

RECOMMENDATION ITU-R F.760-1^{*,**}**Protection of terrestrial line-of-sight fixed wireless systems against interference from the broadcasting-satellite service in the bands near 20 GHz**

(Question ITU-R 111/9)

(1992-1994)

The ITU Radiocommunication Assembly,

considering

- a) that according to the Radio Regulations, the fixed service (FS) and the broadcasting-satellite service (BSS) share the bands 17.7-17.8 GHz in Region 2 and 21.4-22 GHz in Regions 1 and 3;
- b) that the FS uses these bands extensively for line-of-sight fixed wireless systems, particularly in urban areas;
- c) that, because of this use, it is necessary to ensure that emissions from satellites do not exceed permissible levels of interference to line-of-sight fixed wireless systems;
- d) that fixed wireless systems can be protected from the satellite emissions by determining suitable values of power flux-density, set up at the surface of the Earth, in a reference bandwidth;
- e) that the degree of correlation between the fading of the unwanted signal on the space-Earth interference path with the fading of the wanted signal on the fixed wireless system is an important factor to consider when determining acceptable satellite power flux-density values;
- f) that in cases where fading on the wanted/unwanted signal path is highly correlated, the appropriate power flux-density limit will be more dependent on the FS receive antenna characteristics and the normal received carrier level,

recommends

- 1 that in the frequency bands near 20 GHz, shared between systems in the BSS and the line-of-sight fixed wireless systems, the maximum power flux-density produced at the surface of the

* This Recommendation should be brought to the attention of Radiocommunication Study Group 6 (Working Party 6S).

** Radiocommunication Study Group 9 made editorial amendments to this Recommendation in 2004 in accordance with Resolution ITU-R 44.

Earth by emissions from a satellite, for all conditions and methods of modulation, in any 1 MHz band, required for the protection of the FS is:

-115	dB(W/m ²)	for	0° ≤ θ ≤ 5°
-115 + 0.5 (θ - 5)	dB(W/m ²)	for	5° < θ ≤ 25°
-105	dB(W/m ²)	for	25° < θ ≤ 90°

where θ is the angle of arrival of the radio-frequency wave (degrees above the horizontal);

2 that the aforementioned values relate to the power flux-density and angles of arrival which would be obtained under free-space conditions;

3 that the model, and the considerations of this model, given in Annex 1 be used to represent the line-of-sight fixed wireless systems for any further studies of sharing in the bands near 20 GHz.

Annex 1

Permissible levels of interference into a fixed wireless system from transmitting stations of the BSS where the FS and BSS share on an equal primary basis

This Annex describes the interference model from which the power flux-density limits for low and high angles of elevation are derived.

1 Characteristics of the model

As a basis for the calculations a model 64-QAM digital link operating at 22 GHz is assumed, the parameters of which are listed below:

- transmitter power output: power output into antenna is -7 dBW (200 mW),
- receiver feeder/waveguide loss: feeder/waveguide loss is 3 dB,
- antenna gain: antenna gain for a 46 cm microwave antenna with radome is 38 dBi,
- effective antenna area: 0.09 m² (55% efficiency),
- free space loss: 139 dB for a 10 km path length,
- receiver bandwidth: 40 MHz,
- receiver noise figure: 5 dB.

With the above model parameters, the standard receive carrier power, C_r , is -73 dBW and the receiver noise floor, N_r , is -123 dBW. The model does not consider satellites in low-Earth orbits, which may be expected to be users of this band. The interference effects of low-Earth orbit satellites may be considerably different from the effects of satellites in geostationary orbit.

In the following calculations it is assumed that the interference power is uniformly distributed across the receiver passband.

2 Maximum power flux-density

First, the in-beam interference which determines the maximum power flux-density at low angles of elevation is considered. The error performance curves for a 64-QAM receiver determines the C/N and C/I ratios required to maintain a 10^{-3} BER in the presence of maximum permissible interference power (see Recommendation ITU-R SF.766).

The interference, I_r , is given as:

$$I_r = pfd + 10 \log A_r + 10 \log BW - L_r \quad \text{dBW}$$

where:

pfd : power flux-density (dB(W(m² · MHz)))

A_r : effective receive antenna aperture (m²)
= 0.09 m²

BW : bandwidth (MHz)
= 40 MHz

L_r : receiver feeder/waveguide loss (dB)
= 3 dB.

Thus the maximum $pfd = I_r - 3$ (dB(W(m² · MHz))).

Considering rain fading with perfect correlation of wanted and interfering signals, a rain fade of 25 dB will produce outage with no interference. Using the rain attenuation expression from Recommendation ITU-R P.530, one finds that the probability of outage at the 0.005% level would increase by 10% for 0.8 dB reduction in fade margin (again with no interference). Using, for instance, Fig. 4 from Recommendation ITU-R SF.766, one finds that the C/N is degraded by about 0.8 dB where the C/I is 8 dB more than the C/N , i.e. 33 dB.

The unfaded interference power is $I_r = C_r - 33 = -106$ dBW. This corresponds to a pfd of -109 dB(W(m² · MHz)) with no differential fading.

Differential fading in this Recommendation implies that the fading of the wanted signal and the interfering signal does not occur at the same time, i.e. the statistics of the two signals are not perfectly correlated. The power flux-density noted above may need further reduction to allow for differential fading caused by rain and/or multipath.

Propagation measurements of differential fading suggest that an allowance of 6 dB (see Note) for differential fading would be required to protect the fixed service receiver from interference in the presence of precipitation or clear-air fading.

Next, off-beam interference is considered. The aggregate of interference from all sources is mitigated by the receive antenna discrimination. A similar relationship between angle of arrival and angle of elevation is assumed as in setting the pfd limits for sharing with the fixed-satellite service in lower frequency bands. As a result the pfd limit will increase by 0.5 dB per degree up to

25° elevation and will remain at that value for higher elevation angles. A similar curve is generally applicable to space stations in other than low-Earth orbit, transmitting at frequencies above about 15 GHz. In frequency bands shared between the fixed service and low-Earth orbit satellites, different power flux-density limits may be applicable.

Note from the Director, BR: For information, the derivation of this allowance is given in:

ALLEN, K. C., PAPAZIAN, L. B. and DEBOLT, R. [24-28 June, 1991] Presentation at N.A. Radio Science Meeting in London, Ontario, Canada.

COVER, D. A. and RUMMLER, W. D. [1992] Conference Digest, IEEE 1992 International Conference on Communications, Chicago, IL, United States of America.
