RECOMMENDATION ITU-R IS.1142

SHARING IN THE FREQUENCY BANDS IN THE 1-3 GHz FREQUENCY RANGE BETWEEN GEOSTATIONARY SPACE STATIONS OPERATING IN THE MOBILE-SATELLITE SERVICE AND THE FIXED SERVICE

(Question ITU-R 202/2)

(1995)

Pfd thresholds for coordination of assignments for space-to-Earth geostationary space stations in the mobile-satellite service and receiving stations of the fixed service in certain bands in the 1-3 GHz range

The ITU Radiocommunication Assembly,

considering

a) that Resolution Nos. 46, 113, 703 and Recommendation No. 717 of the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (WARC-92) (Malaga-Torremolinos, 1992) invite the ITU-R (ex-CCIR) to study criteria for sharing and coordination between systems in the mobile-satellite and fixed services;

b) that WARC-92 adopted new allocations in the 1-3 GHz range for the mobile-satellite service (MSS) in order to help meet the rapidly growing spectrum requirements of that service;

c) that administrations have submitted advance publication data (Appendix 4 to the Radio Regulations (RR)) for mobile-satellite networks which, as a set, would operate throughout the frequency bands in the 1-3 GHz range that are shared with the fixed service (FS);

d) that for several decades, many administrations have been operating systems in the FS in certain bands shared with the MSS, and will continue to do so,

considering

for the MSS space-to-Earth direction:

e) that the bands 2 170-2 200 MHz, and 2 483.5-2 500 MHz are allocated to the MSS (space-to-Earth) and FS on a co-primary basis in all three Regions;

f) that the bands 1 492-1 525 MHz, 1 525-1 530 MHz and 2 160-2 170 MHz are allocated to the MSS (space-to-Earth) and FS in some Regions and some administrations, on a co-primary basis;

g) that the band 2 500-2 535 MHz may be used by the MSS (space-to-Earth) in all three Regions subject to agreement obtained under the procedure set forth in RR Article 14, the band 2 500-2 520 MHz is allocated to that service on a primary basis as of 1 January 2005, and these and adjoining frequencies are allocated to the FS on a primary basis;

h) that in the band 2 160-2 200 MHz, the allocation for the MSS may not be implemented before 1 January 2005, except in the United States of America where use by the MSS may not commence before 1 January 1996 (RR No. 746C (WARC-92));

j) that in certain bands which are subject to the coordination procedures of Resolution No. 46 (WARC-92), WARC-92 applied the power flux-density (pfd) levels of RR No. 2566 as a threshold for coordination with respect to receiving stations in the FS;

k) that in order to fulfil operating requirements, most types of mobile-satellite systems designed for operation in the 1-3 GHz range will have to generate pfd levels in excess of the levels specified in RR No. 2566;

l) that broadcasters in many countries operate ancillary services which have both fixed and mobile characteristics in the bands shared with the MSS;

m) that some systems described in § d) and l) above may have by necessity a low threshold to interference owing to the nature of their operation or design, based upon their performance and availability requirements,

considering

for the MSS Earth-to-space direction:

n) that the bands 1 970-1 980 MHz and 1 980-2 010 MHz are allocated to the MSS (Earth-to-space) and FS on a co-primary basis;

o) that parts of the bands 1 610-1 626.5 MHz and 1 675-1 710 MHz are allocated to the MSS (Earth-to-space) and the FS on a co-primary basis by some administrations and in Region 2, respectively;

p) that the band 2 670-2 690 MHz is allocated to that service on a primary basis as of 1 January 2005, and these and adjoining frequencies are allocated to the FS on a primary basis; the band 2 655-2 690 MHz may be used by the MSS (Earth-to-space) in all three Regions subject to agreement obtained under the procedure set forth in RR Article 14;

q) that sharing between the FS and the MSS (Earth-to-space) poses risks of harmful interference to the receiving space stations that increase with the geographic deployment density of fixed stations and the percentage of fixed stations operating on the same frequencies as the space station transponders (see Annex 2),

recommends

1 that the following pfd levels at angles of arrival δ (degrees) from geostationary space stations in the MSS should be applied as coordination thresholds with respect to stations in the FS (analogue and digital) that operate on the same frequencies (Note 1):

$$P \quad \text{dB(W/(m}^2 \cdot \text{4 kHz))} \quad \text{for} \quad 0° \le \delta \le 5°$$

$$P + r\,(\delta - 5) \quad \text{dB(W/(m}^2 \cdot \text{4 kHz))} \quad \text{for} \quad 5° < \delta < 25°$$

$$P + 20\,r \quad \text{dB(W/(m}^2 \cdot \text{4 kHz))} \quad \text{for} \quad 25° \le \delta \le 90°$$

where values for the parameters P (pfd at low angles of arrival) and r (rate of pfd increase with increasing angle of arrival) are given in Table 1:

TABLE 1

Frequency range (MHz)	Power flux-density parameters	
	P (dB(W/(m^2 · 4 kHz)))	r (dB/degree)
1 492-1 525	–152	0.5
1 525-1 530	–152	0.5
2 160-2 170	–152	0.5
2 170-2 200	–152	0.5
2 483.5-2 500	–152	0.5
2 500-2 520	–152	0.5
2 520-2 535	–160	0.75

2 that for satellites with overlapping transmit frequencies and orbit separations less than 20°, the pfd thresholds specified in § 1 for the band 2 520-2 535 MHz should be reduced by 3 dB;

NOTE 1 – The pfd thresholds specified in § 1 pertain to situations where there is any overlap between the necessary bandwidths of the subject frequency assignments.

NOTE 2 – Pursuant to the coordination process, it may be possible to exceed the pfd levels specified as a result of technical and operating considerations including those in Annex 1.

ANNEX 1

Fixed system considerations that may facilitate successful coordination*

Fixed radio-relay systems may be either analogue or digital. Many are mature systems which have been designed to take advantage of known topographical features, equipment parameters, and propagation characteristics. As such there are not likely to be many situations where changes can be made to a fixed system that can be used to ameliorate an interference potential. However, the following system parameters or mitigation techniques should be reviewed and used to the extent practical towards achieving successful coordination.

1 Antenna considerations

1.1 Antenna orientation of existing stations

In the establishment of the coordination threshold levels in this Recommendation, the orientation of the receiving antennas with respect to the interfering satellites is not specifically taken into account. In detailed coordination, this factor may provide additional significant protection for some receiving stations in the FS.

1.2 Orbital avoidance by planned stations

Discrimination can be achieved by ensuring that substantial off-axis angles are provided between the receive antenna boresights of future fixed stations and the geostationary-satellite orbit (GSO).

1.3 Polarization discrimination

In situations where the antennas of fixed systems use different polarizations (e.g., linear) than those employed by MSS systems (i.e., circular), polarization discrimination may be available (e.g., up to 3 dB).

2 Receiver/transmitter considerations

2.1 Frequency offset

Discrimination can be obtained by offsetting channel frequencies of receiving fixed stations and transmitting MSS space stations, where possible. Interference may be at acceptable levels in cases where the necessary bandwidths of the MSS space station and fixed station assignments do not overlap.

2.2 Additional allowance for interference

In the determination of coordination threshold level, an allowance of 1 dB is assumed for a reduction in the fade margin, which has a corresponding impact on system availability and performance. However, improved sharing and a successful coordination may be obtained at the expense of fade margin by increasing the allowance for interference from MSS space stations.

* Mobile-satellite system considerations that may facilitate successful coordination are for further study.

2.3 Modulation and bandwidth considerations

pfd thresholds are specified in a 4 kHz bandwidth. When the fixed system signal is digital or analogue video, limiting the interference levels in such a narrow reference bandwidth may lead to undue sharing constraints. The use of a wider reference bandwidth (e.g., the demodulator bandwidth) can more accurately represent the protection requirements and may enable consideration of the duty factor and guardbands in the co-channel MSS signals.

ANNEX 2

Sharing of frequency bands in the 1-3 GHz range between transmitting stations in the fixed service and geostationary space stations operating in the mobile-satellite (Earth-to-space) service

Studies have shown co-channel sharing to be unworkable between the FS and the MSS (Earth-to-space) in bands that are widely used by transmitting stations in the FS, even in cases where the FS is assumed to avoid pointing its antenna main beams within 4°-6° of the GSO.

Sharing studies have further shown that even for scenarios where the geographic deployment density of transmitting fixed stations is of the order of one station per 12 500 km^2 to 300 000 km^2 (moderate to low usage), protection of mobile-satellite space stations would necessitate power limits for the FS that are far more constraining than the limits now specified in RR Article 27. Specifically, it was concluded that co-channel sharing would be feasible only under the following sets of conditions:

– the mobile-satellite space stations employ global beams;

– the total number of fixed stations within the coverage area is limited to 1 250;

– the maximum e.i.r.p. density of fixed stations is limited to –36 dB(W/4 kHz);

or

– the mobile-satellite space stations employ spot beam antennas (beamwidths of about 6° or less);

– transmitting antennas of fixed stations are not pointed within about 5° of the geostationary orbit;

– only point-to-point systems are operating in the FS;

– there are no fixed service systems operating within the mobile-satellite’s coverage area;

– the geographic deployment density of the fixed stations is limited;

– the maximum e.i.r.p. density of fixed stations is limited to –4.5 to +2.5 dB(W/4 kHz) for a population density of one fixed service station per 50 000 km^2 and 300 000 km^2 respectively;

or

– only point-to-multipoint systems with very low e.i.r.p. densities (e.g. using CDMA techniques) are employed;

– the geographic deployment density and an associated e.i.r.p. density of such systems are limited;

– further study is required to derive the above densities.

On the basis that all of these conditions cannot simultaneously be met, it is therefore concluded that co-channel sharing is not feasible for mobile-satellite space stations employing global beam antennas and impractical for space stations employing spot beams (e.g., for subregional or domestic coverage or for multiple beam spacecraft providing global coverage) due to the low e.i.r.p. density restrictions, the requirement for future fixed stations to avoid the geostationary orbit by 5° and the impracticality in developing regulatory controls on the total number of fixed stations.