter bandwidth is 20.5 MHz centred at 1 227.6 MHz. Considering this *PDCLIM* for SAR1 will be:

Using equation (1-7a) from Annex 1 of the Report ITU‑R RS. 2537-0 the degradation ratio of the pulsed interference caused by SAR1 to SBAS receiver is the following:

Or in logarithmic form 10⋅log10(*N*0*,EFF+Y/N*0*,EFF*) = 0.019 dB.

In accordance with Table 1-9 in Annex 1 of the Report ITU‑R RS.2537-0 allowable degradation ratio of SBAS receiver is 10⋅log10(*N*0*,EFF+Y/N*0*,EFF*) = 0.2 dB. Thus, SAR1 system meets the SBAS protection criteria.

Suppose that after some time a new SARA system appears, which is identical in characteristics to the SAR1 system, except that the central frequency of the signal will be 1 243.85 MHz. Thus, due to the greater overlap of frequency bands, the effective pulse duration of such a system will be longer. Applying the same equations presented above, it turns out that the value of the effective pulse duty cycle for SARA is:

Thus, the degradation ratio of SARA interference impact on the SBAS receiver is 10⋅log10(*N*0*,EFF+Y/N*0*,EFF*) = 0.196 dB. This system also meets the protection requirements of the SBAS receiver, since the degradation does not exceed 0.2 dB.

Now consider the cumulative impact of two SAR1 and SARA systems on the SBAS receiver in question if they operate simultaneously. Using equations (3), (4), (7) and (8) from Annex 1 of the Report ITU‑R RS.2537-0, it can be obtained that the degradation for the SBAS receiver with simultaneous operation of SAR1 and SARA will be determined by the following equation:

Or in logarithmic form:

10⋅log10(*N*0*,EFF+A+B/N*0*,EFF) = -*20⋅log10(1-*PDCA*) - 20⋅log10(1-*PDCB*)

Thus, the degradation of simultaneous pulsed interference impact from the two new systems is equal to the sum of the degradations of the systems while they operate separately.

10⋅log10(N0,EFF+A+B/N0,EFF) = 10⋅log10(N0,EFF+A /N0,EFF) + 10⋅log10(N0,EFF+B /N0,EFF)

Considering that for SAR1 and SARA systems the degradation is 0.019 dB and 0.196 dB, respectively, the total degradation will be 0.215 dB. This means that with simultaneous exposure to pulsed interference from SAR1 and SARA systems, the permissible degradation level for the SBAS eceiver will be exceeded.

Thus, taking into account the increasing number of sources of pulsed interference, in order to correctly assess the interference effect of new pulsed systems on RNSS receivers, it is necessary to take into account the current cumulative interference from all operating pulsed systems.

3 Summary and proposals

This annex shows that when evaluating the impact of possible pulsed interference from new spaceborne synthetic aperture radars of the EESS on RNSS receivers based on the methodology of Recommendation ITU-R M.2030 as used in Report ITU-R RS.2537-0, it is necessary to take into account the cumulative simultaneous effect of pulsed interference from multiple sources. The methodology presented in Recommendation ITU-R M.2030 can be used for a preliminary assessment of the impact of pulsed interference to the RNSS receiver.

The issue of possible mechanisms to avoid or mitigate aggregate interference from multiple EESS (active) SAR systems requires further study, taking into account the examples in this Report.