

RECOMMENDATION ITU-R S.1432

**APPORTIONMENT OF THE ALLOWABLE ERROR PERFORMANCE DEGRADATIONS
TO FIXED-SATELLITE SERVICE (FSS) HYPOTHETICAL REFERENCE DIGITAL
PATHS ARISING FROM TIME INVARIANT INTERFERENCE FOR SYSTEMS
OPERATING BELOW 15 GHz**

(Questions ITU-R 73/4, ITU-R 75/4 and ITU-R 78/4)

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that emissions from radio transmitting devices may cause interference to victim receivers of the FSS and space stations;
- b) that increasing use of the radio spectrum requires definition of the maximum allowable error performance degradations to satellite connections due to interference from various sources;
- c) that error performance objectives for satellite digital paths are given in Recommendations ITU-R S.522, ITU-R S.614, ITU-R S.1062 and ITU-R S.1420;
- d) that sharing considerations among FSS systems carrying digital traffic are given in Recommendations ITU-R S.523, ITU-R S.671, ITU-R S.735 and ITU-R S.1323;
- e) that sharing considerations between FSS systems carrying digital traffic and fixed-service systems are given in Recommendation ITU-R SF.558,

recommends

- 1** that all necessary precautions should be taken in establishing digital satellite paths and connections to limit the degradation due to interference so that the error performance does not fall below that set in the performance objectives (see Recommendations ITU-R S.614, ITU-R S.1062 and ITU-R S.1420);
- 2** that the sources of interference to be taken into account may include:
 - emissions from FSS systems operating in the same band;
 - emissions from other radio services sharing the same frequency allocations on a primary basis;
 - emissions from other radio services sharing the same frequency allocations on a non-primary basis;
 - emissions from unlicensed devices;
 - unwanted emissions (e.g. out-of-band and spurious emissions);
- 3** that, when sharing frequencies below 15 GHz, the maximum allowable interference from all sources (aggregate) should be limited to 32% or 27% for systems not practising and for systems practising frequency re-use, of the clear-sky satellite system noise;
- 4** that error performance degradation due to interference at frequencies below 15 GHz should be allotted portions of the aggregate interference budget of 32% or 27% of the clear-sky satellite system noise in the following way:
 - 25% for other FSS systems for victim systems not practising frequency re-use;
 - 20% for other FSS systems for victim systems practising frequency re-use;
 - 6% for other systems having co-primary status;
 - 1% for all other sources of interference,

and that the sum of all of the interference sources should not cause violation of the error performance objectives (see Recommendations ITU-R S.522, ITU-R S.614, ITU-R S.1062 and ITU-R S.1420);

5 that Annex 1 should be used as guidance when applying this Recommendation.

NOTE 1 – This Recommendation neither replaces nor supersedes Recommendations ITU-R S.523, ITU-R S.671, ITU-R S.735, ITU-R S.1323 or ITU-R SF.558. The interference powers allowed under these Recommendations form portions of the maximum allowable interference.

NOTE 2 – In frequency bands allocated solely to the FSS, the maximum allowable interference is given by Recommendations ITU-R S.523, ITU-R S.671, ITU-R S.735 or ITU-R S.1323.

ANNEX 1

Basic considerations related to the maximum allowable error performance and availability degradations of digital satellite paths and connections arising from interference for systems operating below 15 GHz

1 Introduction

This Annex provides information on the apportionment of error performance and availability degradations due to interference into satellite communications systems carrying digital traffic.

2 Error performance and availability degradations due to frequency sharing among FSS systems

According to Recommendations ITU-R S.735 and ITU-R S.1323, digital satellite links should be designed to accommodate aggregate interference power from other FSS systems up to 25% of the total system noise power under clear-sky conditions. For systems utilizing frequency re-use, interference from other FSS systems is limited to 20% of the clear-sky system noise.

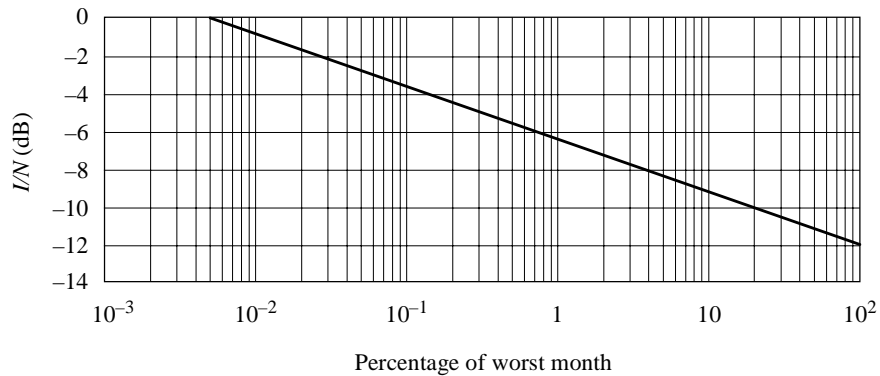
3 Error performance and availability degradations due to frequency sharing on a primary basis

For the greatest number of allocations, the FSS shares frequencies with the fixed service and the mobile service. Recommendation ITU-R SF.558 deals with interference from fixed service systems into FSS systems and allows an interference level equivalent to 10% of the clear-sky satellite system noise that would give rise to a BER of 1×10^{-6} for not more than 20% of any month. There are currently no Recommendations dealing with interference from co-primary allocated mobile systems into FSS systems.

Recommendation ITU-R SF.558 goes on to indicate that interference from fixed service systems should not cause the BER to exceed 1×10^{-4} for more than 0.03% of any month nor cause the BER to exceed 1×10^{-3} for more than 0.005% of any month.

These interference allowances, in terms of percentage of system noise, can be converted into corresponding values of interference-to-noise ratio, I/N . Ten per cent of the system noise is equal to an I/N of -10 dB. If a conservative BER characteristic of 1 dB increase in noise yielding a tenfold increase in BER is assumed, I/N values for the other BERs are found to be I/N of -2.4 dB for 0.03% of any month and I/N of 0 dB for 0.005% of any month. This information is presented graphically in Fig. 1. Extrapolating the line from an I/N of -2.4 dB for 0.03% of any month to -10 dB I/N for 20% of any month on to 100% of any month yields an I/N of -12 dB. This I/N corresponds to 6% of the satellite system noise. Thus the interference from the fixed service which shares frequencies on a primary basis is equivalent to a single interference entry from another satellite system, according to Recommendations ITU-R S.735 and ITU-R S.1323.

FIGURE 1
**Digital satellite path I/N due to fixed
 service interference**



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4 Error performance and availability degradations due to frequency sharing on a non-primary basis

There are no Recommendations pertaining to the amount of interference that a digital satellite circuit will receive from systems that share frequencies on a non-primary basis. Since, according to the RR, non-primary allocated services and all other emissions must operate on a non-interference basis, allotting 1% of the satellite system noise to these non-primary sources of interference should adequately accommodate these interferers.

5 Summary

As elaborated above, it is recommended that 32% or 27% of the satellite clear-sky system noise be allotted to interference. These allotments correspond to approximately 1.2 dB or 1.0 dB degradation in the carrier-to-thermal noise ratio for victim systems not utilizing and utilizing, respectively, frequency re-use. Interference from FSS systems, including non-GSO FSS systems, accounts for 25% of the clear-sky system noise (see Recommendations ITU-R S.735 and ITU-R S.1323), interference from the fixed service and other co-primary allocated services accounts for 6% of the clear-sky system noise, as derived in § 3 of this Annex, and interference from all other sources accounts for 1% of the clear-sky system noise.