**Annex 2.1.**

**System parameters for FWS in the fixed service**

1. **Introduction**

This nnex provides the necessary FWS system parameters required for interference evaluation and for frequency sharing studies betweeen FS and other services. The system parameters are shown in tables for these frequency ranges required to undertake sharing studies between the FS and other services.

**2. Transmitter characterization**

## 2.1. Equipment parameters

The basic transmitter parameters for the assessment of potential interference towards other services are as follows:

– carrier frequency;

– spectral characteristics (e.g. bandwidth and transmitter power density);

– equivalent isotropically radiated power (e.i.r.p.);

– antenna radiation pattern.

Operational radio transmitter emissions normally correspond to radio-frequency channel arrangements specified in ITU-R Recommendations and/or ECC/CEPT decisions. The modulation type and radio-frequency channel arrangement define the spectral characteristics of the emissions for generic statistical evaluations, where only co-channel interference situation is usually taken into account.

The e.i.r.p. of the transmitter is determined by transmitter power, feeder/multiplexer losses and antenna gain. Basically the maximum e.i.r.p. value corresponds to maximum antenna gain, minimum feeder/multiplexer losses and maximum transmitter output power, which represents the worst interference potential towards other services.

Antenna radiation patterns are essential for detailed sharing studies. In cases, where measured antenna patterns are not available, the reference radiation patterns, addressed in the following ITU-R Recommendations, should be used.

**3. Receiver characterization**

## 3.1. Equipment parameters

For the assessment of the effects of interference towards FS caused by other services performance characteristics of the radio receiver have to be known. The following receiver parameters are important for frequency sharing studies:

– noise figure;

– noise bandwidth;

– receiver thermal noise power density;

– received signal power for certain levels of bit error rates (BER) 1 × 10−3, 1 × 10−6, 1 × 10−10 BER (post-error-correction);

– nominal receiver input level.

NOTE 1 –  For uncoded systems the carrier level corresponding to 1 × 10−6 BER is typically around 4 dB higher than for 1 × 10–3 BER. The carrier level difference between 1 × 10−6 and 1 × 10−10 BER is also about 4 dB. For radio equipment using forward error correction (FEC) the carrier level corresponding to 1 × 10−6 BER is only 1 to 2 dB higher than for 1 × 10−3 BER with similar difference of 1 to 2 dB between 1 × 10−6 and 1 × 10−10 BER. In the following Tables, the received signal power is only addressed for 1 × 10−6 BER, since the corresponding parameters for other BERs could be theoretically derived by taking modulation scheme and error correction gain by coding into account.

## 3.2. Permitted interference

It is necessary to specify maximum interference levels for both long- and short-term time. Fore aggregate long-term interference assessment interference from multiple sources can simultaneously occur. It should be noted, that single-entry interference criteria will be correspondingly lower. In the case of short-term interference, the time percentages of interest will be related to the system performance objectives.

**4. Tables of system parameters**

Tables 1 in Appendix 1 to Annex 2.1 show representative parameter values to be used in studies of sharing/compatibility for digital FWS that are used in various frequency bands.

In most of the bands a large variety of FWS expecially with respect to channel spacing and modulation formats are worldwide in operation . Their specific characteristic in a geographical area depends on regional and national allocations and needs. Therefore the system parameters shown are not representative for any actual FS system, but represent an averaging or an expected range of values suitable for generic sharing/compatibility studies.

## 4.1. Nominal long-term interference power density (dBW/MHz)

Recommendation ITU-R F.1094 lays the foundations for the apportionment of EPO and APO.

In this section, relations between the following two issues a) and b) are considered with the exclusion of short-term interference considerations:

a) Degradation in the error performance (EP) or the availability performance (AP) resulting from interference from the co-primary service, which is clearly specified as 10% in Recommendation ITU-R F.1094 (and also in Recommendation ITU-R F.1565).

b) Degradation in fade margin due to the interference, which is directly calculated from (*I*/*N*) value, as 10 log ((*N*+ *I*)/*N*) = 10 log ((1 + (*I*/*N*))) (dB).

It should be noted that the *I*/*N* ratio is generally defined in terms of mean (root-mean-square (rms)) power of both noise and interference; however, when continuously pulsed/burst interference emissions are concerned, their peak-to-mean power ratio might play a significant role in defining the protection criteria.

When the peak-to-mean power ratio becomes very high and the fixed service receiver bandwidth becomes large, it may be necessary to take into account an *I*/*N* objective in terms of peak interference integrated over the whole victim bandwidth to correctly evaluate the fade margin degradation due to the interference. Background on high peak interference impact and protection criteria may be found in Recommendation ITU-R F.1097, for radar interference, and Recommendation ITU-R SM.1757, further detailed in Report ITU-R SM.2057, for UWB-SRR (ultra-wideband short-range radars) interference.

The long-term interference power density given in Tables 5-12 and Tables 14-17 is equal to *NRX* + *I*/*N*. This value is intended to provide a starting point for sharing or compatibility considerations. Although a value for *NRX* is available in the second row above this entry in each column of these Tables, an appropriate value for *I/N* depends on the frequency band and the sharing or compatibility conditions as shown in Table 1 below. In most cases, in the past, an aggregate value of −10 dB has been used for sharing conditions with one co-primary service; however, other values have also been used or developed in sharing and compatibility studies in different interference environments.

A value of −6 dB was used in some cases of co-primary sharing in bands below 3 GHz. In addition, further guidance is provided for sharing studies involving more than one co-primary service; Table 4 provides some guidance in the choice of *I/N* values for use in determining an appropriate long-term interference power density.

TABLE 1: Guidance in the choice of *I*/*N* values for long-term interference

|  |  |  |  |
| --- | --- | --- | --- |
| *I/*N1 | Frequency range | Sharing/compatibility conditions | Comments and relevant ITU-R Recommendations |
| –6 dB | 30 MHz to 3 GHz | Sharing condition except as noted elsewhere in this Table | Generally applicable value for the aggregate interference  See the relevant Recommendations |
| –10 dB | Above 3 GHz |
| ≤ −6 dB | 30 MHz to 3 GHz | Sharing with more than one co-primary service | Apportionment of F.1094 objectives (See § 2 in Annex 1 of this Recommendation)  −6 dB or –10 dB, as appropriate, may be applicable where the risk of simultaneous interference from the stations of the other co-primary allocations is negligible. In other cases, a more stringent criterion may be required to account for aggregate interference from all interfering co-primary services (i.e. −6 dB or −10 dB should be intended as maximum aggregate *I/N* from all other co-primary services). |
| ≤ –10 dB | Above 3 GHz |
| –13 dB | 3-6 GHz | Compatibility with UWB | For indoor FWA terminals only  SM.1757 |
| –15 dB | 27-31 GHz | Sharing with FS using HAPS | ITU-R F.1609 |
| –20 dB | 3-8.5 GHz | Compatibility with UWB | SM.1757 |
| –20 dB | All | Compatibility with secondary services and other intentional radiators | Including unwanted emissions and radiations  ITU-R F.1094 |
| 1. These values of *I/N* apply to the aggregate interference from the operations of the shared service. | | | |

**References:**

* Radio Regulations (Edition 2012)
* ITU-R Recommendations (F)
* ITU-R Reports (F)