RECOMMENDATION ITU-R F.1495

INTERFERENCE CRITERIA TO PROTECT THE FIXED SERVICE FROM TIME VARYING AGGREGATE INTERFERENCE FROM OTHER SERVICES SHARING THE 17.7-19.3 GHz BAND ON A CO-PRIMARY BASIS

(Question ITU-R 127/9)

(2000)

The ITU Radiocommunication Assembly,

considering

a)   that it is desirable to determine the protection criteria of FS systems operating in the 18 GHz (17.7-19.3 GHz) band with respect to aggregate interference from systems operating co-primary, especially short-term interference;

b)   that in interference situations involving non-GSO space stations, FS systems are potentially exposed to high levels of interference for short periods of time which could affect the performance or availability of these systems;

c)   that the FS link design in the 18 GHz band is controlled by rain attenuation, which can be modelled using Recommendation ITU-R P.530;

d)   that in the 18 GHz band, some administrations employ automatic transmit power control (ATPC) on some FS links and that the use of ATPC will increase the susceptibility of FS systems especially with regard to short-term interference;

e)   that some FS systems employing small net fade margins may not be fully protected from interference from non-GSO satellite systems without unduly constraining those services;

f)   that typical FS links using ATPC will require tighter protection criteria than those needed for FS links with large fade margin that do not use ATPC;

g)   that it is desirable to derive the aggregate FS protection criteria based on the calculation of the allowable degradation of error performance objective (EPO) due to interference, considering typical FS links using ATPC features;

h)   that the determination of the maximum degradation of EPO allowable to interference from other services sharing the same frequency band on a co-primary basis is given in Recommendation ITU-R F.1094;

j)   that Recommendation ITU-R F.1189 gives the EPO allowable for constant bit rate digital path at or above the primary rate carried by digital radio-relay systems which may form part of the national portion of a 27 500 km hypothetical reference path (HRP);

k)   that the allowable degradation in performance of FS systems due to interference from other services sharing the same frequency bands on a primary basis, expressed as a permissible fraction of the total EPO is defined in Recommendation ITU-R F.1398 for the FS systems which may form part of the national portion of a 27 500 km HRP,

recognizing

a)   that the application of the criteria in this Recommendation may be subject to further consideration within sharing studies with other services;

b)   that any further development of this Recommendation that may be necessary is unlikely to require further study of the appropriateness of the non-GSO satellite FSS pfd limits in this band,

recommends

1 that the following interference criteria should be used to protect the FS from time varying aggregate interference from other services in the 17.7-19.3 GHz band on a co-primary basis:

1.1 for the long term, the *I/N* at the input of the FS receiver should not exceed −10 dB for more than 20% of the time;

1.2 for the short term, the *I/N* at the input of the FS receiver should not exceed +14 dB for more than 0.01% of the time;

1.3 for the short term, the *I/N* at the input of the FS receiver should not exceed +18 dB for more than 0.0003% of the time;

2 that the information contained in Annex 1 should be used as guidance for the use of this Recommendation.

ANNEX 1

Derivation of FS aggregate protection criteria in the 17.7-19.3 GHz band

1 Introduction

The methodology presented in this Annex is based on the assumptions that the fading in the 18 GHz band is dominated by rain and that, therefore, even if long-term interference has an effect on the performance of the link, the main way to have an outage of the FS link is to have an interference level higher than the fade margin of the link, whatever the propagation conditions may be.

On this basis, the following apportionment of the effect of interference on the degradation of the link (and on EPO) has been assumed:

– 20% of FS link degradation due to long-term interference,

– 80% of FS link degradation due to short-term interference.

2 Error performance objective

The allowable degradation in performance of FS systems due to interference from other services sharing the same frequency bands on a primary basis are expressed as a permissible fraction (10%) of the total EPO and are defined in Recommendation ITU-R F.1398 for the FS systems which may form part of the national portion of a 27 500 km HRP, assumed to be representative of the 18 GHz FS links, usually used in the access networks or mobile telephone infrastructure networks.

The corresponding values are given in Table 1, and correspond to the following assumptions:

– short haul inter-exchange network section (see Table 2 of Recommendation ITU-R F.1398) composed of five hops of 8 km;

– rate from 15 to 55 Mbit/s;

– $B = 8\%$.

TABLE 1

	EPO (fraction of any month)		
	Total allowable to interference	Long-term interference (20%)	Short-term interference (80%)
Errored second ratio (ESR)	1.2×10^{-4}	2.4×10^{-5}	9.6×10^{-5}
Severely errored seconds ratio (SESR)	3.2×10^{-6}	6.4×10^{-7}	2.6×10^{-6}
Background block error ratio (BBER)	3.2×10^{-7}	6.4×10^{-8}	2.6×10^{-7}

3 Short-term criteria

As explained in § 1, the main way to have an outage of the FS link considering short-term interference is to have an interference level higher than the fade margin of the link, whatever the propagation conditions may be.

The definition of short-term criteria is then linked to both values of fade margins (or net fade margins considering ATPC (see Note 1)) and EPO allocated to short-term interference as defined in Table 1, considering that the fade margin is allocated to the short-term criteria.

The following criteria definition has been based on a 19 dB (for a BER of 1×10^{-3}) fade margin. In the United Kingdom and France there are respectively 23% and 20% of the 18 GHz links with fade margins (or net fade margin (see Note 1)) lower than 19 dB.

NOTE 1 – For an FS link using ATPC, the net fade margin = total fade margin – ATPC range.

As this fade margin is given for a BER of 1×10^{-3} which is a triggered severely errored seconds (SES) event in ITU-T Recommendation G.821 and as the EPO are referenced to ITU-T Recommendation G.826 definition, it is necessary to extrapolate the fade margin corresponding to errored second (ES) and SES levels. On the basis of the agreed assumptions that the fade margins (FM) for ES and SES are respectively 5 dB and 1 dB lower than the FM referenced to the BER 1×10^{-3} level which is 2 dB higher than the FM referenced to the BER 1×10^{-6} level, Table 2 summarizes these different values of fade margins and, associated with the correspondent EPO ratios, allows to define two short-term criteria for the FS in the bands.

TABLE 2

	Fade margin (dB)	EPO ratio
ES	**14**	9.6×10^{-5}
BER 1×10^{-6}	17	
SES	**18**	2.6×10^{-6}
BER 1×10^{-3}	19	

Thus, the short-term criteria proposed to be used in the 18 GHz band have been defined associating the ES and SES EPO (see Table 2) and the corresponding *I/N* as defined in Table 3.

TABLE 3

	I/N (dB)	Percentage of time not to be exceeded (%)
Criterion 1	14	0.01
Criterion 2	18	0.0003

4 Long-term criteria

The long-term criterion specified in Recommendation ITU-R F.758 to be used for the 18 GHz band is $I/N = -10$ dB (which gives a 0.5 dB degradation of the fade margin) not to be exceeded for more than 20% of the time.

Finally, considering low net fade margin, and based on the information provided by Radiocommunication Working Party 3M that, under clear air conditions, multipath effects would have to be considered, it has been acknowledged that some performance degradation could occur due to the simultaneous effect of interference and multipath fading using, for example, the following formula:

$$D_{EPO} = 0.89 \times \sum \left(\Delta t \times \left[10^{\frac{10}{\lambda} \log(1 + I_i/N)} - 1 \right] \right)$$

where:

D_{EPO}: degradation on error performance objectives

λ: slope of the fading cumulative distribution (dB/decade).

The significance of this degradation will require further study. The significance of degradation to availability may also need to be assessed.