

RECOMMENDATION ITU-R S.1429

**ERROR PERFORMANCE OBJECTIVES DUE TO INTERNETWORK INTERFERENCE
BETWEEN GSO AND NON-GSO FSS SYSTEMS FOR HYPOTHETICAL
REFERENCE DIGITAL PATHS OPERATING AT OR ABOVE
THE PRIMARY RATE CARRIED BY SYSTEMS
USING FREQUENCIES BELOW 15 GHz**

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

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that interference between GSO and non-GSO FSS systems can be of a short-term nature;
- b) that error performance objectives for satellite digital paths operating at or above the primary rate with systems utilizing frequencies below 15 GHz are given in Recommendation ITU-R S.1062;
- c) that the error performance objectives for satellite digital paths given in Recommendation ITU-R S.1062 can be expressed in terms of errored seconds (ES) and severely errored seconds (SES);
- d) that sharing considerations between FSS systems carrying digital traffic are given in Recommendations ITU-R S.735 and ITU-R S.1323;
- e) that Recommendation ITU-R S.1323 requires that time varying interference be responsible for at most 10% of time allowance for a given BER;
- f) that availability objectives for satellite digital paths are given in Recommendation ITU-R S.579,

recommends

1 that, for satellite hypothetical reference digital paths (HRDPs) operating at or above the primary rate, 10% of the error performance objectives for these HRDPs be allotted to short-term interference between GSO and non-GSO FSS systems. These allotments are shown in terms of bit error probability (BEP) in Table 1. Tables 2 and 3 give the objectives in terms of ES and SES (see Note 1).

NOTE 1 – The technical basis for the interference allotments is given in Annex 1.

NOTE 2 – This Recommendation should be used in conjunction with Recommendation ITU-R S.1062.

TABLE 1

Allowable BEPs due to short-term interference between GSO and non-GSO FSS systems

Bit rate (Mbit/s)	Percentage of total time (worst month)	BEP/ $\alpha^{(1)}$
1.5	0.02	7×10^{-7}
	0.2	3×10^{-8}
	1.0	5×10^{-9}
2.0	0.02	7×10^{-6}
	0.2	2×10^{-8}
	1.0	2×10^{-9}
6.0	0.02	8×10^{-7}
	0.2	1×10^{-8}
	1.0	1×10^{-9}
51.0	0.02	4×10^{-7}
	0.2	2×10^{-9}
	1.0	2×10^{-10}
155 ⁽²⁾	0.02	1×10^{-7}
	0.2	1×10^{-9}
	1.0	1×10^{-10}

⁽¹⁾ For example, Alpha (α) = 10. Errors on satellite links employing FEC and scrambler schemes tend to occur in clusters. The appearance of the clusters, which can also be called error events, is random following a Poisson distribution. The resulting block error rate is the same as if it were caused by randomly (Poisson distribution) occurring bit errors with a BER/ α ratio, where α is the average number of errored bits within a cluster, α also represents the ratio between the BER and the error-event ratio.

⁽²⁾ These objectives should be used at bit rates below 155 Mbits/s when it is desirable or necessary for certain services (see ITU-R Recommendation S.1062, Note 2).

Allowable errored interval objectives due to short-term interference which correspond to the BEPs given in Tables 1 and 2 of Recommendation ITU-R S.1062 are shown in the following Tables. These values are obtained by taking 10% of the errored interval objectives computed using the method given in Annex 1 of Recommendation ITU-R S.1062.

TABLE 2

**Allowable errored interval objectives due to short-term interference between
GSO and non-GSO FSS systems for systems using the objectives
of Table 1 of Recommendation ITU-R S.1062**

Bit rate (Mbit/s)	1.5-5	> 5-15	> 15-55	> 55-160
Allowable ES per day	121	151	226	483
Allowable SES per day	6	6	6	6

TABLE 3

**Allowable errored interval objectives due to short-term interference between
GSO and non-GSO FSS systems for systems using the objectives
of Table 2 of Recommendation ITU-R S.1062**

Bit rate (Mbit/s)	1.5-5	> 5-15	> 15-60	> 60-155
Allowable ES per day	13	31	116	483
Allowable SES per day	0 ⁽¹⁾	0 ⁽¹⁾	0 ⁽¹⁾	6

⁽¹⁾ Connections that meet the stringent level of performance given in Table 2 of Recommendation ITU-R S.1062 and operate at less than 60 Mbit/s cannot experience SESs because SESs occur at much worse BERs than those in Table 2 of Recommendation ITU-R S.1062. Operation at the BERs prescribed in Table 2 of Recommendation ITU-R S.1062, therefore, precludes the generation of SESs during the available time since the threshold of unavailability are reached before the BER reaches a level that would cause SESs.

NOTE 1 – The BEPs given in Table 2 of Recommendation ITU-R S.1062 and referenced in Note 2 of that Recommendation are to be used when more stringent performance is desired or when carriage of certain traffic requires it.

ANNEX 1

Apportioning error performance objectives due to short-term interference

1 Introduction

With the initiation of non-GSO FSS systems, it has become necessary to consider the allocation of error performance objectives due to time varying nature interference between GSO and non-GSO FSS systems. This Annex provides the rationale for the apportionment of error performance objectives due to short-term interference by relating the sharing criteria in Recommendation ITU-R S.1323 and the error performance objectives given in Recommendation ITU-R S.1062.

2 Error performance objectives

Error performance objectives for FSS systems providing digital paths operating at or above the primary rate are given in Recommendation ITU-R S.1062. This Recommendation contains a detailed exposition of how those objectives can be applied to the design of FSS digital paths. Most useful to satellite system designers are error objectives in terms of BEPs which can be directly related to required carrier-to-noise ratios (C/N_s). Recommendation ITU-R S.1062 provides the techniques needed to equate errored interval requirements given in terms of ES and SES to required BEPs as a function of time.

Recommendation ITU-R S.1062 includes a set of BEP objectives, in Table 2, that meet the ITU-T requirements at 155.52 Mbit/s and are better than the required performance at lower bit rates. These BEPs are referenced in Note 2 of that Recommendation and are to be used when more stringent performance is desired or when the carriage of certain traffic services requires it. Allowable errored interval objectives due to short-term interference which correspond to these BEPs can be obtained by taking 10% of the errored interval objectives computed using the method given in Annex 1 of Recommendation ITU-R S.1062.

3 Sharing criteria

Sharing criteria for FSS networks carrying digital traffic are given in Recommendations ITU-R S.735 and ITU-R S.1323. Specifically, Recommendation ITU-R S.1323 provides guidance on the allowable interference between networks that is of a time varying nature. This allotment is 10% of the time allowance for given BEPs according to Recommendation ITU-R S.1062.

4 Interference apportionment

Given the 10% apportionment for short-term interference from Recommendation ITU-R S.1323, the BEP objectives are determined simply by taking 10% of the BEP objectives for the overall path performance. These results are shown in Table 1 of the preceding Recommendation.

The 10% apportionment is applied to the errored interval objectives on a daily basis. Recommendation ITU-R S.1062 notes that satellite HRDPs must be available 99.96% of a year. This implies that on an average daily basis, since there are 86 400 s in a calendar day, applying this availability standard indicates that 35 s will be unavailable, leaving 86 365 s in the available time. It must be noted that not all days are average and that the number of unavailable seconds may be more or less than 35 depending upon conditions including propagation. For the purpose of allocating intersystem interference, it has been assumed that there are 35 unavailable seconds per day.

Table 4 summarizes the requirements of Recommendation ITU-R S.1062 and provides the corresponding apportionment for short-term interference. The requirements for ES are contained in the errored second ratio (ESR) and the requirements for SES are contained in the severely errored second ratio (SESR).

TABLE 4

**Allowable error performance objectives due to short-term interference
between GSO and non-GSO FSS systems**

Bit rate (Mbit/s)	1.5-5	> 5-15	> 15-55	> 55-160
Allowed ES per day (Note 1 of Recommendation ITU-R S.1062)	121	151	226	484
Allowed ES per day (Note 2 of Recommendation ITU-R S.1062)	13	31	116	483
Allowed SES per day (Note 1 of Recommendation ITU-R S.1062)	6	6	6	6
Allowed SES per day (Note 2 of Recommendation ITU-R S.1062)	0	0	0	6

5 Summary

This Annex has provided the technical rationale for the apportionment of error objectives due to short-term interference into a satellite HRDP operating at or above 1.5 Mbit/s. This apportionment is achieved through using the error objectives given in Recommendation ITU-R S.1062 and applying the sharing criteria given in Recommendation ITU-R S.1323.