

SECTION 4/9B: COORDINATION AND INTERFERENCE CALCULATIONS

RECOMMENDATION ITU-R SF.1006

DETERMINATION OF THE INTERFERENCE POTENTIAL BETWEEN EARTH STATIONS
OF THE FIXED-SATELLITE SERVICE AND STATIONS IN THE FIXED SERVICE

(Questions ITU-R 32/4 (1990) and 109/9 (1990))*

(1993)

The ITU Radiocommunication Assembly,

considering

- a) that when the coordination area of an earth station, as established by the methods given in Recommendation ITU-R IS.847**, includes territory of another administration, mutual consultation between the administrations concerned is required;
- b) that each station in the fixed service within the coordination area must be examined to determine whether it will experience or cause more than a permissible amount of interference;
- c) that Recommendation ITU-R PN.452** provides the requisite propagation bases for individual point-to-point interference evaluation;
- d) that experience has shown that, in many instances, separation distances as small as a few kilometres, when allowing for typical terrain and shielding, are achievable (see Fig. 1);
- e) that the methodology for determining the level of interference is a matter for agreement between the administrations concerned;
- f) that guidance to administrations on the detailed determination of these levels for performing a preliminary analysis may nonetheless be of value to some in the detailed coordination and interference evaluation,

recommends

- 1. that the methods described in Annex 1 may be used for assessing interference potential between earth stations and specific stations in the fixed service within the coordination area.

ANNEX 1

**Determination of the interference potential between fixed satellite
service earth stations and stations in the fixed service**

The following method may be used for assessing whether interference between earth stations and specific terrestrial stations can be expected to exceed a pre-determined level.

1. Preliminary elimination procedure

The method of calculating coordination area as described in Recommendation ITU-R IS.847** assumes certain reference values for the parameters of terrestrial stations. A very large percentage of the actual or planned terrestrial stations within a coordination area can be eliminated from further consideration when their actual or planned parameters are known, by using the auxiliary contours as defined in Appendix 28 of the Radio Regulations (Geneva, 1979).

* Former CCIR Questions 32/4 and 109/9.

** Former CCIR Recommendations 847 and 452.

One set of contours is associated with values of the terrestrial station interference sensitivity factor, S which is defined as:

$$S = G_r - P_r(p) \quad \text{dBW} \quad (1)$$

where:

- G_r : net gain (dBi) (i.e. the gain of the antenna itself minus the feeder loss (dBi) relative to isotropic; where the feeder loss is not known, its value should be assumed to be 0 dB) of the receiving antenna of the terrestrial station in the direction of the earth station
- $P_r(p)$: permissible interference power (dBW) in the reference bandwidth to be exceeded for no more than p percent of the time at the receiver input of a station suffering interference (in this case a terrestrial station).

The other set of contours is associated with values of terrestrial station e.i.r.p.:

$$E = P_t' + G_t' \quad \text{dBW} \quad (2)$$

where:

- P_t' : available transmitting power (dBW) in reference bandwidth B at the input to the antenna of an interfering station (in this case a terrestrial station)
- G_t' : gain (dBi relative to isotropic) of the transmitting antenna of the terrestrial station in the direction of the earth station.

Each terrestrial station which is located within the coordination area may now be examined to determine whether it can be excluded from further considerations:

- for terrestrial stations which may be receiving interference from the earth station, the interference sensitivity factor in the direction of the earth station should be determined. If this value is less than that associated with the nearest contour outside which the station is located, then the station may be excluded. Otherwise, detailed calculations as described in § 2 must be carried out;
- for terrestrial stations which may be causing interference to the earth station, the actual e.i.r.p. in the direction of the earth station should be determined. If this value is less than that associated with the nearest contour outside which the terrestrial station is located, then the station may be excluded. Otherwise, detailed calculations as described in § 2 must be carried out.

The above method has been based on the assumption that the number of interference entries assumed in Recommendation ITU-R IS.847* for the calculation of the auxiliary contours is not exceeded.

Terrestrial stations eliminated by the above procedure from further consideration with regard to great circle propagation mechanisms need, nevertheless, to be considered further with regard to rain scatter propagation, when they lie within the rain scatter coordination area.

2. Determination of interference potential due to great-circle propagation mechanisms, mode (1)

Terrestrial stations located within the coordination area, which cannot be eliminated from further consideration by the method described in § 1 must be subjected to a more detailed analysis.

* Former CCIR Recommendation 847.

For each terrestrial station it is necessary to compare the available basic transmission loss for the path and the minimum permissible basic transmission loss value, at which interference is negligible for two time percentages on the one hand equal to 20% of the time p_1 , and on the other, a low percentage of the time ($< 1\%$) designated p_2 .

Interference is negligible when, for both time percentages, the available basic transmission loss for the path exceeds the minimum permissible basic transmission loss.

2.1 Level of maximum permissible interference

The level of permissible interference power at the input of the receiver of a terrestrial or an earth station may, in the most general form, be expressed as the unwanted radio-frequency power P_r from any one of n sources of interference, in a reference bandwidth B , to be exceeded for not more than specified percentages of the time, p_i . For most practical purposes two such percentages of the time will be adequate; one, p_1 , chosen to reflect normal (near median) conditions for which interference contributions from all interference sources may be assumed to occur simultaneously and to add on a power basis, given by:

$$P_r(p_1) = 10 \log (k T_r B) + J - W \quad \text{dBW} \quad (3)$$

and another p_2 , chosen to reflect significantly enhanced (small percentages of the time) interference conditions, for which interference contributions from all interfering sources may be assumed to occur non-simultaneously and to add on a percentage-of-the-time basis, given by:

$$P_r(p_2 / n_2) = 10 \log (k T_r B) + 10 \log (10^{M_s / 10} - 1) + N_L - W \quad \text{dBW} \quad (4)$$

where:

- p_1, p_2 : percentages of the time during which the interference from all sources may exceed the permissible level; p_1 represents long-term ($p_1 \geq 1\%$) and p_2 short-term conditions ($p_2 \leq 1\%$)
- n_1 : effective number of expected simultaneous equal-level interference contributions, associated with p_1 (see Notes 1 and 2)
- n_2 : effective number of expected non-simultaneous equal-level and equal-percentage-of-time, interference contributions, associated with p_2 (see Note 1)
- k : Boltzmann's constant: 1.38×10^{-23} J/K
- T_r : noise temperature of receiving system (for earth stations under clear-sky conditions), (K)
- B : reference bandwidth (Hz) (bandwidth, of concern to the interfered-with system, over which the interference power can be averaged)
- J : ratio (dB) of the permissible long-term (20% of the time) interfering power from any one interfering source to the thermal noise power in the receiving system (see Note 2)
- M_s : fade margin of link (see Note 3)
- N_L : link noise contribution (see Note 4)
- W : ratio (dB) of incremental thermal noise power to interference power, at radio frequencies, in the reference bandwidth, for equivalent post-detection signal degradation (see Note 4 of § 2.3.1 of Annex 1 to Recommendation ITU-R IS.847*).

Numerical values for these parameters are listed in Table 1.

* Former CCIR Recommendation 847.