

RECOMMENDATION ITU-R S.1063

**CRITERIA FOR SHARING BETWEEN BSS FEEDER LINKS AND OTHER
EARTH-TO-SPACE OR SPACE-TO-EARTH LINKS OF THE FSS**

(Question ITU-R 210/4)

(1994)

The ITU Radiocommunication Assembly,

considering

- a) that under the Radio Regulations (RR) the Earth-to-space links used as feeder links to satellites in the broadcasting-satellite service (BSS) are part of the fixed-satellite service (FSS);
- b) that the frequency and technical characteristics of such feeder links may depend on the technical characteristics of systems using the broadcasting satellite, but that risks of interference with satellites in the FSS providing links between specified points on the Earth should also be taken into account;
- c) that the system constraints of the BSS may affect the efficiency with which the FSS frequency bands are used for links between earth stations;
- d) that the following Earth-to-space FSS frequency bands have been identified for use by BSS feeder links; 10.7-11.7 GHz (Region 1), 14.5-14.8 GHz (all Regions except Europe), 17.3-17.8 GHz (Region 2 also allocated to the BSS), 17.3-18.1 GHz (Regions 1 and 3), 18.1-18.4 GHz (all Regions by Footnotes RR 870A and 870B), 24.75-25.25 GHz (Regions 2 and 3), 27.5-30.0 GHz (all Regions);
- e) that certain BSS feeder links are planned as in RR Appendix 30A to pair with the BSS Plan of RR Appendix 30,

recommends

- 1. that when considering sharing between the FSS and BSS feeder links:
 - 1.1 the requirements and constraints of both systems should be taken into account;
 - 1.2 reducing the required bandwidth of the feeder links should be considered;
 - 1.3 suitable interference calculations should be performed and results compared against required protection ratios;
- 2. that the factors and examples given in Annex 1 be considered to help facilitate § 1.

ANNEX 1

**Criteria for sharing between BSS feeder links and other Earth-to-space
or space-to-Earth links of the FSS****1. Introduction**

Frequency bands allocated to the BSS are, by definition, in the space-to-Earth direction. Feeder links to broadcasting satellites, operating in any frequency band must, under the current provisions of the Radio Regulations, use the Earth-to-space allocations of the FSS. For the purpose of this Annex, the term “fixed-satellite service” is as defined in the Radio Regulations, but excludes feeder links to broadcasting satellites.

The World Administrative Radio Conference (Geneva, 1979) (WARC-79), and subsequently the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992) (WARC-92), allocated a number of Earth-to-space bands for use by feeder links for the BSS. These bands are: 10.7-11.7 GHz (Region 1), 14.5-14.8 GHz (all Regions except Europe), 17.3-17.8 GHz (Region 2, this band is also allocated to the BSS), 17.3-18.1 GHz (Regions 1 and 3), 18.1-18.4 GHz (all Regions by Footnotes RR 870A and 870B), 24.75-25.25 GHz (Regions 2 and 3), 27.5-30.0 GHz (all Regions).

Since, however, the up-link requirements of the BSS, particularly around 12 GHz, are expected to be fairly substantial and feeder links for broadcasting satellites may be drawn from any fixed-satellite Earth-to-space allocation (though subject to coordination in bands not exclusively designated for feeder links), and since the higher frequency bands for that purpose may be unattractive to some administrations, the problem of using Earth-to-space allocations by both the FSS and the BSS remains a matter of concern.

The simultaneous use of the 14 to 14.5 GHz band by broadcasting-satellite systems and around 12 GHz by the FSS having different space-to-Earth allocations will be a problem in congested parts of the orbit. In addition to individual and community type BSSs in the 12 GHz band, it is envisioned that interactive services (voice, data and video) may be provided through the use of earth stations with small aperture antennas. This may place additional requirements and constraints on both services.

This Annex evaluates the impact of sharing, associated with using fixed satellite allocations for feeder links to broadcasting satellites with regard to the Plans developed by the World Administrative Radio Conference for the Planning of the Broadcasting-Satellite Service, (Geneva, 1977) (Regions 1 and 3) (WARC BS-77), the related subsequent Regional Administrative Radio Conference for the Planning of the Broadcasting-Satellite Service in Region 2 (RARC SAT-R2) (Geneva, 1983), and the BSS feeder-link plan for Regions 1 and 3 developed at the Second Session of the World Administrative Radio Conference on the Use of the Geostationary-Satellite Orbit and on the Planning of Space Services Utilizing It (Geneva, 1988) (WARC ORB-88).

2. Technical and operational characteristics required for feeder links to broadcasting satellites

2.1 *Broadcasting-satellite systems around 12 GHz*

The WARC BS-77 established certain technical standards which affect the feeder links for Regions 1 and 3. One important requirement is that the reduction in the quality in the down-link due to thermal noise in the feeder link is taken to be equivalent to a degradation in the down-link C/N not exceeding 0.5 dB for 99% of the worst month. To limit the impairment to this value, the C/N on the feeder link must be about 10 dB higher than that required for the down-link C/N , which in this case would mean a feeder link C/N of up to 24 dB, if the modulation indices were the same.

WARC BS-77 also established a value of 30 dB as the total protection ratio to which each broadcasting satellite transmission must be protected. Similarly, with the division of overall performance requirements, the total protection ratio of the feeder link of a broadcasting satellite may have to be of the order of 40 dB, with a single-entry protection ratio which may be as high as 45 dB. Standards for either of these two latter values have not yet been established. For interference caused by the adjacent channels, recent simulation experiments have shown that the operation of broadcasting-satellite power tubes at saturation reduces interference received from the adjacent channels by about 4 dB relative to that observed under reduced-drive conditions of the power tube. This improvement may also benefit adjacent-channel interference planning of feeder links in Regions 1 and 3.

For Region 2, the RARC SAT-R2 concluded that an overall co-channel protection ratio of 28 dB is required, and that is reflected in the development of the Region 2 Plan. Also, it was decided that, for feeder links, a noise temperature increase of 10% at satellite receiver input should be the threshold which, if exceeded by actual interfering emissions, would require coordination.

Further information is to be found in Recommendations ITU-R BO.793, ITU-R BO.794 and ITU-R BO.795 in RR Appendix 30, and in the Final Acts of the RARC SAT-R2 (Geneva, 1983).

3. Feeder link bandwidth requirements

3.1 Down-link allocations

The feeder link bandwidth requirement has to be viewed in the context of the overall bandwidth allocated to the BSS. These are summarized in Table 1.

TABLE 1

Bandwidth allocated to the BSS below 40 GHz

Part of the spectrum	Amount of bandwidth (MHz)
700 MHz	170
2.5 GHz	190
12 GHz	800 (Region 1)
	500 (Region 2)
	500 + 250 (Region 3)
17 GHz	500 (Region 2)
21 GHz	600 (Regions 1 and 3)

3.2 Reduction of bandwidth required for feeder links to 12 GHz broadcasting satellites

Substantial bandwidth has been allocated to the BSS for its space-to-Earth links, and it is foreseen that these bands will ultimately be used extensively for television with frequency re-use obtained by means of high-gain satellite transmitting antennas and the use of cross-polarization techniques. A similar measure of frequency re-use will, no doubt, be obtained in the feeder link direction by means of high-gain satellite receiving antennas, but it is doubtful whether this technique can provide a significantly greater degree of frequency re-use in the feeder link than in the downlink, in parts of the world where broadcasting coverage areas are relatively small. The usage of the fixed-satellite Earth-to-space bands for broadcasting satellite feeder links could be reduced if means could be found for a further measure of frequency re-use in the feeder link. Four possible ways of achieving this have been identified:

- Feeder link frequency re-use using the higher directivity of the transmitting earth-station antenna, relative to broadcast receiving antennas.
- Dual polarization.
- Alternative modulation methods for the feeder links.
- Integrated sound-vision systems.

4. Feasibility of sharing allocations to the FSS (Earth-to-space) with feeder links for the BSS

4.1 Use of the 14.0 to 14.5 GHz band

An example is used to demonstrate interference by a broadcasting-satellite service feeder-link transmission to a satellite with INTELSAT-V characteristics, and the reverse situation of interference by a fixed-satellite service up-link transmission to a broadcasting-satellite feeder link. The interfering signals are assumed to be co-frequency and co-polarized.