

RECOMMENDATION ITU-R F.1706

Protection criteria for point-to-point fixed wireless systems sharing the same frequency band with nomadic wireless access systems in the 4 to 6 GHz range

(Question ITU-R 133/9)

(2005)

Scope

This Recommendation provides the protection criteria for point-to-point (P-P) fixed wireless systems (FWS) from nomadic wireless access systems (NWS) in the 4 to 6 GHz range operating in areas near international borders. Annex 1 gives the basic analysis factors and simulation examples of separation distances to protect P-P FWS from interference caused by NWS.

The ITU Radiocommunication Assembly,

considering

- a) that in many parts of the spectrum the fixed service and the mobile service are sharing the same frequency bands;
- b) that, with appropriate sharing criteria and geographical separation, both systems can efficiently coexist and use frequency spectrum;
- c) that the necessary separation distance to protect P-P FWS from interference caused by NWS has not been determined in many frequency bands including the 4 to 6 GHz range;
- d) that in many parts of the above frequency range, FWS are also sharing the same band with space services,

noting

- a) that P-P FWS and NWS sharing the same frequency band in the 4 to 6 GHz range may operate in mutually close area beyond international borders,

recommends

1 that the protection criteria for P-P FWS sharing the same frequency bands with NWS should be as follows:

- the maximum aggregate interference from the NWS including base station and terminal stations should be such that the degradation to an FWS receiver threshold does not exceed 0.5 dB under free space propagation conditions (equivalently the aggregate interference noise should not exceed one-tenth of the thermal noise level of the FWS receiver) (see Note 1);

2 that for additional information Annex 1 can be referred to, including the separation distance to protect FWS from interference caused by NWS.

NOTE 1 – This criterion is derived taking into account *considering* c), as well as a number of system parameters for sharing studies given in Recommendation ITU-R F.758 in the 4-6 GHz range.

Annex 1

Consideration on separation distance to protect P-P FWS from interference caused by NWS sharing the same frequency band in the 4 to 6 GHz range

1 Introduction

In many parts of the spectrum the fixed service and the mobile service are sharing the same frequency bands. Studies on compatibility between both services will become more important including the bands above 3 GHz.

Recently use and applications of terrestrial wireless communication systems are so increasingly expanding that some countries may consider future use of the bands above 3 GHz for wireless access systems including nomadic/mobile applications. It should be noted that many frequency bands in the 4 to 6 GHz range are widely used for traditional radio-relay systems in the fixed service. Therefore, review of the spectrum use requires careful consideration on compatibility of both existing and new applications. Also the impact of deploying a new application on other systems should be evaluated, in some cases, beyond international borders.

This Annex provides consideration on the necessary separation distance to protect conventional digital radio-relay systems (DRRS) from unacceptable interference caused by NWS in the 5 GHz frequency band.

2 Basic factors to be considered in the analysis

The analysis made in the later sections takes into account the following factors:

- in the frequency range around 5 GHz, e.g. 4 400-5 000 MHz, DRRS are densely deployed around urban cities;
- system parameters used in the analysis should, as far as possible, be based on those given in other ITU-R Recommendations on sharing studies;
- NWS can be operated in both outdoor and indoor environments;
- DRRS are usually operated utilizing most of the available bandwidth and therefore it is difficult to apply interference mitigation measures to NWS such as dynamic frequency selection (DFS) within the shared band;
- interference paths from NWS to DRRS, are basically considered.

Furthermore, the analysis is conducted for both theoretical models and practical examples.

3 System parameters of DRRS and NWS

3.1 Parameters of DRRS

Examples of the technical parameters of DRRS are given in Table 1, which are based on those in Table 13 in Recommendation ITU-R F.758.

TABLE 1
DRRS parameters

Parameter	Symbol	Value and unit	Reference
Centre frequency of operation	f	5 000 MHz	
Antenna height above ground	H_D	70 m	⁽¹⁾
Maximum antenna gain	—	42.5 dB	Rec. ITU-R F.758 ⁽²⁾
Antenna radiation pattern	$G_D(\theta)$	— dB	Rec. ITU-R F.699
Feeder loss	L_{f-}	3.5 dB	Rec. ITU-R F.758
Receiver bandwidth	B_D	30.2 MHz	
Receiver thermal noise	N_{thD}	−97.5 dBm	
Transmitter power	P_{tD}	33 dBm	

⁽¹⁾ The agreed value in the sharing study between the fixed service and earth station on board vessels (ESVs) in Recommendation ITU-R SF.1650.

⁽²⁾ A single antenna is commonly used for the receiver and the transmitter.

3.2 Parameters of N WAS

Examples of the technical parameters of N WAS are given in Table 2, which are based on those for HiperLAN (Type-2) used in the sharing study between the radio local area network (RLAN) and the Earth exploration-satellite service (EESS) described in Recommendation ITU-R M.1653.

TABLE 2
N WAS parameters reference

Parameter	Symbol	Value and unit		Reference
		Outdoor	Indoor	
Centre frequency of operation	f	5 000 MHz	5 000 MHz	
Antenna height above ground	H_N	10 m	30 m	⁽¹⁾
Maximum antenna gain	$G_{N WAS}$	0 dBi	0 dBi	⁽²⁾
Antenna radiation pattern	—	Omni	Omni	
Receiver bandwidth	B_N	16 MHz	16 MHz	
Minimum receive level	P_{rminN}	−85 dBm	−68 dBm	
Transmitter e.i.r.p.	P_{tN}	30 dBm	20 dBm ⁽³⁾	
Active ratio (worst case)	—	100 % ⁽⁴⁾	5 % or less	

⁽¹⁾ The height of the N WAS base station antenna.

⁽²⁾ Recommendation ITU-R M.1653.

⁽³⁾ Transmitter power control effect (3 dB) is considered.

⁽⁴⁾ Total effect of a base station and terminals operating within its coverage is considered.

In the case that NWA is operated in the outdoor environment, each base station forming a service coverage with a radius of about 100 m. Within this coverage, several or more nomadic wireless access (NWA) terminals are operating. If all the antennas (of a base station and the terminals) are designed in the omni-type, the total interference effect on DRRS stations located at sufficiently long distance could be approximated by that from the base station at the coverage centre, assuming that only a single transmitter is active (actually transmits a signal) at any instantaneous time. Thus the total effect of a base station and all the terminals within its coverage may lead to a worst-case active ratio of 100%. However, it requires further study whether the worst-case active ratio of 100% is appropriate.

In the case of indoor environments, for active ratio (transmit-to-silent ratio) of RLANs a value of 5% is assumed in general sharing studies. This number has been derived from a wide range of environments including in-building office networks. In this Recommendation it is assumed that one building contains a number of NWA/RLAN terminals operating in the same frequency as DRRS. The number of the terminals and their aggregate interference effect are assumed as given in Table 3.

TABLE 3
Operational condition for indoor NWA

Active ratio	5% or less
Number of the terminals operating in the same frequency as victim DRRS within one building	several tens
Aggregate effect of all the terminals	$\Delta A_g = +5$ dB
Building blockage loss	$L_B = 12$ dB ⁽¹⁾

⁽¹⁾ Recommendation ITU-R M.1454 gives a range of 7-17 dB for the low to high elevation angle satellite interference.

3.3 Interference criteria for DRRS

It is assumed that DRRS and NWA are operating in the band to which both the fixed and mobile services are allocated on a primary basis. Therefore, an interference criterion of $I/N = -10$ dB could be applied to the fixed service DRRS for the long-term interference. Therefore the maximum permissible interference level, I_{maxD} , for the DRRS is given by:

$$I_{maxD} = N_{thD} - 10 = -107.5 \quad \text{dBm} \quad (1)$$

3.4 Interference from DRRS to NWA

Interference criteria for NWA have not yet been defined in an ITU-R Recommendation. As an example, NWA based on the HiperLAN (type-2) specification has the minimum operation carrier level, P_{minN} , of -85 dBm, or -68 dBm (at 6 Mbit/s capacity or 54 Mbit/s capacity, respectively), according to Recommendation ITU-R M.1653. In this case, the maximum permissible interference level, I_{maxN} , for NWA is derived from required C/I of 8 dB (for BPSK), or 24 dB (for 64-QAM) as follows.

$$I_{maxN} = P_{minN} - 8 = -93 \quad \text{dBm} \quad (\text{for outdoor system}) \quad (2a)$$

$$I_{maxN} = P_{minN} - 24 = -92 \quad \text{dBm} \quad (\text{for indoor system}) \quad (2b)$$

In this Annex, these limits are regarded only as examples and not precisely considered.

4 Theoretical interference model

4.1 General assumptions

In the later sections the analysis is made on the following assumptions:

For interference between DRRS and outdoor NWA:

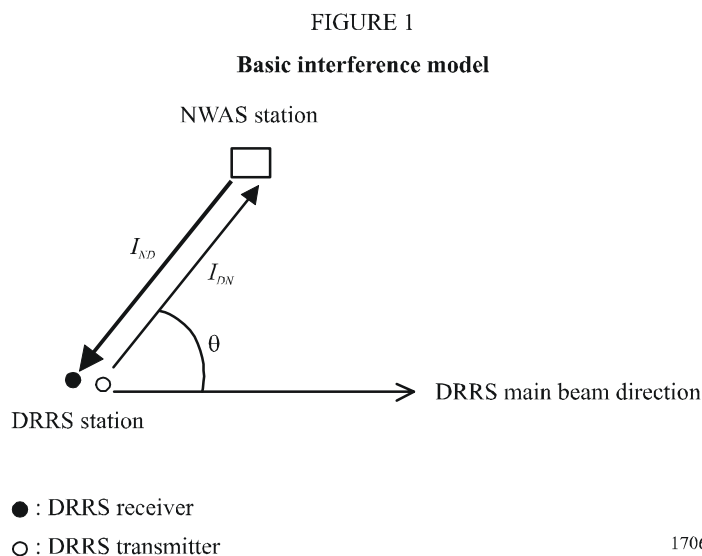
- An NWA base station is allowed to operate if it does not give interference above the specified criterion to any existing DRRS stations.
- Effects of NWA terminals operating within the coverage of a base station are converged to the location point of the base station, and that they are represented by the interference from the base station with high active ratio (100% for the worst case).
- The interference path loss between two stations (one NWA base station and one DRRS station) follows line-of-sight (LoS) free-space condition.
- Effects of interference mitigation options for NWA, e.g. transmitter power control (TPC) or DFS, are not considered.
- Aggregate effect of more than one NWA base stations on a DRRS station is not taken into account. (This requires further study.)

For interference between DRRS and indoor NWA:

- NWA deployed in one building is allowed to operate if it does not give interference above the specified criterion to any existing DRRS stations under the conditions given in Table 3.
- The interference path loss between two systems, other than building blockage loss in Table 3, follows LoS free-space condition.
- Effect of TPC of NWA is taken into account as the equivalent power reduction of 3 dB (i.e. 20 dBm in Table 2).
- Aggregate effect of more than one building containing NWA on a DRRS station is not taken into account. (This requires further study.)

4.2 Separation distance for a single station

A basic interference model of one DRRS station and a single NWA base station is given in Fig. 1.



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