

RECOMMENDATION ITU-R SM.1599-1

Determination of the geographical and frequency distribution of the spectrum utilization factor for frequency planning purposes

(Question ITU-R 66/1)

(2002-2007)

Scope

This Recommendation serves as a guideline for determining the geographical and frequency distribution of the spectrum utilization factor for frequency planning purposes.

The ITU Radiocommunication Assembly,

considering

- a) that the availability of unoccupied radio-frequency spectrum is a condition for meeting the demand for spectrum;
- b) that in frequency planning, i.e. the assignment of frequencies to new radio stations, limited use is in practice made of quantitative methods of finding the best assignments that will lead to the most economical use of the spectrum;
- c) that in the process of redistributing frequency bands in the interests of other radio services, the approach is, as a rule, to use heuristic methods, together with individual empirical data indicating the probability of harmful interference between radio stations;
- d) that for the purposes of frequency planning it is useful to know the potential capacity of the frequency resources available by geographical location at the notified site of the radio station and that to this end it is necessary to have sufficiently accurate methods of determining the geographical and frequency distribution of the spectrum utilization factor as defined for general purposes in Annex 1 to Recommendation ITU-R SM.1046,

recommends

- 1 that administrations should, in the planning process, use data on the geographical and frequency distribution of the spectrum utilization factor;
- 2 that the methods used to determine the geographical and frequency distribution of the spectrum utilization factor should be those given in Annex 1.

Annex 1

Methods of determining the geographical and frequency distribution of the spectrum utilization factor

1 General description of methods

There are a number of ways of obtaining detailed information on the degree of spectrum congestion which are based on calculating the power characteristics of the electromagnetic environment (EME) formed by radio station emissions.

One of them calls for the construction of a so-called frequency panorama of spectrum congestion, showing the field strength or spectral power flux-density of emissions at a given geographical point as a function of frequency, and for determination of the frequency bands in which the level of the EME characteristics in question exceeds a certain threshold value. This method as a whole gives an idea of the situation with regard to spectrum utilization. However, the results obtained by this means are approximate. This is due to the following reasons. In the process of determining the EME characteristics, practically no account is taken of the time parameters of emissions. In particular, continuous signal modulation parameters and class of emission data are completely lost. Pulse signals are treated as continuous with constant mean power. The variety of signals emitted by existing radio stations makes it necessary to fix a floating value (different for different signals) for the permissible level of EME characteristics determining the boundaries between congested sectors of the spectrum, which becomes a rather laborious business when the EME is a complex one. Setting a single threshold is not really appropriate and leads to approximate results.

Similar shortcomings affect another well-known method of evaluating spectrum use, which involves constructing two-dimensional representations of the isolines for equal strength of the combined electromagnetic field of sources of radio interference (EME maps). As a result no simple answer can be given to the question of whether the frequency under consideration is or is not congested for a particular radio station at a point with a given level of field strength. Accordingly, these methods find practical application mainly in situations where the signals emitted by different sources belong to one and the same class.

A more logical approach to the task of obtaining detailed data on the degree of spectrum utilization in different areas is based on the method of sampling the geographical and frequency resource in question with the aid of a reference radio station and checking whether conditions are met for ensuring the compatibility of this radio station with existing ones to which frequencies have been assigned previously.

The main disadvantages of this method, which limit its widespread use in practice, are as follows:

- the calculation takes a long time because of the need to directly determine the power conditions of the interaction between signals and interference in relation to all the given geographical and frequency sampling points;
- the radio-frequency bodies responsible for examining frequency notices need to have available a large volume of initial data, particularly on the technical characteristics of radio stations, which in many cases may be very difficult to get hold of.

A rather simpler and more convenient method of obtaining detailed data on the degree of spectrum utilization in different geographical areas, which is based on wide use of the frequency-distance rules set forth in general terms in Annex 2 to Recommendation ITU-R SM.337, is given below.

The main approach taken as a basis for this method is also applicable for the determination of the degree of spectrum-orbit congestion in application to satellite communication systems. In this case detailed data concerning orbital positions and technical parameters of satellites should be available.

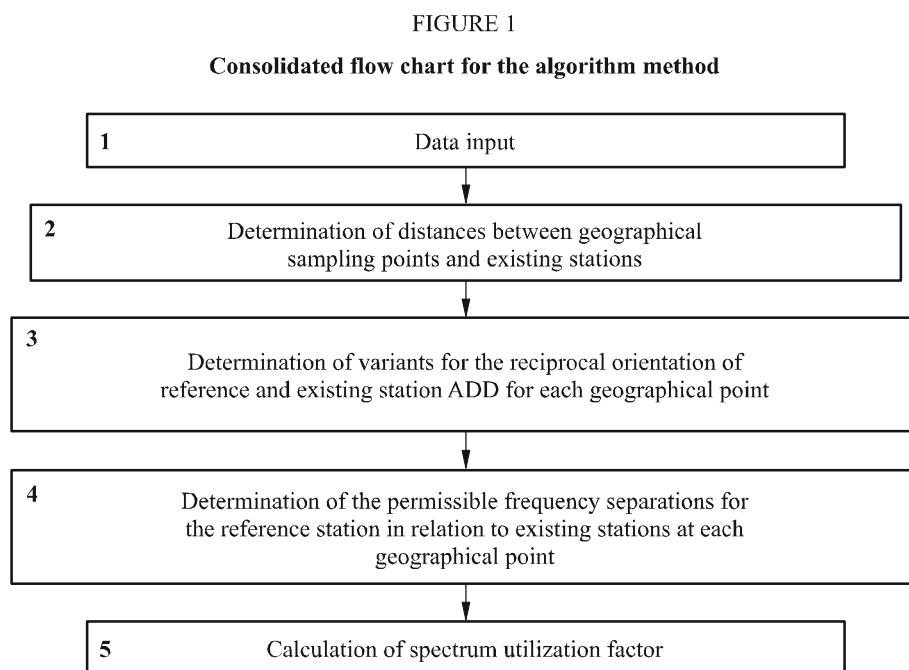
2 A simplified method for detailed evaluation of the degree of spectrum congestion

2.1 Description of the method

The aim of this method is to obtain objective data on the degree of spectrum congestion in the form of a function reflecting the limitations on the use of the spectrum by a particular additional reference radio station depending on its operating frequency and location.

Calculations by this method will be more accurate the more highly developed the frequency-distance rules are, covering in aggregate form all the necessary parameters and basic conditions relating to the interaction (co-, adjacent- and side-channel) of signals and interference and making it possible to check efficiently the conditions for ensuring the compatibility of radio stations in relation to the given geographical and frequency sampling points.

A consolidated flow chart of the algorithm method is given in Fig. 1.



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The content of the boxes is as follows:

Box 1 – Input of initial data, including: dimensions of geographical area under consideration; lower and upper limits of the frequency band in question; characteristics of existing radio stations (assigned nominal frequencies, geographical coordinates, orientation of antenna directivity diagrams (ADD)); frequency-distance rules for the reference and existing radio stations; basis for carrying out calculations (at individual points in the area, over the whole area, over the whole band, at individual frequencies); geographical and frequency sampling intervals.

Box 2 – Determination of distances between geographical sampling points and existing radio stations. The initial data are the coordinates of the sites of existing radio stations and the corresponding sampling points.