

RECOMMENDATION 793*

**PARTITIONING OF NOISE BETWEEN FEEDER LINKS FOR
THE BROADCASTING-SATELLITE SERVICE (BSS)
AND BSS DOWN LINKS****

(Questions 83/11, 86/11)

(1992)

The CCIR,

considering

- a) that the broadcasting-satellite service (BSS) is normally expected to provide service to a relatively large geographical area encompassing a large population of receivers;
- b) that in minimizing the effects of feeder-link noise on the overall link noise budget the cost and complexity of the BSS receiver will be minimized;
- c) that the satellite output e.i.r.p. is maintained at the nominal output level during feeder-link fades by employing techniques such as automatic gain control (AGC);
- d) that higher up-link power requirements would affect only a few feeder-link stations;
- e) that in terms of availability, rain fades on the down link would only have a local affect on the performance whereas rain fade on the feeder link would affect performance over the whole service area;
- f) that a further degradation of the overall link due to thermal noise occurs due to the non-linearity of the satellite high power amplifier coupled with AM/PM conversion (see Annex 1),

recommends

that as a guide to system design, for a given service availability objective for analogue-modulated emissions in the BSS, the apportionment of the down-link noise contribution to the feeder-link noise contribution should be of the order of 10:1 (see Annex 1).

ANNEX 1

Partitioning of noise between feeder links and down links

For the purposes of planning, the WARC-BS-77 adopted a maximum reduction of 0.5 dB of the overall carrier-to-noise (C/N) ratio, to represent the contribution of the feeder link to the C/N ratio for 99% of the worst month. This corresponds to a difference of about 10 dB between the carrier-to-noise ratios of the down links and feeder links.

According to an EBU study, the contribution of the noise resulting from the feeder link may be rendered negligible by adopting a relatively small margin in the carrier-to-noise ratio of the down link. This study considered the case of automatic gain control (AGC) in the satellite and was based on a statistical analysis of the attenuations on the feeder link and down link.

Numerical applications have been made assuming that the attenuations (in dB) follow a log-normal relationship for which the parameters fit measurements made in Europe. It is seen, first, that the results obtained assuming either total correlation or total independence between feeder-link and down-link fadings, are more or less identical. The influence of a margin of 0.5 dB on the down link, however, is crucial. The improvement due to this margin is better than that obtained by dimensioning the C/N ratio of the feeder link for 99.9% of the worst month instead of for 99%. Hence, if a down-link C/N ratio of 14 dB for 99% of the worst month is assumed, the noise contribution from the feeder link to the overall circuit causes the overall link C/N to drop below 14 dB, 50% to 10%

* This Recommendation should be brought to the attention of Study Group 4.

** Note from the Director, CCIR – Report 952-2 (§ 3.2 and 3.3) was used in preparing Annex 1.

more often (depending on whether the feeder link is dimensioned to give a C/N ratio of 24 dB for 99% or 99.9% of the worst month). If account is taken of the 0.5 dB margin on the down link, the percentage of the time during which the overall C/N drops below 14 dB, including the noise contribution of the feeder link is still smaller than the specified 1% of the worst month in both cases.

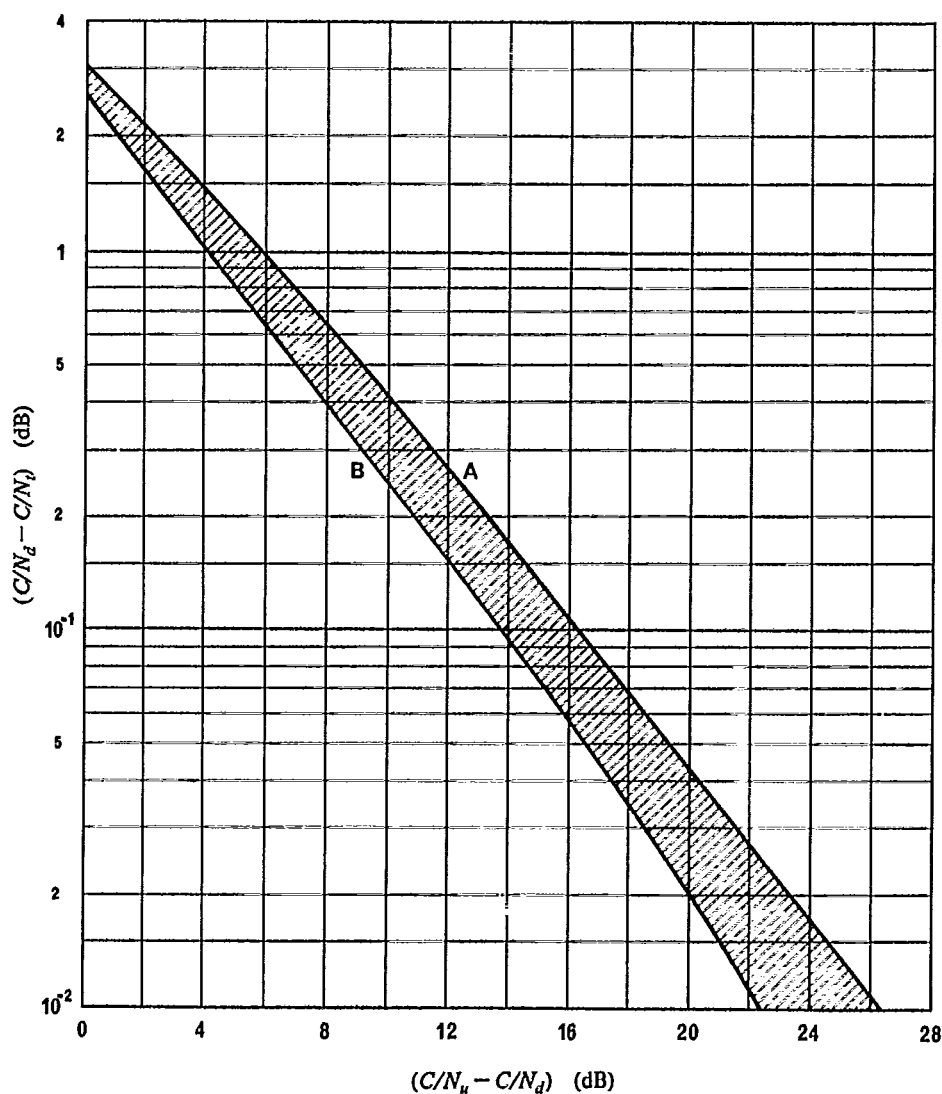
This result confirms the suitability of the choice, made by the WARC-BS-77, to take account of the feeder link by means of such a margin, even at frequencies of the order of 18 GHz.

Similar studies were conducted in Canada on the effects of rain attenuation and satellite transponder characteristics as related to the partitioning of the noise contributions on the feeder links and down links in a broadcasting-satellite service.

Some of the results can be found in Fig. 1, where the same assumptions as in the above-mentioned study were made. The curves in this figure represent the degradation of the down-link C/N due to the noise contribution from the feeder link, $(C/N_d - C/N_f)$ as a function of the difference between the C/N of the feeder link and the C/N of the down link $(C/N_u - C/N_d)$. Full correlation and independence of the fadings on both links are illustrated. All C/N values are specified for 99% of the worst month.

FIGURE 1

Noise contribution of the feeder link



A: correlated
B: uncorrelated