

RECOMMENDATION ITU-R SM.1540-0*

**Unwanted emissions in the out-of-band domain
falling into adjacent allocated bands**

(2001)

Scope

This Recommendation serves as a basis for the requirements and guidance to reduce interference due to unwanted emissions in the OoB domain falling into adjacent allocated frequency bands.

Keywords

Unwanted emissions, out-of-band domain, spurious domain, adjacent allocated bands

The ITU Radiocommunication Assembly,

considering

- a) that Recommendation ITU-R SM.329 provides limits for unwanted emissions in the spurious domain from a given emission into all other bands in the radio spectrum, and that for regulatory purposes, the boundary between out-of-band (OoB) and spurious domains (which is a function of the necessary bandwidth of the emission) and its possible variation are defined in Recommendations ITU-R SM.329 and ITU-R SM.1539, respectively;
- b) that Recommendations ITU-R SM.1541 and ITU-R SM.329 give the definitions of the terms “out-of-band domain” and “spurious domain”;
- c) that in cases where part or whole of the OoB domain falls within the allocated band for the emission, the unwanted emission limits in the OoB domain are dealt with in other ITU-R Recommendations or by more stringent local standard;
- d) that there are other related system specific studies which may lead to specific methodology for the limitation of unwanted emissions when the OoB domain falls into adjacent allocated bands, however for cases where no other methodology is available, there is a requirement for guidance;
- e) that in accordance with the Radio Regulations (RR), only the necessary bandwidth of the emission is contained in the assigned frequency band (RR No. 1.147), and therefore the OoB domain, particularly that of the outermost frequency channel, may fall into the adjacent allocated band;
- f) that the likelihood of the OoB domain falling into the adjacent allocated band may increase when using digital modulations or wide band emissions;
- g) that in order to use the spectrum as efficiently as possible, in many cases it may be necessary that part of the OoB domain, as defined in Recommendation ITU-R SM.329, is outside the allocated band;
- h) that there are no general guidelines available in other Recommendations covering unwanted emissions in the OoB domain from a transmission at the edge of one allocation into the adjacent allocation,

* Radiocommunication Study Group 1 made editorial amendments to this Recommendation in the years 2018 and 2019 in accordance with Resolution ITU-R 1.

recognizing

- a) that RR No. 15.10 states: “The out-of-band emissions of transmitting stations should not cause harmful interference to services which operate in adjacent bands in accordance with these Regulations and which use receivers in conformity with Nos. **3.3**, **3.11**, **3.12**, **3.13** and relevant ITU-R Recommendations”;
- b) that RR No. 3.3 states: “Transmitting and receiving equipment intended to be used in a given part of the frequency spectrum should be designed to take into account the technical characteristics of transmitting and receiving equipment likely to be employed in neighbouring and other parts of the spectrum, provided that all technically and economically justifiable measures have been taken to reduce the level of unwanted emissions from the latter transmitting equipment and to reduce the susceptibility to interference of the latter receiving equipment”;
- c) that RR No. 3.13 states: “The performance characteristics of receivers should be adequate to ensure that they do not suffer from interference due to transmitters situated at a reasonable distance and which operate in accordance with these Regulations”;
- d) that RR No. 4.3 states: “Any new assignment or any change of frequency or other basic characteristic of an existing assignment (see Appendix 4) shall be made in such a way as to avoid causing harmful interference to services rendered by stations using frequencies assigned in accordance with the Table of Frequency Allocations in this Chapter and the other provisions of these Regulations, the characteristics of which assignments are recorded in the Master International Frequency Register”;
- e) that RR No. 4.5 states: “The frequency assigned to a station of a given service shall be separated from the limits of the band allocated to this service in such a way that taking into account the frequency band assigned to a station, no harmful interference is caused to services to which frequency bands immediately adjoining are allocated”;
- f) that RR No. 15.22 states: “It is essential that Member States exercise the utmost goodwill and mutual assistance in the application of the provisions of Article 45 of the Constitution and of this Section to the settlement of problems of harmful interference”;
- g) that RR No. 1.147 states: “*assigned frequency band*: The frequency band within which the *emission* of a *station* is authorized; the width of the band equals the *necessary bandwidth* plus twice the absolute value of the *frequency tolerance*. Where *space stations* are concerned, the assigned frequency band includes twice the maximum Doppler shift that may occur in relation to any point of the Earth’s surface”;
- h) that RR No. 1.152 states: “*necessary bandwidth*: For a given *class of emission*, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions”;
- j) that RR No. 1.153 states: “*occupied bandwidth*: The width of a frequency band such that, below the lower and above the upper frequency limits, the *mean powers* emitted are each equal to a specified percentage $\beta/2$ of the total *mean power* of a given *emission*.”

Unless otherwise specified in an ITU-R Recommendation for the appropriate *class of emission*, the value of $\beta/2$ should be taken as 0.5%”,

recommends

- 1** that the necessary bandwidth, and preferably the overall occupied bandwidth, of any emission should be maintained completely within the band allocated to the service in question, including any offsets such as Doppler shift or frequency tolerances;

2 that, where other methodologies are not available in existing ITU-R Recommendations, the power of an unwanted emission in the OoB domain falling into the adjacent band allocation should be evaluated and, where appropriate, in order to avoid unacceptable interference into the adjacent allocated bands, this unwanted power should be reduced for the outermost frequency assignments and/or for unwanted emissions in the OoB domain (see Notes 1 and 2);

3 that *recommends* 1 and 2 should be regarded as providing basic requirements and guidance; however for specifically identified cases where more detail is required, this will be a subject of further study;

4 that the methodology described in Annex 1 should be used as an example of a generic approach to addressing this problem.

NOTE 1 – In this Recommendation the term “adjacent allocated band” means the frequency band immediately adjoining (see RR No. 4.5 quoted in *recognizing e*). This Recommendation does not apply to the case in which the adjacent allocated band is used by one administration for the same service.

NOTE 2 – For the purpose of this evaluation, when actual measurements are required, care should be taken so that, if relevant, the power of unwanted emissions in the spurious domain, as defined in Recommendation ITU-R SM.329, is excluded.

ANNEX 1

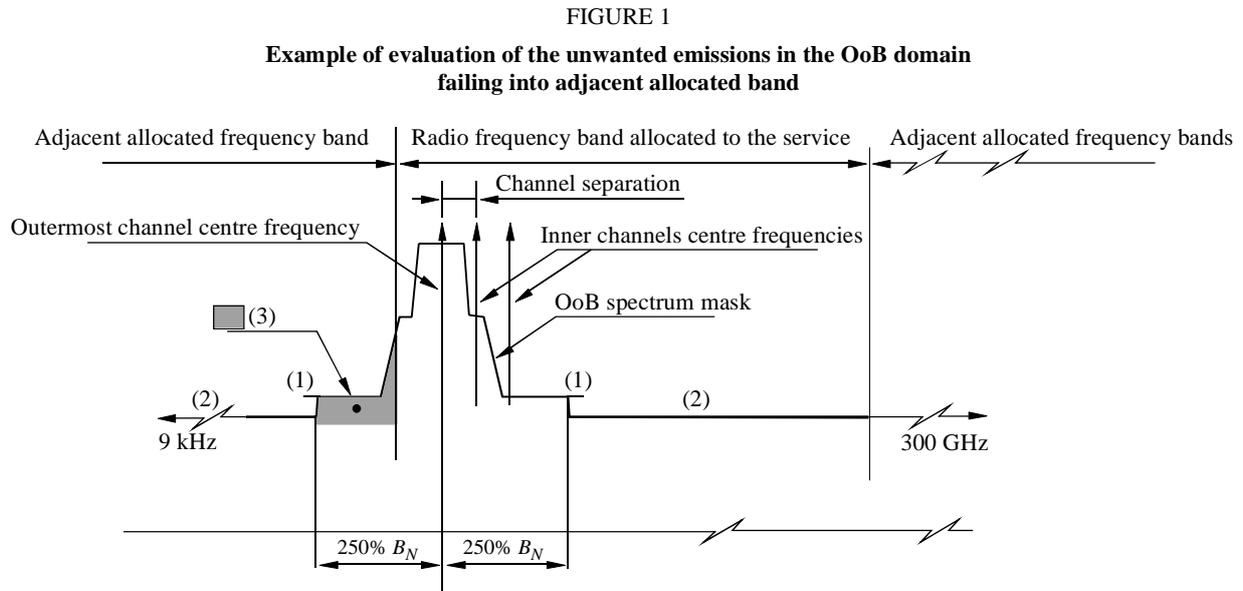
Methodology to reduce interference due to unwanted emissions in the OoB domain falling into adjacent allocated frequency bands

The general principles to efficiently manage the problem of the outermost frequency assignments are:

- to analyse the amount of OoB power spill-over into the adjacent allocated band;
- to consider the characteristics of the services concerned and options to mitigate the interference;
- to employ, when practicable, OoB filtering of the transmitter in order that the total unwanted emission portion in the OoB domain, which falls in the adjacent band, is reduced to an acceptable level, as shown in Fig. 1;
- to adjust the operating frequency of the transmitter or receiver until the unwanted emission interference from the OoB domain is sufficiently reduced to achieve compatibility;
- to consider other interference mitigation techniques such as: site selection, site shielding, reduced receiver or transmitter antenna side lobes, error correction, etc.

This methodology is not exhaustive and other methods may be applicable to reduce the level of the interference.

Figure 1 gives a generic example of evaluation of the unwanted emissions in the OoB domain falling into the adjacent allocated band, where the boundary between the OoB and spurious domains is 250% of the necessary bandwidth B_N .



- (1) Actual OoB mask for the system under consideration
- (2) Spurious limit defined by RR Appendix 3 or Recommendation ITU-R SM.329
- (3) Unwanted emissions in the OoB domain falling in the adjacent allocated frequency band