

RECOMMENDATION 738

**PROCEDURE FOR DETERMINING IF COORDINATION IS REQUIRED
BETWEEN GEOSTATIONARY-SATELLITE NETWORKS SHARING
THE SAME FREQUENCY BANDS**

(Question 49/4)

(1992)

The CCIR,

considering

- a) that FSS networks may share the same frequency bands;
- b) that they may cause and experience mutual interference;
- c) that this mutual interference can be minimized through coordination;
- d) that it is necessary to determine whether there is a need for coordination,

recognizing

that under Article 11 of the Radio Regulations, the need for coordination is determined by Appendix 29,

recommends

1. that the method given in Annex 1, called the $\Delta T/T$ method, be used to determine if coordination is required between geostationary-satellite networks sharing the same frequency bands;
2. that coordination be required when the calculated value of $\Delta T/T$ of the potentially interfered with network is greater than 6%;
3. that the following Notes will be considered part of this Recommendation.

Note 1 – The $\Delta T/T$ method gives an apparent increase in equivalent satellite link noise temperature, and treats the effect of interference as an increase in thermal noise in the wanted network. The power of the interfering signal is assumed to be spread evenly over the frequency bandwidth, with a power density equal to its maximum power density. The ratio $\Delta T/T$ is expressed as a percentage.

Note 2 – The above approach is similar to that in Appendix 29 of the Radio Regulations and is applicable with the data provided under Appendix 4 of the Radio Regulations. It also includes additional information to facilitate the application of Appendix 29.

Note 3 – The threshold value of 6% is consistent with Appendix 29.

ANNEX 1

**Method of calculation for determining if coordination is required
between geostationary-satellite networks sharing the same frequency bands**

1. Characteristics of networks

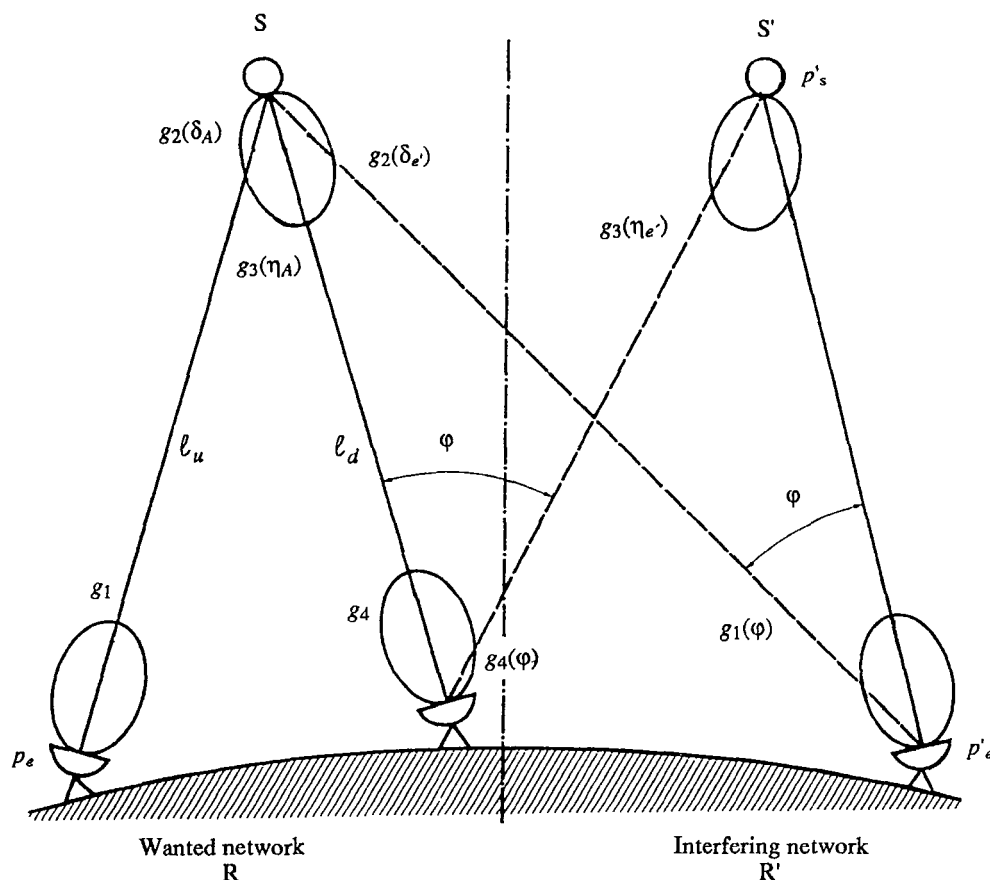
Radiocommunication satellites require frequency assignments in two bands, one for the up link and the other for the down link. It is current practice for frequency bands to be associated in pairs, one of each pair being used for up links and the other for down links. Case I below is concerned with the possibility of interference between two systems which have been assigned frequency bands in this way. However, it should be feasible to use a pair of frequency bands

in the reverse sense (bidirectional use) for some systems, the up-link band for one network being the same as the down-link band for the network using an adjacent satellite; this is Case II. These two cases cover all relative satellite positions from closely-spaced to near-antipodal positions.

Let A be a satellite link of network R associated with satellite S and A' be a satellite link of network R' associated with satellite S'. The symbols such as a, b and c refer to satellite link A and symbols such as a', b' and c' refer to satellite link A' (see Figs. 1a and 1b).

FIGURE 1a

Geometry - Case I - Wanted and interfering networks sharing the same frequency band in the same direction of transmission

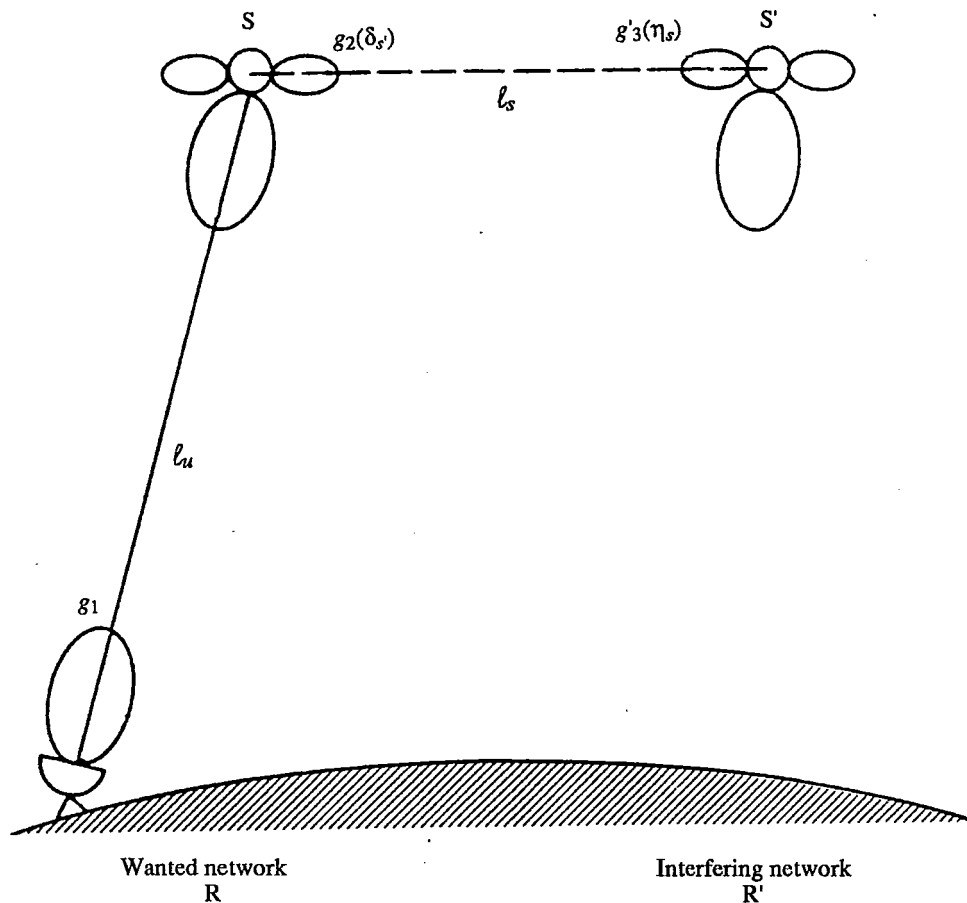


The parameters are defined as follows (for satellite link A):

- T : the equivalent satellite link noise temperature, referred to the output of the receiving antenna of the earth station (K);
- T_s : the receiving system noise temperature of the space station, referred to the output of the receiving antenna of the space station (K);
- T_e : the receiving system noise temperature of the earth station, referred to the output of the receiving antenna of the earth station (K);
- ΔT : apparent increase in the equivalent noise temperature for the entire satellite link referred to the output of the receiving earth station antenna, caused by interference emissions from other satellite networks;

FIGURE 1b

Geometry – Case II – Wanted and interfering networks sharing the same frequency band in opposite directions of transmission (bidirectional use)



ΔT_s : apparent increase in the receiving system noise temperature of the satellite S, caused by an interfering emission, referred to the output of the receiving antenna of this satellite (K);

ΔT_e : apparent increase in the receiving system noise temperature of the earth station e_R , caused by an interfering emission, referred to the output of the receiving antenna of this station (K);

p_s : maximum power density per Hz delivered to the antenna of satellite S (averaged over the worst 4 kHz band for a carrier frequency below 15 GHz or over the worst 1 MHz band above 15 GHz) (W/Hz);

$g_3(\eta)$: transmitting antenna gain of satellite S in the direction η (numerical power ratio);

η_A : direction, from satellite S, of the receiving earth station e_R of satellite link A;

$\eta_{e'}$: direction, from satellite S, of the receiving earth station e'_R of satellite link A';

Note – The product $p_s g_3(\eta_{e'})$ is the maximum e.i.r.p. per Hz of satellite S in the direction of the receiving earth station e'_R of satellite link A';

- $\eta_{S'}$: direction, from satellite S, of satellite S';
- p_e : maximum power density per Hz delivered to the antenna of the transmitting earth station e_T (averaged over the worst 4 kHz band for a carrier frequency below 15 GHz or over the worst 1 MHz band above 15 GHz) (W/Hz);
- $g_2(\delta)$: receiving antenna gain of satellite S in the direction δ (numerical power ratio);
- δ_A : direction, from satellite S, of the transmitting earth station e_T of satellite link A;
- $\delta_{e'}$: direction, from satellite S, of the transmitting earth station e'_T of satellite link A';
- $\delta_{S'}$: direction, from satellite S, of satellite S';
- $g_1(\varphi)$: transmitting antenna gain of the earth station e_T in the direction of satellite S' (numerical power ratio);
- $g_4(\varphi)$: receiving antenna gain of the earth station e_R in the direction of satellite S' (numerical power ratio);
- φ : topocentric angular separation between the two satellites, taking the longitudinal station-keeping tolerances into account.
- Note* – Only the topocentric angle φ should be used in dealing with Case I;
- φ_g : geocentric angular separation in degrees between the two satellites, taking the longitudinal station-keeping tolerance into account.
- Note* – Only the geocentric angle φ_g should be used in dealing with Case II;
- k : Boltzmann's constant (1.38×10^{-23} J/K);
- ℓ_d : free-space transmission loss on the down link (numerical power ratio); evaluated from satellites to the receiving earth station e_R for satellite link A;
- ℓ_u : free-space transmission loss on the up link (numerical power ratio); evaluated from the earth station e_T to satellite S for satellite link A;
- ℓ_s : free-space transmission loss on the inter-satellite link (numerical power ratio), evaluated from satellite S' to satellite S;
- γ : transmission gain of a specific satellite link subject to interference evaluated from the output of the receiving antenna of the space station S to the output of the receiving antenna of the earth station e_R (numerical power ratio, usually less than 1).

In the foregoing symbols, the gains $g'_1(\varphi)$ and $g_4(\varphi)$ are those of the earth stations concerned. In the event of precise numerical data relating to earth-station antennas not being available, the reference radiation pattern given in Recommendation 465 should be used.

2. Calculation of the equivalent satellite link noise temperature and the transmission gain

2.1 Introduction

The purpose of this section is to provide some guidance for determining, for simple frequency changing transponders, values of equivalent satellite link noise temperatures and transmission gains and in particular the sets of values for:

- the lowest equivalent link noise temperature and the associated transmission gain, and
- the value of transmission gain and associated equivalent link noise temperature that correspond to the highest ratio of transmission gain to equivalent satellite link noise temperature.