RECOMMENDATION ITU-R S.1069*

Compatibility between the fixed-satellite service and the space science services in the band 13.75-14 GHz

(1994)

The ITU Radiocommunication Assembly,

considering

a) that the World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum (Malaga-Torremolinos, 1992) (WARC-92) allocated the frequency band 13.75-14 GHz to the fixed-satellite service (FSS) on a primary basis;

b) that this band is also allocated to the space research service on a secondary basis and may also be employed by the Earth exploration-satellite and space research services on a secondary basis for radiolocation stations installed on spacecraft;

c) that No. S5.502 of the Radio Regulations (RR) places restrictions on the fixed-satellite, radiolocation and radionavigation services in order to allow these services to share this band;

d) that RR No. S5.503 provides for geostationary space stations in the space research service, for which information for advance publication has been received by the ex-IFRB prior to 31 January 1992, to operate on an equal basis with stations in the FSS;

e) that non-geostationary-satellite orbit (GSO) space stations in the space research and Earth exploration-satellite services are to be protected until 1 January 2000 in accordance with RR No. S5.503;

f) that until 1 January 2000 it is necessary for FSS users, in order to be compatible with the space science services, to take certain steps to provide protection to them;

g) that the permissible levels of interference for the current space services are specified in Annex 2 of Recommendation ITU-R SA.1071. These should be applied until 1 January 2000 when considering specific sharing situations;

h) that Recommendation ITU-R SA.1071 states that there is a need to extend, beyond 1 January 2000, protection to the links from a data relay satellite in the band 13.772-13.778 GHz in support of space research and Earth exploration-satellite missions;

j) that, whilst non-GSO science service space stations intended for use beyond 1 January 2000 should be designed for operation outside of the band 13.75-14 GHz, unforeseen circumstances may create the need for individual stations to operate within this band after that date, on a secondary basis and without the regulatory protection from FSS emissions afforded before that date;

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* Radiocommunication Study Group 4 made editorial amendments to this Recommendation in 2001 in accordance with Resolution ITU-R 44 (RA-2000).

k) that maximum pfd levels likely to be produced at the GSO by space stations in the space science services are those given in Annex 1;

l) that it would be desirable for future data relay satellite networks operating in the space science services to be designed to operate at frequencies outside the 13.75-14 GHz band;

m) that the interference environment for space science services continuing to operate in the band after the protection period is likely to be fairly severe,

recommends

1 that to protect spaceborne altimeters from unacceptable interference until 1 January 2000, the following consultative steps should be taken:

1.1 upon publication of the RR Appendix S4 information of an FSS network intending to use the 13.75-14 GHz band, the administration with a spaceborne altimeter in the band should inform the notifying administration of the geographic constraints, if any, which may affect the location of earth stations in the FSS network;

1.2 the FSS network operator should review the information above and advise the operator of the spaceborne system about the location(s) of proposed earth stations in the network, that would not meet the geographic constraints;

1.3 the consultation should then focus on these earth stations in order to ensure the protection required by the spaceborne altimeter;

2 that to protect spaceborne scatterometers using fan beams from unacceptable interference until 1 January 2000, FSS earth stations should not exceed an e.i.r.p. density toward the scatterometer orbit over the oceans of 25 dBW in any 2 kHz band between 13.99356 GHz and 13.99644 GHz. To meet this condition it may be advisable to avoid operation between these frequencies. Exceptionally, on a case-by-case basis the avoidance of unacceptable interference may be accomplished through consultation;

3 that to protect spaceborne precipitation radars from unacceptable interference:

3.1 until 1 January 2001:

3.1.1 the e.i.r.p. density of any FSS earth station at a latitude between ±55° should not exceed 61 dBW in any 600 kHz band between 13.793 GHz and 13.805 GHz;

3.1.2 the elevation angle of any FSS earth station using the band 13.75-14 GHz should not exceed 71°;

3.2 until 1 January 2000, implementation of individual FSS earth stations planned to use the band 13.75-13.86 GHz at latitudes between ±40° will require consultation on a case-by-case basis, in order to ensure that the appropriate protection is given (see Note 1);

3.3 the consultation process in § 3.2 should be extended until 1 January 2001, with a view to ensuring that whenever practicable the appropriate protection is given (see Note 1);

NOTE 1 – The consultation process in § 1 is also applicable to the consultations carried out under § 3.2 and § 3.3 to protect spaceborne precipitation radars from unacceptable interference. An administration planning an FSS network should provide detailed information regarding the emissions in the band 13.793-13.805 GHz with its RR Appendix S4 submission.

4 that to protect the links from data relay satellites (DRS) to low-Earth orbiting satellites operating in the space science service until such time, that all data relay satellites in the GSO, for which information concerning advance publication was received by the ex-IFRB prior to 31 January 1992, cease to operate within the band 13.772-13.778 GHz, the e.i.r.p. density of transmissions from any fixed-satellite earth station within this band should not exceed 71 dBW per 6 MHz;

5 that administrations who continue to operate data relay satellite networks in the space science services after 1 January 2000 are urged to vacate those systems from the band 13.75-14 GHz as soon as practicable;

6 that after the periods indicated in the foregoing *recommends*:

6.1 the FSS will no longer be obligated to protect non-geostationary space stations in the space research and Earth exploration-satellite services in accordance with the criteria indicated in § g) above;

6.2 the guidelines in Annex 2 could be used by the operators of any space science service stations which remain in operation in the band 13.75-14 GHz.

ANNEX 1

Maximum pfd levels produced at the geostationary orbit by space stations in the space science services

Type of space station transmitter	Maximum antenna input power density	Case of near-antipodal satellite positions				Case of minimum separation distance			
		Spacecraft antenna gain (dBi)	pfd at the geostationary orbit (dB(W/m²)) in the reference bandwidth			Spacecraft antenna gain (dBi)	pfd at the geostationary orbit (dB(W/m²)) in reference bandwidth		
			Total	1 MHz	4 kHz		Total	1 MHz	4 kHz
Altimeter	13 dBW per 320 MHz	0	–147.2	–172.2	–196.2	0	–144.7	–169.8	–193.7
Spot beam scatterometer	19 dBW per 180 Hz	10	–135.0	–135.0	–135.0	0	–142.9	–142.9	–142.9
Fan beam scatterometer	19 dBW per 180 Hz	28	–117.0	–117.0	–117.0	–14	–156.9	–156.9	–156.9
Precipitation radar	28 dBW per 800 kHz	0	–135.8	–135.8	–158.8	0	–134.0	–134.0	–157.0
DRS to user spacecraft	–5 dBW (Note 4)	53	–121.4	–121.6	–140.2	0	–133.3	–133.5	–152.1

NOTE 1 – The altimeter is assumed to be at 1 336 km altitude and have a uniform spectral power density over the emission bandwidth.

NOTE 2 – The scatterometers are assumed to be at 800 km altitude and the peak envelope power is used.

NOTE 3 – The precipitation radar is assumed to be at 350 km altitude and the peak envelope power is used.

NOTE 4 – The DRS spacecraft is assumed to be located 1° from the FSS satellite in the minimum separation distance case. Reductions in the DRS antenna input power due to the effects of power control are not taken into account. The pfd levels specified for DRS are based on integration of power density in a $\sin^2 x/x^2$ power spectral distribution over the reference bandwidth. A DRS data rate of 300 kbit/s is assumed in the above Table with no spreading by a PN code, which yields the worst case pfd levels when considering all possible data rates.

ANNEX 2

Guidelines for the operation of satellites in the space science services after the periods of protection from interference by FSS earth stations using the band 13.75-14 GHz

1 Protection of FSS satellites in the GSO (see Note 1)

An emission from a non-GSO space station in the space science services would be likely to cause unacceptable interference to satellites of the fixed-satellite service if its pfd incident on the GSO should exceed –130 dB(W/m^2) per 40 MHz anywhere in the frequency range 13.75-14 GHz.

The above values could probably be increased by up to 7 dB for short periods aggregating to no more than 0.02% of any month.

An emission from a GSO space station in the space science services would be likely to cause unacceptable interference to satellites of the fixed-satellite service if its pfd incident on the GSO should exceed –127 dB(W/m^2) per 40 MHz anywhere in the frequency range 13.75-14 GHz, within an angle of ±10°, subtended at the GSO and in the plane of the GSO, with respect to a line between the GSO and the Earth's centre. For angles of incidence outside that range, interference pfds up to –97 dB(W/m^2) per 20 MHz anywhere in the frequency range 13.75-14 GHz could probably be tolerated.

NOTE 1 – Planners for future space science services are cautioned, however, that values contained in Annex 2 may not be appropriate in future years.

2 Interference environment for the space science services

It is expected that the 13.75-14 GHz band will be used to carry mainly digitally modulated traffic, although use of analogue television carriers by systems implemented before the year 2000 can be expected. Although television distribution to network affiliates, cable television headends, TV transmitters, and to subscriber homes is expected to use digital MPEG-like compression algorithms and digital transmission by the year 2000, there will also be a need for analogue FM-TV transmissions for inter-studio programme exchange.

In this band, there are no limitations on the type of traffic that can be carried as long as the provisions of RR Nos. S5.502, S21.8 and S21.16 are met.

In addition to analogue video carriers, this band could support a variety of digitally compressed video (DCV) carriers, such as:

– high bit rate carriers operating at transponder saturation for point-to-multipoint applications;

– multiple digital carriers per transponder carrying multiplexed video programmes for distribution, and

– lower rate carriers using FDMA satellite access for collection purposes.

Other carrier types are digital traffic which could form part of a larger digital telecommunications network.

Thus, from the point of view of interference to the space science services, a pattern of use of the 13.75-14 GHz band by FSS carriers, not dissimilar to the current utilization of the 14-14.5 GHz band, may be anticipated, except that the constraints of RR No. S5.502 on earth station e.i.r.p. and antenna size may result in a smaller proportion of low-capacity carriers. The fact that this band is seen by the operators of large satellite networks as a solution to the problems created by the previous imbalance in 14/11-12 GHz up- and down-path allocations, suggests that early in the decade 2000 to 2010 the number of FSS earth stations transmitting in the band will average two or three per country. The e.i.r.p. per carrier will vary between 68 and 85 dBW and the bandwidth per carrier is likely to vary between 1 MHz and 36 MHz. The angular velocities of the LEO satellites in the space science services are such that bursts of severe interference lasting for periods of a few seconds to a few minutes can thus be expected several times per day, but aggregating to typically less than 1% of the time.