

RECOMMENDATION ITU-R F.1669-1*

Interference criteria of fixed wireless systems operating in the 37-40 GHz and 40.5-42.5 GHz bands with respect to satellites in the geostationary orbit

(Question ITU-R 127/9)

(2004-2007)

Scope

Recommendation ITU R F.1669 provides the interference criteria to protect fixed wireless systems (FWSs) from interference produced by GSO satellites in the 38 and 40 GHz bands. It includes two sets of criteria for, on the one hand, some links in certain broadband wireless access applications and, on the other hand, all other FWSs.

The ITU Radiocommunication Assembly,

considering

- a) that it is desirable to determine the protection criteria of fixed wireless systems (FWSs) operating in the 38 GHz (37-40 GHz) and 40 GHz (40.5-42.5 GHz) bands with respect to interference from geostationary-satellite (GSO) systems operating on a co-primary basis;
- b) that in interference situations involving GSO space stations, fixed service (FS) systems are potentially exposed to high levels of interference for some geometric cases which could affect the performance or availability of these systems;
- c) that the FS link design in the 38 and 40 GHz bands is controlled by rain attenuation, which can be modelled using Recommendation ITU-R P.530;
- d) that in the 38 and 40 GHz bands, some administrations employ automatic transmit power control (ATPC) on some FS links and that such use will increase the susceptibility of these links especially with regard to short-term interference;
- e) that some FS links employing small net fade margins may not be fully protected from interference from 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 no pointing restrictions apply to FS systems in the 38 and 40 GHz bands, and that such restrictions are not practicable in view of the large-scale, cost-sensitive deployment,

recognizing

- a) that the bands 37.5-40 GHz and 40.5-42.5 GHz are shared on a co-primary basis with the FSS, and that the ITU-R established Recommendation ITU-R SF.1573, on pfd levels that are required to protect the FS in these bands;

* This Recommendation should be brought to the attention of Radiocommunication Study Groups 3, 4 and 7.

b) that the application of the criteria in this Recommendation is not intended to lead to a revision of Recommendation ITU-R SF.1573,

noting

a) that the representation of the interference produced by GSO satellites on a FS receiver versus the whole azimuth of this FS receiver presents, as shown in Fig. 2, two interference peaks for two particular FS azimuth for which, depending on the geometry of the FS link, the pointing direction of this link passes through the GSO arc,

recommends

1 that the following interference criteria, defining an interference mask such as described in Fig. 1, should be used to protect the fixed service systems from interference produced by GSO satellites from various services in the 37-40 GHz and the 40.5-42.5 GHz bands on a co-primary basis:

1.1 for fixed wireless systems in general:

1.1.1 the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed -10 dB except within $\pm 15^\circ$ separation from the azimuth where the FS antenna main beam intersects with the GSO arc (Notes 1 and 2);

1.1.2 for the FS azimuth within this $\pm 15^\circ$ range, interference-to-noise ratio at the input of the FS receiver can be accepted up to $+4$ dB for the azimuth corresponding to the peaks (Notes 1 and 2);

1.2 for some links in certain BWA applications:

1.2.1 the interference-to-noise ratio (I/N) at the input of the FS receiver should not exceed -10 dB except within $\pm 5^\circ$ separation from the azimuth where the FS antenna main beam intersects with the GSO arc (Notes 1 and 2);

1.2.2 for the FS azimuth within this $\pm 5^\circ$ range, interference-to-noise ratio at the input of the FS receiver can be accepted up to 0 dB for the azimuth corresponding to the peaks (Notes 1 and 2);

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

NOTE 1 – These I/N levels are referenced to the total noise at the receiver input including system noise level (kTBF) and intra-service interference (see § 5 in Annex 1).

NOTE 2 – The $\pm 15^\circ$ or $\pm 5^\circ$ azimuth range specified in *recommends* 1.1 and 1.2, respectively, are based on the application of a temporal approach methodology and elements of a specific rain cell model. Further refinement of this rain cell model or a new model may have some impact on these azimuth ranges and may lead to further development of this Recommendation.

Annex 1

Derivation of FS protection criteria in the 38 GHz and 40 GHz bands to be applied in the GSO sharing scenarios

1 Introduction

The methodology presented in this Annex is based on the assumptions that the bit error performance in the 38 GHz and 40 GHz bands is dominated by rain fading. Therefore, in the situations where the interference from GSO satellites arrives at azimuths close to the azimuth of the main-beam axis of the FS receiving antenna, both the desired and the interfering signal will be subjected to fading. As a consequence, the unfaded interference power may be higher than that which would be permissible if the interference power was constant. This unfaded interference power is determined by requiring that the controlling bit error performance criterion be met for the same percentage of time regardless of whether any correlation exists between the fading of the desired and interfering power.

2 FS fade margins

In the 38 GHz and 40 GHz bands, and since link lengths are likely to be shorter than 2 km, an FS fade margin of 14 dB was considered representative of conventional links since it was assumed that a majority of such links have a fade margin (or net fade margin¹) higher than this value. It has to be noted that this 14 dB fade margin, when considering systems using ATPC, corresponds to a link with a higher margin (e.g. = 14 dB net fade margin +10 dB ATPC range).

On the other hand, it was also noted that in certain BWA applications, a fade margin of 10 dB is used for some short links and that these links would consequently require a lower I/N value.

In support of the consideration of these margins, Table 2 which is based on Recommendation ITU-R P.530, gives the required rain margin for link lengths up to 1.6 km at five different rain rates for both vertical and horizontal polarization.

However, it has to be noted that the 14 dB or the 10 dB rain fade margin in these 38 and 40 GHz bands are justified on calculations using Recommendation ITU-R P.530 which does not provide values of fade margin referenced to an error performance measure but gives absolute attenuation values (rain fading) for a given percentage of time.

In addition, according to Recommendation ITU-R F.1498, for a link designed for a 99.999% availability and in particular BWA systems which are assumed to compete with fibre, the fade margin may refer to the BER 1×10^{-6} or severely errored seconds (SESS) level. It was also agreed that the design of the FS link should take into account a 1 dB allowance for interference from the FS which hence increases the reference noise power to 1 dB above the system noise power.

In addition, it was also considered that, due to technical reasons (minimum practicable power, available antenna sizes, fixed transmit power for hub stations, ...), the FS links in the 38 and 40 GHz bands, and in particular point-to-multipoint systems, are likely to present an “extra design margin” compared to the rain margin. At the minimum, for point-to-point links, the value of this “extra design margin” depends on the level of granularity of the power setting, the possible attenuators as well as the antenna gain that would allow the FS designer to adjust the receiver level as close as possible to the theoretical level. Even though it has not been taken into account in the

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

definition of the reference total margin of the FS link, it was agreed to consider it as an additional confidence factor in the derivation of the protection criteria.

On the basis of the agreed assumptions that the fade margins, M_F , for errored seconds (ESs) and SESs are respectively 3 dB lower and 1 dB higher than the fade margin referenced to the BER 1×10^{-6} level which is 2 dB lower than the fade margin referenced to the BER 1×10^{-3} level, Table 1 summarizes the different values of fade margins corresponding to a $M_F = 14$ dB and 10 dB referenced to the SES level.

TABLE 1
Correspondence of rain fade margin and
error performance objectives

	14 dB rain margin	10 dB rain margin
ES (dB)	10	6
BER 1×10^{-6} (dB)	13	9
SES (dB)	14	10
BER 1×10^{-3} (dB)	15	11

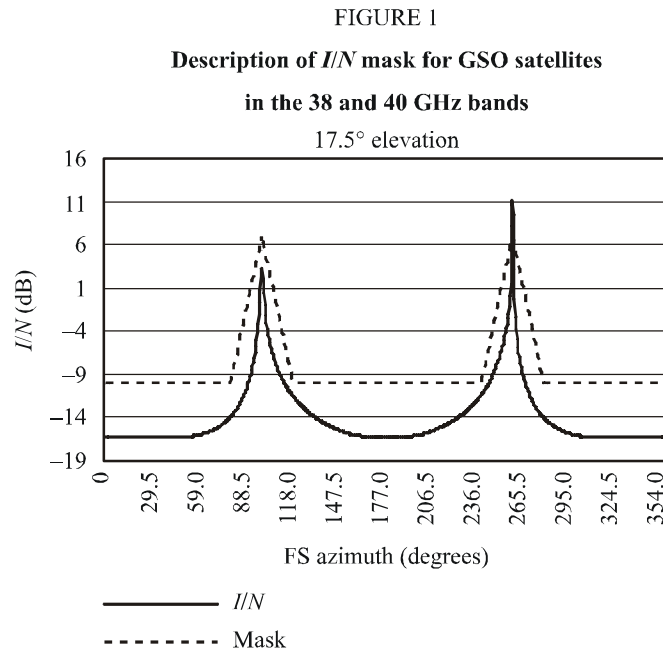
3 Derivation of the I/N mask

The derivation of the I/N mask to be applied to FSS GSO satellites has been based on the assessment of two different factors:

- the impact on the FS of interference and in particular, in the main beam of the FS antenna in rainy conditions, of the composite interference resulting of faded and unfaded portions of the interference (see Appendix 2 to Annex 1);
- the correlation between the rain attenuation on the signal and interference in the main beam of the FS antenna in order to determine angle X° from the main beam at which this level of correlation can be assumed correlated with a certain level of confidence (see Appendix 3 to Annex 1).

4 I/N criteria mask

Based on the elements in § 3, Fig. 1 describes the I/N masks that represents the azimuth related protection criteria of the FS presenting a maximum I/N for the peak interference that relate to the case where the FS receiver is pointing through the GSO arc and an azimuth range for which the I/N decreases from this maximum down to -10 dB.



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For fixed wireless systems (FWSs) in general, for which a 14 dB fade margin has been agreed as being representative, the maximum I/N and azimuth range have been determined to be respectively +4 dB and $\pm 15^\circ$.

For some links in certain BWA applications that use a fade margin of 10 dB, these parameters have been determined to be respectively 0 dB and $\pm 5^\circ$.

5 Noise level reference

The I/N masks as described in § 4 above refer to the total noise level which includes an agreed 1 dB intra-service interference allowance. It means that $N = k T B F + 1$ dB.