

RECOMMENDATION ITU-R S.523-4*

Maximum permissible levels of interference in a geostationary-satellite network in the fixed-satellite service using 8-bit PCM encoded telephony, caused by other networks of this service

(1978-1982-1986-1990-1992)

The ITU Radiocommunication Assembly,

considering

- a) that geostationary-satellite networks in the fixed-satellite service operate in the same frequency bands;
- b) that interference between networks in the fixed-satellite service degrades the bit error ratio performance relative to its value in the absence of frequency sharing;
- c) that it is desirable that the bit error ratio in networks in the fixed-satellite service caused by transmitters of different networks in that service should be such, as to give a reasonable orbit utilization efficiency;
- d) that the overall performance of a network should essentially be under the control of the system designer;
- e) that it is necessary to protect a network in the fixed-satellite service from interference by other such networks;
- f) that it is necessary to determine the maximum permissible interfering radio frequency power in a satellite system to establish space station and earth station characteristics such as required protection ratios and minimum orbital spacing;
- g) that networks in the fixed-satellite service may receive interference both into the space station receiver and into the earth station receiver;
- h) that it is desirable that the increase in bit error ratio due to interference from other satellite networks should be a controlled fraction of the total bit error ratio, as set out in Recommendation ITU-R S.522;
- j) that where adjacent satellites serve networks with similar characteristics the largest interference contributions to a geostationary-satellite network will be from the networks using those adjacent satellites; but this may not be true where network characteristics are inhomogeneous;

* Radiocommunication Study Group 4 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44 (RA-2000).

- k) that the levels of interference between geostationary-satellite networks in the fixed-satellite service below 10 GHz are not expected to exhibit a large variation with time, and under these conditions it is preferable to define the permissible interference limit as a fraction of the pre-demodulator noise power, as this allows multiple interference entries to be superimposed on each other on the basis of RF power addition;
- l) that in frequency bands between 10 and 15 GHz where very high propagation attenuation may occur for short periods of time, it would generally be desirable for systems to make use of adaptive up-link power control or earth-station site diversity or other techniques to counteract signal fading and that under these circumstances the levels of interference from other satellite systems would also not undergo a large variation with time;
- m) that the carrier-to-interference ratio can be used to evaluate the degradation of the BER performance of a digital signal in the channel,

recommends

1 that networks in the fixed-satellite service operating in the same frequency bands below 15 GHz, and using geostationary satellites be designed and operated in such a manner that the total interference to an 8-bit PCM telephony system in the fixed-satellite service caused by the earth station and space station transmitters of all other networks, should conform provisionally to the following limits:

1.1 in frequency bands in which the network does not practise frequency re-use, the interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 25% of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 ;

1.2 in frequency bands in which the network practises frequency re-use, the interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 20% of the total noise power level at the input to the demodulator that would give rise to a bit error ratio of 1 in 10^6 ;

2 that the maximum level of interference power in any such 8-bit PCM telephony system caused by the transmitters of another fixed-satellite network, averaged over any 10 min, should not exceed, for more than 20% of any month, 6% on a provisional basis of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 ;

3 that the maximum level of interference noise power caused to that network should be calculated on the basis of the following values for the receiving earth station antenna gain, in a direction at an angle φ (in degrees) referred to the main beam direction:

$$G = 32 - 25 \log \varphi \quad \text{dBi} \quad \text{for} \quad 1^\circ \leq \varphi < 48^\circ$$

$$G = -10 \quad \text{dBi} \quad \text{for} \quad 48^\circ \leq \varphi < 180^\circ$$

except when the actual gain is known and is less than the above value, in which case the actual value should be used;

4 that the following Notes should be regarded as part of this Recommendation:

NOTE 1 – For the calculation of the limits quoted in § 1.1, 1.2 and 2 it should be assumed that the total noise power at the input to the demodulator is of thermal nature.

NOTE 2 – It is assumed in this Recommendation that the interference from other satellite networks is of a continuous nature; further study is required with respect to cases where interference is not of a continuous nature.

NOTE 3 – The values quoted in § 1 and 2 are not intended to apply:

a) to networks for which a complete advance publication information was submitted to the ex-IFRB by the time of the ex-CCIR XIVth Plenary Assembly, 1978: for such networks the aggregate interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 10% of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 ; and the single-entry interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 4% of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 ;

b) to networks for which complete advance publication was submitted after the ex-CCIR XIVth Plenary Assembly, 1978 and prior to the end of 1987: for such networks the aggregate interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 20% of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 for networks which do not practise frequency re-use, and 15% for those works which do practise frequency re-use, and the single-entry interference power level, averaged over any 10 min, should not exceed, for more than 20% of any month, 4% (see Note 5) of the total noise power level at the input to the demodulator which would give rise to a bit error ratio of 1 in 10^6 .

NOTE 4 – In some cases it may be necessary to limit the single entry interference value to less than the value quoted in § 2 above in order that the total value recommended in § 1 may not be exceeded. In other cases, particularly in congested arcs of the geostationary-satellite orbit, administrations may agree bilaterally to use higher single entry interference values than those quoted in § 2 above, but any interference noise power in excess of the value recommended in § 2 should be disregarded in calculating whether the total value recommended in § 1 is exceeded.

NOTE 5 – The provisional single-entry value of 6% in § 2 has provisionally replaced the 4% value, pending the results of studies to determine the most appropriate value, taking into account the increase in the effective number of interferers contributing to the aggregate interference because of the increasing use of spot beam antennas at space stations. Study of the relationship between the single-entry interference value quoted in § 2 above and the aggregate interference values quoted in § 1 is required as a matter of urgency.

NOTE 6 – There is an urgent need for study of the acceptability of an increase in the maximum total interference noise values recommended in § 1, since some studies have shown that the optimum interference allowances, from the point of view of GSO efficiency, could be greater than the present allowances for bandwidth and/or power limited satellite networks.

NOTE 7 – In segments of the geostationary-satellite orbit not likely to be crowded, interference allowances less than those recommended in § 1 above, may be utilized, allowing a corresponding increase in other noise contributions within total acceptable noise limits. However, § 1.1 and 1.2 above should normally be evaluated with the assumption that the total power noise level present is that which produces the specified bit error ratio under unfaded conditions of the received signal.

NOTE 8 – Although this Recommendation has been extended to an upper frequency limit of 15 GHz, in the frequency range from 10 to 15 GHz short-term propagation data are not available uniformly throughout the world and there is a continuing need to examine such data to confirm the appropriateness of the interference noise allowances.

NOTE 9 – There is a need for urgent study to be given to the interference noise allowances appropriate to systems operating at frequencies above 15 GHz.

NOTE 10 – The interference power levels indicated in § 1 and 2 above apply only to the transmission of PCM telephony (see Recommendation ITU-R S.522 and ITU-T Recommendation G.711). Further study by Radiocommunication Study Group 4 is required regarding the performance objectives appropriate to the transmission of digital services other than PCM telephony, as information on the performance requirements of such services becomes available to the ITU-R.

NOTE 11 – Particularly in cases where interference is caused by transmitters using code-division-multiple-access techniques, the interference from another fixed-satellite network referred to in § 2 is the composite interference from all transmissions having overlapping spectra in that network.

NOTE 12 – Methods to calculate the carrier-to-interference ratio are contained in Recommendation ITU-R S.741 and other relevant ITU-R texts.
