

Subject: WRC-12 Agenda item 7

Document 4A/TEMP/166-E
30 March 2010
English only

Reference: Documents 4A/234, 4A/278(Annex 14), 4A/343

Working Party 4A

ELEMENTS TOWARDS DRAFT CPM TEXT ON WRC-12 AGENDA ITEM 7
PRELIMINARY VIEWS ON THE AVERAGING BANDWIDTH PRESCRIBED
IN ANNEX 2 OF APPENDIX 4 TO THE RADIO REGULATIONS

Summary

At the September 2009 meeting of WP 4A, a contribution (Document 4A/234), dealing with the possible modification of Footnote 2 to Tables A, B, C and D of Annex 2 of RR Appendix 4 was submitted. The proposal aimed at clarifying the calculation method of the power densities of a carrier whose bandwidth is smaller than the averaging bandwidth (4 kHz for assignments below 15 GHz, 1 MHz for assignments above 15 GHz). Accordingly, proposed modifications of Appendix 4 were given and these are shown in the annex to this document. Discussions on this proposal also showed the need for further studies on the impact of this proposal to the compliance assessment of the various pfd limits contained in Article 21 or Appendix 30B of the Radio Regulations.

Another contribution (Document 4A/343), submitted to the March 2010 meeting of WP 4A showed much concern that if the proposed modifications were adopted, unnecessary extra workload and the possibility of over-estimating the interference could result. In the process of coordination, the worst case would always be taken into account on the actual case basis, i.e. interference situation would be calculated where the averaging bandwidth would be filled in by actual carriers. Thus, this contribution concluded that a more accurate result can be reached regardless of any differences in understanding of the "averaging bandwidth issue". Accordingly it was proposed that no modification is needed to this footnote.

Questions with the intention of clarification of the on-going ITU BR examination method were raised to ITU BR and the following reply was offered:

If the bandwidth of the carrier is less than the averaging bandwidth, the Bureau calculates the pfd based on the maximum power density calculated, as if the one single carrier with maximum peak power (C8a1) occupied the averaging bandwidth. Multiple carriers are not considered.

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The result of this pfd calculation is used to establish findings under RR No.11.31 where there is a hard pfd limit. Where pfd “trigger” limit applies this same method of calculation is used to establish affected administrations, under RR No.11.32, on whose territory the trigger limit is exceeded.

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As regards question related to RR No. 11.32A examination, the calculation is not based on single interfering carrier. It is assumed that the interfering satellite has its transponders loaded with number of carriers. The number of carriers considered in the C/I calculation is limited either, by the number of interfering carrier that can be placed in the wanted bandwidth or the number of carriers that can be operated within the maximum total peak power of the transponder.

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Administrations are invited to submit contributions on this topic to the next meeting of Working Party 4A.

1 Introduction

Footnote 2 to Tables A, B, C and D of Annex 2 of RR Appendix 4 provides guidance to compute the maximum power density of a carrier. In particular, it indicates the averaging bandwidth over which the maximum power density shall be computed (4 kHz for assignments below 15 GHz, 1 MHz for assignments above 15 GHz). In case of a carrier having a bandwidth smaller than the averaging bandwidth, Footnote 2 currently mentions that “the maximum density is calculated *as if the assignment occupied the averaging bandwidth*”. If such a guideline is followed, this will possibly underestimate the interference potential of the carrier by a factor corresponding to the ratio between the averaging bandwidth and its necessary bandwidth.

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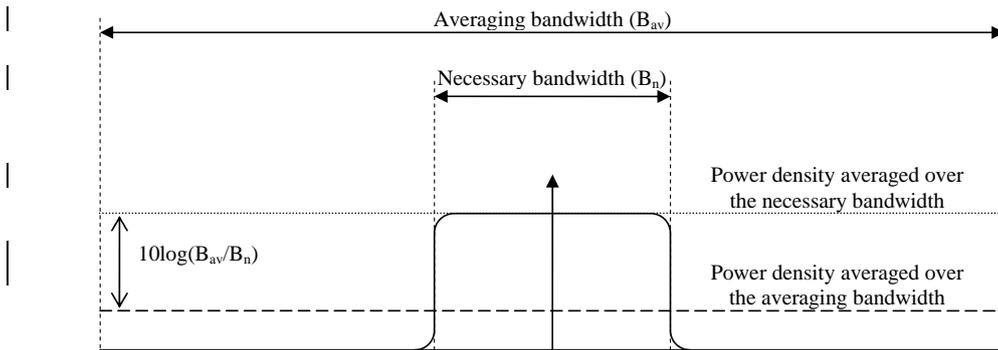
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2 Comments on the proposed modifications

Figure 1 shows the difference between the power density averaged over the necessary bandwidth and over the averaging bandwidth in case of a carrier having a bandwidth smaller than the averaging bandwidth. In this first case, since there is only one carrier, the interference potential of this sole carrier is better described by using the power density averaged over the necessary bandwidth.

FIGURE 1

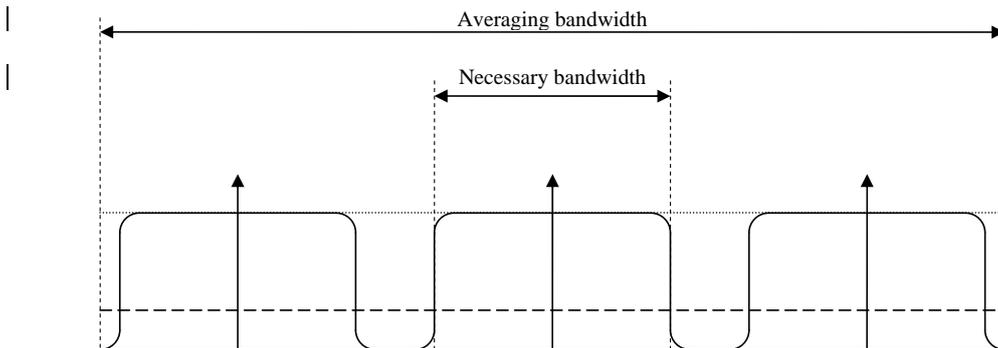
Difference of power density values according to the bandwidth (single carrier case)



However, when submitting satellite networks using RR Appendix 4 data elements, it is required to submit power densities “for each carrier type” (see items C.8.a.2 and C.8.c.3). Therefore, if multiple carriers of the same type are used within the averaging bandwidth (see Figure 2), the current wording of Footnote 2 leads to underestimating the interference potential of the filed carrier type. Noting that carriers having small bandwidth are very often used through transponders in a multi-carrier mode, this situation is most likely to occur in practice.

FIGURE 2

Difference of power density values according to the bandwidth (multiple carrier case)



It is proposed to correct Footnote 2 to Tables A, B, C and D of Annex 2 of RR Appendix 4 in order to clarify that the number of carriers planned to be operated within the averaging bandwidth shall be used for computing maximum power densities of carriers whose bandwidths are smaller than the appropriate averaging bandwidth. The detailed proposal is contained in the Annex to this document.

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Two editorial improvements to RR Appendix 4 are also proposed:

- in the introduction of RR Appendix 4, include a reference to the radio astronomy service in addition to space services;
- in Footnote 2 to the title of Annex 2, replace the reference to footnote 1 by the text of footnote 1 amended to apply to Annex 2 (i.e. by replacing “Terrestrial” by “Space”).

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Comments:

The following comments are made based on the on-going ITU BR examination methods and general practice during coordination meetings:

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Footnote 2 to Tables A, B, C and D of Annex 2 of RR Appendix 4, to be specific the expression “the maximum density is calculated as if the assignment occupied the averaging bandwidth”, has been widely practiced and by far the following observations are noticed and according proposal is made.

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- The current method for the ITU BR to perform examinations when dealing with a carrier having a bandwidth smaller than the averaging bandwidth has been averaging the power of this one single carrier into the whole averaging bandwidth.
- The basis of the proposed modification is to eliminate the possibility of under-estimating the interference. However, the possibility of over-estimating the interference might be introduced at the same time. It all depends on whether the system works in a multi-carrier or a single-carrier mode within this averaging bandwidth. It should be noted that both of these two modes exist and in practice the situation varies from one end to another. The key for the proposed method to function well and excel to the current ITU BR method depends on whether or not an operator can precisely predict its future carrier plan. Otherwise, it appears that the real situations just lay somewhere in between.
- Each case during a coordination meeting can be unique and detailed carrier plan would usually be introduced for the other side to evaluate. Thus a more accurate result can be reached. Considering the precision required and the amount of the possible combinations among different types of carriers, the proposed modification to Appendix 4 would cast extra workload for an Administration when preparing a filing and for the ITU BR when processing one.

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The general stages where the method prescribed in Footnote 2 is referred to can be summarized as follows:

- 1) for the administrations to prepare a filing;
- 2) for the ITU BR to perform the examinations;
- 3) for the administrations to conduct the coordination meetings.

Consequently, the following results can be observed respectively:

- a) The ambiguity of the expression might lead to different treatments for administrations at stage 1. To meet the RR limitations required, some administrations might calculate the power level as if the averaging bandwidth were filled by the carriers, while others might average a single carrier into the whole averaging bandwidth. With the clarification from the ITU BR quoted in Summary of this document, the confusion should be eliminated.
- b) See as the quoted reply from the ITU BR.
- c) At the coordination process and when the detailed actual carrier plan is introduced, more accurate assessment would be realizable regardless of different treatments.

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Therefore, current common practice does not cause substantial problem. The coordination process itself already eliminates the possibility of under-estimating or over-estimating the interferences. It's not necessary to modify the current method in footnote 2 as proposed.

3 Consideration of some issues related to the proposal

This section intends to provide some elements to answer these issues:

- Impact on RR Appendix 4 data elements referring to this note (note that items C.8.b.3.b and C.8.h do not refer to Footnote 2, even though they relate to power densities): only three data elements (i.e. items C.8.a.2, C.8.b.2 and C.8.c.3) refer to Footnote 2.
 - Item C.8.a.2 is “the maximum power density, in dB(W/Hz), supplied to the input of the antenna for each carrier type”.
 - Item C.8.b.2 is “the maximum power density, in dB(W/Hz), supplied to the input of the antenna” “[f]or the case where it is not appropriate to identify individual carriers” (see heading C.8.b).
 - Item C.8.c.3 is “the minimum power density, in dB(W/Hz), supplied to the input of the antenna for each carrier type”.

The proposed change is considered applicable to these three data elements since the new formula more adequately reflects the actual power density that, for instance, could be measured on a spectrum analyser.

- Receiving filters’ bandwidth: it was mentioned that the averaging bandwidth is linked with typical receiving filters bandwidths. This is well-agreed however the point remains because of the possible aggregation of multiple carriers of the same type in the bandwidth of a receiver. This situation is very frequent in real operations.
- Applicability to spread spectrum carriers: even if it is unlikely that spread spectrum carriers have necessary bandwidths small enough to be less than the averaging bandwidth, the definition of the necessary bandwidth also applies to such carriers and the proposed formula (dividing the power by the necessary bandwidth) is therefore considered appropriate.

A fourth issue – i.e. the link between the power densities submitted under various data items of Appendix 4 and the regulatory examinations performed by the Bureau with regard to the compliance with some power limits contained in RR Articles 5, 21 and 22 – is considered more in depth in the following section.

4 Link with the examination of the power limits contained in RR Articles 5, 21 and 22

One might argue that changing Footnote 2 would have consequences on the examination under RR No. 11.31 of some power limits contained in RR Articles 5, 21 and 22, because the averaging bandwidth in Appendix 4 is somehow linked to the reference bandwidths in these other Articles. However, while this may have been true in the past, it should be noted that the current version of the Radio Regulations contains many provisions indicating reference bandwidths that are different from 4 kHz below 15 GHz and 1 MHz above 15 GHz (e.g. RR No. 21.13A, various rows below 15 GHz in Table 21-4, RR No. 21.16.2, Tables 22-1A, 22-1B, 22-1C, 22-1D, 22-2, 22-3, RR Nos. 22.26 and 22.32). Therefore, it seems more appropriate that these power limits in their associated reference bandwidths be checked against using a uniform methodology rather than sometimes using the fact that the numerical values of the reference bandwidth and of the averaging bandwidth are identical and sometimes using another method.

Besides, it should be pointed out that, if carrier power densities were actually computed according to the current wording of Footnote 2 and then used to check compliance with power limits set forth in the Radio Regulations, it could also underestimate the interference potential of such carriers when more than one is planned to be used within the averaging bandwidth.

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APPENDIX 4 (REV.WRC-07)

Consolidated list and tables of characteristics for use in the application of the procedures of Chapter III

1 The substance of this Appendix is separated into two parts: one concerning data and their use for terrestrial radiocommunication services and another concerning data and their use for space radiocommunication services and the radio astronomy service.

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ANNEX 2

Characteristics of satellite networks, earth stations or radio astronomy stations² (Rev.WRC-07)

Footnotes to Tables A, B, C and D

- 1) Not required for coordination under No. 9.7A.
- 2) The most recent version of Recommendation ITU-R SF.675 should be used to the extent applicable in calculating the maximum power density per Hz. For carriers below 15 GHz, the power density is averaged over the worst 4 kHz band. For carriers at or above 15 GHz, the power density is averaged over the worst 1 MHz band. In the case of assignments with a bandwidth less than the stated averaging bandwidth, the maximum density is calculated by taking into account the largest number of carriers planned to be operated within the averaging bandwidth.

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² The Radiocommunication Bureau shall develop and keep up-to-date forms of notice to meet fully the statutory provisions of this Appendix and related decisions of future conferences. Additional information on the items listed in this Annex together with an explanation of the symbols is to be found in the Preface to the BR IFIC (space services).

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Items in Appendix	C – CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH STATION OR RADIO ASTRONOMY ANTENNA	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including space operation functions under Article 2A of Appendices 30 or 30A)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy

(...)

C.8.h	the maximum power density per Hz supplied to the input of the antenna, in dB(W/Hz), averaged over the necessary bandwidth In the case of Appendix 30A, required only in the band 17.3-18.1 GHz <u>In cases other than Appendices 30, 30A and 30B, required only where the necessary bandwidth of the carrier is less than the averaging bandwidth</u>										C.8.h	

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