RECOMMENDATION ITU-R S.466-6*

Maximum permissible level of interference in a telephone channel of a geostationary-satellite network in the fixed-satellite service employing frequency modulation with frequency-division multiplex, caused by other networks of this service

(1970-1974-1978-1982-1986-1990-1992)

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 contributes to the noise in the network;

c)   that it is desirable that the interference noise in the telephone channels of 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 specify the maximum permissible interference power in a telephone channel, to determine space station and earth station characteristics;

g)   that the value selected for the maximum permissible single entry of interference noise should not result in too wide a minimum orbital spacing;

h)   that for coordination between two satellite networks, it is necessary to know the maximum permissible level of interference in a telephone channel of the wanted network caused by transmitters of the other network;

j)   that networks in the fixed-satellite service may receive interference both into the space station receiver and into the earth station receiver;

k)   that the mean interference noise power should be an appropriate fraction of the total noise power permitted in the hypothetical reference circuit;

l)   that in many cases the largest interference contributions to a geostationary-satellite network will be from the networks using geostationary satellites in orbit nearby and serving an overlapping coverage area. The value of interference from any other network will generally be less;

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m)   that the accumulation of interference from many entries from other satellite networks and from terrestrial stations is not likely to be equal to the arithmetic sum of the individual interference entries at their maximum value across the band, and the total interference noise level in any single channel may be significantly less;

n)   that the levels of interference between geostationary-satellite networks in the fixed-satellite service operating in frequency bands below 10 GHz are not expected to undergo a large variation with time;

o)   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-path 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;

p)   that the use of syllabic companding may be useful in reducing transmitter power requirements or increasing transmission capacity, but that companded transmissions have a sensitivity to interference which is different from that of uncompanded transmissions

q)   that the level of baseband degradation is inversely proportional to the carrier-to-interference ratio,

recommends

1   that different geostationary-satellite networks in the fixed-satellite service operating in the same frequency bands, below 15 GHz, be designed in such a manner that the interference noise power at a point of zero relative level in any telephone channel of a hypothetical reference circuit of a network in the fixed-satellite service, employing frequency modulation, caused by the aggregate of the earth station and space station transmitters of other fixed satellite networks, should not exceed:

1.1   in frequency bands in which the network does not practise frequency re-use: 2 500 pW0p, psophometrically weighted one minute mean power for more than 20% of any month;

1.2   in frequency bands in which the network practices frequency re-use; 2 000 pW0p, psophometrically weighted one minute mean power for more than 20% of any month;

2   that the maximum level of the interference noise power at a point of zero relative level in any telephone channel of the hypothetical reference circuit of a geostationary-satellite network in the fixed-satellite service employing frequency modulation, caused by the transmitters of another fixed-satellite network, should not exceed 800 pW0p, psophometrically weighted one minute mean power, for more than 20% of any month;

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:

$$G = 32 - 25 \log \varphi \qquad \text{dBi} \qquad \text{for} \qquad 1° \leq \varphi < 48°$$

$$G = -10 \qquad \text{dBi} \qquad \text{for} \qquad 48° \leq \varphi < 180°$$

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 – The values quoted in § 1.1, 1.2 and 2 are not intended to apply:

a)   to networks for which a complete advance publication was submitted to the ex-IFRB by the time of the ex-CCIR XIVth Plenary Assembly, 1978; for such networks the aggregate interference power in any telephone channel should not exceed 1 000 pW0p psophometrically weighted one minute mean power for more than 20% of any month, and the single-entry interference noise power should not exceed 400 pW0p, psophometrically weighted one minute mean power, for more than 20% of any month;

b)   for networks which have submitted complete advance publication after the ex-CCIR XIVth Plenary Assembly, 1978 and prior to the end of 1987, the aggregate interference power in any telephone channel should not exceed 2 000 pW0p psophometrically weighted one minute mean power for more than 20% of any month for networks which do not practise frequency re-use and 1 500 pW0p psophometrically weighted one minute mean power for more than 20% of any month for networks which practise frequency re-use, and the single-entry interference noise power should not exceed 600 pW0p, psophometrically weighted one minute mean power, for more than 20% of any month.

NOTE 2 – The pW0p values given in § 1 and 2 apply to interfered with transmissions which do not use syllabic companding. When a transmission uses syllabic companding, the equivalent values to be used result from multiplication of the values from § 1 and 2 with the numerical companding gain for which the transmissions have been characterized. This is predicated on an overall subjective channel performance objective of 10 000 pW0p.

NOTE 3 – Only a small fraction of the channels of a network will experience the maximum value of interference from any single network and therefore the aggregate level for many channels will be less than the totals contained in § 1. System designers may provide for a lower value in their noise budgets for a large portion of the spectrum. The way in which the aggregate values are to be taken into account in the general noise objectives for networks in the fixed-satellite service is defined in Note 6 of Recommendation ITU-R S.353.

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 – There is a need for study to be given to means of increasing the single entry interference level quoted in § 2 above without causing the total interference noise level to exceed the values quoted in § 1; this study should include, for example, the feasibility of overcoming problems of interference which result from inhomogeneous network parameters.

NOTE 6 – There is a need for study of the acceptability of an increase in the maximum total interference noise values in § 1, since some studies have shown 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, an interference allowance less than that recommended in § 1 above, may be utilized, allowing a corresponding increase in other noise contributions within total acceptable noise limits.

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 – 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 11 – The expected level of carrier-to-interference ratio can be evaluated by using the methods provided in Recommendation ITU-R S.741 and other relevant ITU-R texts.