

RECOMMENDATION ITU-R S.522-5

**ALLOWABLE BIT-ERROR RATIOS AT THE OUTPUT OF THE HYPOTHETICAL
REFERENCE DIGITAL PATH FOR SYSTEMS IN THE FIXED-SATELLITE
SERVICE USING PULSE-CODE MODULATION FOR TELEPHONY**

(Question ITU-R 52/4)

(1978-1982-1986-1990-1992-1994)

The ITU Radiocommunication Assembly,

considering

- a) that the hypothetical reference digital path (HRDP) is intended as a guide to the design and construction of actual systems;
- b) that the costs of establishing and maintaining digital communication-satellite systems are critically dependent on the overall bit-error ratio performance;
- c) that the bit-error ratio in the HRDP should not be such as to appreciably affect conversation in most telephone calls, or the transmission of telephone signalling;
- d) that the bit-error ratio may vary with time due to the effect of varying propagation conditions;
- e) that high bit-error ratios may occur for short periods due to other sources of noise, such as interference,

recommends

1. that the bit-error ratio at the output of the HRDP, as defined in Recommendation ITU-R S.521, should not exceed the provisional values given below:
 - 1.1 one part in 10^6 , 10 min mean value for more than 20% of any month;
 - 1.2 one part in 10^4 , 1 min mean value for more than 0.3% of any month;
 - 1.3 one part in 10^3 , 1 s mean value for more than 0.05% of any month;
2. that the following Notes should be regarded as part of the Recommendation.

Note 1 – The performance of a digital satellite system is generally much more sensitive to a variation in performance in the radio-frequency part of the network than is the case with analogue systems. It is therefore particularly important for designers to allow adequate margins for degradations which may occur during the life of the system if the recommended performance is to be maintained.

Note 2 – The objectives for bit-error ratio indicated in § 1 above, include the effects due to interference noise, and noise due to atmospheric absorption and rain, but exclude the unavailable time due to equipment (see Recommendation ITU-R S.579).

Note 3 – It is assumed that no framing information other than that required for the adequate operation of the satellite system, would be transmitted over the satellite. If PCM multiplex framing information is to be transferred unmodified via the satellite link, note should be taken of the possible effect of the higher error ratios in § 1.2 and 1.3 on the alarm indication system of the terrestrial systems.

Note 4 – The objectives for bit-error ratio indicated in § 1 above, apply only to the transmission of PCM-telephony (see ITU-T Recommendation G.711). Further study by Radiocommunication Study Group 4 is required regarding the performance objectives appropriate to other digital services.

Note 5 – Fixed-satellite systems operating below 10 GHz would not generally be limited by the short-term 10^{-3} bit-error ratio performance objective and system designers should assume this short-term objective is in terms of total time.

Note 6 – For systems operating above 10 GHz the performance objectives in § 1 would apply during the available time. For such systems, rain effects for small percentages of time could degrade the system to more than 10^{-3} bit-error ratio. For these percentages of the time the circuit should be considered unavailable in accordance with the definition of unavailability as given in Recommendation ITU-R S.579, i.e. periods of high bit-error ratio which persist for ten consecutive seconds or longer are considered unavailable. Short interruptions (less than 10 s) shall be treated as available time and are equivalent to the case in which the bit-error ratio of a link exceeds 10^{-3} . Therefore the overall design objective for the 10^{-3} criteria (total time) would comprise those periods of time from § 1.3 plus those periods of unavailable time from Recommendation ITU-R S.579 (§ 3.1).

Note 7 – In § 1.3, the 10^{-3} bit-error ratio is specified over a period of any month which has been assumed to correspond to a period of any year by a conversion factor of 5, i.e. 0.05% of any month would correspond to 0.01% of any year. Referring to the term “any year”, see Note 11 of Recommendation ITU-R S.353.

Note 8 – It may be necessary to make special provision regarding the performance of satellite-to-satellite links. The extent of this provision is a matter requiring further study.

Note 9 – The performance recommended to be met for “any month” should be based on the propagation data corresponding to the “worst month” of the year taken from the monthly statistics covering a period of at least four years for which reliable data are available. The “worst month” should be calculated in accordance with Recommendation ITU-R S.581.

Note 10 – In order to comply with the values given in § 1, for systems operating above 10 GHz, it may be advantageous to make use of fade countermeasures strategies and techniques for which basic guidance is provided in Recommendation ITU-R S.1061.
