

RECOMMENDATION ITU-R S.741-2

CARRIER-TO-INTERFERENCE CALCULATIONS BETWEEN NETWORKS
IN THE FIXED-SATELLITE SERVICE

(Question ITU-R 49/4)

(1992-1993-1994)

The ITU Radiocommunication Assembly,

considering

- a) that during the planning stage of a satellite network it may be useful to calculate carrier-to-interference (C/I) ratios between carriers of the interfering and interfered-with networks for the purpose of determining levels of interference;
- b) that such calculations depend on the relative geometry of the satellite network involved;
- c) that the carrier-to-interference ratios can be used in the determination of interference levels contributing to performance degradation;
- d) that the carrier-to-interference ratios can be used for all modulation methods and signal types;
- e) that the carrier-to-interference calculation may be an element to complete frequency coordination of satellite networks in accordance with the Radio Regulations;
- f) that alternative methods may be used, by agreement between the administrations concerned, to calculate levels of interference between satellite networks (see for example Recommendation ITU-R S.740),

recommends

- 1. that when carrier-to-interference ratios (C/I s) are used to calculate the levels of interference between satellite networks:
 - the method shown in Annex 2 of Recommendation ITU-R S.740 be used as the basis for these calculations in so far as geometrical considerations are concerned;
 - the methods given in Annex 1 to this Recommendation be used to calculate the interference power in the interfered-with carrier.

ANNEX 1

**Determination of carrier-to-interference ratios
and baseband noise power for coordination
of carriers in the fixed-satellite service (FSS)**

1. Types of interfering carriers

1.1 The types of interference experienced by the FSS carriers from adjacent networks can be classified as follows:

- noise-like interference;
- slowly swept interference arising from a TV-FM carrier modulated only with an energy dispersal (ED) signal;
- interference from one TV-FM carrier to another (this category is not addressed in this annex).

2. Types of FSS carriers

2.1 The types of carriers normally used in FSS networks are:

- *Analogue:*
 - FDM-FM and CFDM-FM;
 - TV-FM;
 - single-channel-per-carrier (SCPC)-FM.
- *Digital:*
 - narrow-band and intermediate bandwidth carriers with and without FEC coding (e.g. SCPC-PSK);
 - large bandwidth carriers (e.g. TDMA, CDMA).

3. Methodologies used to assess interference into FSS carriers

3.1 *Interference into FDM-FM and CFDM-FM carriers*

The effect of interference into FDM-FM or CFDM-FM carriers is treated in terms of the baseband interference noise power in a telephony channel and is given by the following expression:

$$10 \log(np) = 87.5 - B - 10 \log(c/i) \quad (1)$$

where:

- np : weighted interference power (pW0p)
- B : interference reduction factor (dB)
- c : power of the desired carrier (W)
- i : power of the interfering carrier (W).

The factor B depends on the signal characteristics of both the desired and the interfering carriers and the frequency separation between the centre frequencies of the two carriers.

The expressions for the interference reduction factor for all types of interfering carriers are given in Recommendation ITU-R SF.766.

In the case of CFDM-FM, the applicable value of companding advantage (around 9 dB) should be considered along with the interference power level during speech excitation.

3.2 *Interference into a non-FDM-FM carrier*

The assessment of interference into a non-FDM-FM carrier depends on the nature (i.e. digital or analogue or slowly sweeping) of the interfering carrier and on whether the interfering carrier bandwidth is larger or smaller than the desired carrier occupied bandwidth.

Table 1 shows the C/I ratios for different combinations of the desired and interfering carriers.

3.3 *Interference from noise-like digital carriers*

The ratio of the carrier to interference power in the desired carrier signal bandwidth, for co-frequency operation of the desired and interfering carriers is given by:

$$C/I = 10 \log(c/i) - 10 \log(M) \quad \text{for } BW_D > BW_{Ia} \quad (2)$$

$$C/I = 10 \log(c/i) - 10 \log(BW_D / BW_{Io}) \quad \text{for } BW_D \leq BW_{Ia} \quad (3)$$

where:

- C/I : ratio (dB) of desired carrier power and the total interference power in the desired carrier bandwidth
- c : power of the desired carrier (W)
- i : power of one interfering carrier (W)