Radiocommunication Study Groups

Russian Federation

PROPOSED EXTENSION OF CROSS-REFERENCES IN ITU-R RECOMMENDATIONS AND REPORTS DEDICATED TO BANDWIDTHS AND OUT-OF-BAND EMISSIONS OF TRANSMITTER EMISSION SPECTRA

Introduction

Documentation of ITU-R Study Group (SG) 1 contains a number of closely interrelated Recommendations and Reports concerning bandwidths and out-of-band emissions of transmitters, and namely:

– Recommendation ITU-R SM.328-11 – *Spectra and bandwidth of emissions*;

– Recommendation ITU-R SM.853-1 – *Necessary bandwidth*;

– Recommendation ITU-R SM.1138-3 – *Determination of necessary bandwidths including examples for their calculation and associated examples for the designation of emissions*;

– Recommendation ITU-R SM.1539-1 – *Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329*;

– Recommendation ITU-R SM.1541-6 – *Unwanted emissions in the out-of-band domain*;

– Report ITU-R SM.2048-0 – *Use of the x dB bandwidth criterion for determination of spectral properties of a transmitter in the out-of-band domain*;

– Report ITU-R SM.2421-0 – *Unwanted emissions of digital radio systems*

These documents contain some cross-references but these references do not cover all aspects of their close interdependence. References in the Recommendations to Reports ITU-R SM.2048 and ITU-R SM.2421 are completely absent, although they contain a large amount of useful additional information on this subject.

It is proposed to expand the scope of such cross-references as that will make it easier for readers to navigate through the variety of different aspects reflected in this set of ITU-R SG 1 documentation. As a side, but significant, effect it can be mentioned that the amendments to important Recommendations ITU-R SM.853-1 and ITU-R SM.1539-1 will allow for their translation into Russian, Arabic and Chinese, as these translations are currently not available at the ITU website.

As it concerns Recommendation ITU-R SM.328-11, in addition to expanding the cross-references, it seems appropriate, as a partial answer to Question ITU-R 222/1, to describe in more detail the specifics of the necessary bandwidth in comparison with the occupied and *x* dB bandwidths, as well as to indicate how the necessary bandwidth can be identified on the emission spectrum. Some editing of the text of the Recommendation is also proposed, in particular correction of the typing mistake "dB bandwidth" in the Keywords section.

Proposals

1 Proposed revisions to Recommendation ITU-R SM.328-11

1.1 Amend section Keywords as follows:

Spurious emission, dB bandwidth, emitted spectra, adjacent-channel, necessary band

Emitted spectra, unwanted emissions, out-of-band emission, spurious emission, bandwidth of emission, adjacent channel

1.2 Amend § e) of the considering section as follows:

e) that with regard to the efficient use of the radio-frequency spectrum necessary bandwidths for individual classes of emission must be known, that in some cases the formulae listed in Recommendations ITU-R SM.1138, ITU-R SM.853 and Report ITU-R SM.2048 can only be used as a guide and that the necessary bandwidth for certain classes of emissions is to be evaluated corresponding to a specified transmission standard and a quality requirement;

1.3 Amend § g) of the considering section as follows:

g) that, in addition to limiting the spectrum occupied by an emission to the most efficient value in each case, rules have been established in Recommendation ITU-R SM.1541 to limit unwanted emissions in the out-of-band domain and in Recommendation ITU-R SM.329 to limit unwanted emissions in the spurious domain; Recommendation ITU-R SM.1539 specifies borders between out-of-band and spurious domains, the issue is also considered in Report ITU-R SM.2421 in application to digital radio systems;

*1.4 Amend footnote to Nos. **144**, **1.145** and **1.146** of RR in the recognizing section as follows:*

* The terms associated with the definitions given by Nos. **1.144**, **1.145** and **1.146** shall be expressed in the working languages as follows:

Numbers	In French	In English	In Spanish
1.144	Emission hors bande	Out-of-band emission	Emisión fuera de banda
1.145	Rayonnement non essentiel	Spurious emission	Emisión no esencial
1.146	Rayonnements non désirés	Unwanted emissions	Emisiones no deseadas

NOTE 1 – In accordance with Resolution 115 (Marrakesh, 2002) the Table should be amended to present equivalents in Arabic, Chinese and Russian languages.

Numbers	In French	In English	In Spanish	In Arabic	In Chinese	In Russian
1.144	Emission hors bande	Out-of-band emission	Emisión fuera de banda	بث خارج النطاق	带外发射	внеполосное излучение
1.145	Rayonnement non essentiel	Spurious emission	Emisión no esencial	بث هامشي	杂散发射	побочное излучение
1.146	Rayonnements non désirés	Unwanted emissions	Emisiones no deseadas	بث غير مطلوب	无用发射	нежелательные излучения

1.5   Amend the first sentence of § 1 in the recommends section as follows:

1   Definitions

That the following additional definitions should be used when dealing with bandwidth, channel spacing and interference problems:

1.6   Amend § 3 of the recommends section as follows:

3   Limits for out-of-band emissions

that this Recommendation could be used as guidance in deriving the limits for out-of-band emissions. Such limits should be defined considering the degradation caused by modulation imperfections, phase noise, intermodulation and practical limitations on filter implementation. Recommendation ITU-R SM.1541 provides limiting masks for out-of-band emissions of different classes of emissions. Report ITU-R SM.2048 presents breakpoints of such limiting masks for some other classes of emissions.

1.7   Add a new § 5 to the recommends section as follows:

5   Features of the necessary bandwidth

As it concerns the necessary bandwidth, the following should be noted. This bandwidth fundamentally differs from the occupied and x dB bandwidths. If the latter bandwidths directly characterize the emission spectrum of the transmitter, then the necessary bandwidth is a system characteristic and represents parameters of the entire radio channel from the transmitter modulator to the receiver demodulator. In the definition of the necessary bandwidth (No. **1.152** of the RR, see above), it is not directly related to the emission spectrum, but it is related to the spectrum only indirectly through the class of emission which in its turn characterizes the emission spectrum only in very general terms.

If, for example, for a certain specific class of emission the IF path band of the receiver is narrower than the relevant necessary bandwidth, the quality of the signal at the reception will be reduced, similarly, to some extent, as it would happen in the case of emission narrower than "optimal" at the transmitter output (see Figure 1). If the radio channel contains repeaters, the width of the through-pass frequency response of each repeater, in order to avoid distortions, should not be less than the necessary bandwidth, that is fulfilled by all operating radio lines.

Precisely, because the necessary bandwidth is a system characteristic, it, unlike the occupied and x dB bandwidths, cannot be directly counted on the emission spectrum of the transmitter. The reconciliation of the necessary bandwidth and the emission spectrum can only be made indirectly as follows. The value of the necessary bandwidth is calculated by the formula for the class of emission in question in accordance with Recommendations ITU-R SM.1138 and ITU-R SM.853 or Report ITU-R SM.2048 (where the class of emission in question is presented). Then the obtained value is superimposed on the emission spectrum and this determines the initial points of out-of-band

emissions at both sided of the spectrum (see Figure 1). Based on these points, the relative powers of out-of-band emissions are determined by integration, the obtained data are compared with the normalized value of $\beta/2\%$ for this class of emission (usually $\beta/2 = 0.5\%$), and by this it can be concluded whether the emission is "optimal". Due to the complexity of this process measurements of occupied or x dB bandwidths are used in practice in accordance with their definitions.

1.8   Renumber existing § 5 of the recommends section to be § 6.

1.9   All other points and Annexes of the Recommendation to be unchanged.

2   Proposed revisions to Recommendation ITU-R SM.853-1

2.1   Amend § b) of the considering section as follows:

b)   that with regard to the efficient use of the radio-frequency (RF) spectrum, necessary bandwidths for individual classes of emission must be known, that in some cases the formulae listed in Recommendation ITU-R SM.1138 and Report ITU-R SM.2048 can only be used as a guide and that the necessary bandwidth for certain classes of emissions is to be evaluated corresponding to a specified transmission standard and required quality;

2.2   Amend the first sentence of the recommends section as follows:

that the necessary bandwidth formulae (contained in Recommendation ITU-R SM.1138) be supplemented with the ~~following~~ formulae given below. It also concerns the formulae presented in Report ITU-R SM.2048.

2.3   All other items and Annexes of the Recommendation to be unchanged

2.4   Provide translation of the Recommendation into Russian, Arabic and Chinese languages.

3   Proposed revisions to Recommendation ITU-R SM.1539-1

3.1   Amend § 1 of the recommends section as follows:

1   that Annex 1 should be referred to in the case of variation of the boundary between the OoB and spurious domains which may be required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329. Report ITU-R SM.2421 also contains useful information on the issue in application to digital radio systems.

NOTE 1 – Recommendation ITU-R SM.1138, which is incorporated by reference into the Radio Regulations (RR), deals with the determination of necessary bandwidth for various emissions. Recommendation ITU-R SM.853 and Report ITU-R SM.2048 present~~s~~ additional information concerning the determination of necessary bandwidth for certain emissions, including unmodulated and modulated pulse emissions and ~~some~~various types of digital modulation.

3.2   Amend last sentence at page 3[1] (§ 2 of Annex 1) as follows:

In the case of narrow-band and wideband systems, the variation of the spurious boundary also affects the OoB masks specified in Recommendation ITU-R SM.1541. This is covered in *recommends* 5 of Recommendation ITU-R SM.1541. It also concerns OoB masks that can be reconstructed by breakpoints presented by various x dB bandwidths given in Report ITU-R SM.2048 for many classes of emissions.

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[1] Here and below the page number is given in relation to the English text of the document in Word format at the ITU website.

3.3   All other items of the Recommendation and its Annex 1 to be unchanged.

3.4   Provide translation of the Recommendation into Russian, Arabic and Chinese languages.

4   Proposed revisions to Recommendation ITU-R SM.1541-6

4.1   Insert the following sentence in § 4 of the recommends section just after Table 2 (page 8):

Report ITU-R SM.2048 contains data on breakpoints of out-of-band emission masks at various levels up to −60 dB for a number of emission classes. Masks similar to those shown in the Annexes to this Recommendation, which are listed in Table 2 above, can be reconstructed based on these points as it is demonstrated in Report ITU-R SM.2048.

4.2   Amend § 6 of recommends section as follows:

6   Measurement methods

that the methods for measurement of OoB described in detail in Annex 13 should be used; Report ITU-R SM.2048 contains additional information on OoB measurements indicating test signals and reference 0 dB levels.

4.3   All other items of the Recommendation and its Annexes 1-6 to be unchanged.

4.4   Insert proposed modifications in Annex 18 to Document 1A/73 dated 14 December 2020 "Working document towards a preliminary draft revision of Recommendation ITU-R SM.1541-6".

Attachment:

Annex_Proposed
version of Annex 18.d

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