

RECOMMENDATION ITU-R SA.1277-0*, **

**SHARING IN THE 8 025-8 400 MHz FREQUENCY BAND BETWEEN THE
EARTH EXPLORATION-SATELLITE SERVICE AND THE FIXED,
FIXED-SATELLITE, METEOROLOGICAL-SATELLITE AND
MOBILE SERVICES IN REGIONS 1, 2 AND 3**

(Question ITU-R 214/7)

(1997)

The ITU Radiocommunication Assembly,

considering

- a) that fixed services (FS), fixed-satellite services (FSS) and mobile services are allocated on a primary basis in the 8 025-8 400 MHz frequency band in the three Regions;
- b) that the meteorological-satellite (METSAT) service is allocated on a primary basis in the 8 175-8 215 MHz frequency band in the three Regions;
- c) that the Earth exploration-satellite service (EESS) is allocated on a primary basis in Region 2, and on a secondary basis in Regions 1 and 3 in the 8 025-8 400 MHz frequency band;
- d) that no interference can be caused by the EESS to the FS and the mobile service when the power flux-density (pfd) limits imposed by the Radio Regulations (RR) No. S21.16 are respected (see § 1 of Annex 1);
- e) that no interference can be caused by the EESS to the FSS and the METSAT when the pfd limits at the geostationary orbit, imposed by the RR No. S22.5, are respected (see § 2 of Annex 1);
- f) that the study in § 2 of Annex 2 shows that there exists extensive possibilities for siting of EESS earth stations among a network of fixed stations;
- g) that *considering* f) may be extended also for siting EESS earth stations with respect to fixed-satellite and meteorological earth stations (see § 3 of Annex 2);
- h) that the study in § 4 of Annex 2 shows that, as in *considering* f), there exists extensive possibilities for siting of EESS earth stations among mobile stations;
- j) that from the experience gained over the last 20 years, it is demonstrated that no frequency sharing problems can be encountered between the EESS and the FS, the FSS, the METSAT and mobile services in the three Regions;
- k) that the effective planning and development of future EESS networks with global coverage require a primary allocation status in the three Regions,

recommends

- 1** that sharing between the EESS and the FS, the FSS, the METSAT and the mobile services in the 8 025-8 400 MHz band is feasible subject to the following conditions:
- RR No. S22.5 and RR No. S21.16 provisions apply;
 - the method described in Annex 2 be used to calculate separation distances between earth stations of the EESS and terrestrial stations or earth stations of the other services. (Separation distance refers to the distance that could be achieved in coordination).

* This Recommendation should be brought to the attention of Radiocommunication Study Groups 4, 8 and 9.

** Radiocommunication Study Group 7 made editorial amendments to this Recommendation in the year 2017 in accordance with Resolution ITU-R 1.

ANNEX 1

Analysis of interference from the EESS to other services in the frequency band 8 025-8 400 MHz

1 Interference potentiality from space stations of the EESS to terrestrial stations of the FS and the mobile service

The RR No. S21.16 imposes pfd limits at the ground level relative to the space stations' emissions. These limits are given in Table 1 for the 8 025-8 400 MHz frequency band in 4 kHz bandwidth.

TABLE 1
pfd limits in the 8 025-8 400 MHz frequency band

Arrival angle, θ	pfd limit (dB(W/(m ² .4 kHz)))
$0^\circ \leq \theta \leq 5^\circ$	-150
$5^\circ < \theta \leq 25^\circ$	$-150 + (\theta - 5) / 2$
$25^\circ < \theta \leq 90^\circ$	-140

In so far as the transmitters of the Earth exploration-satellite stations respect these constraints, the FS and mobile service receivers are protected because these limits have been set so as to avoid the interferences from space stations transmitters to terrestrial services.

2 Interference from space stations of the EESS to space stations of the FSS and the METSAT service

The relative position of the near-polar circular orbit of an EESS satellite and the GSO is shown in Fig. 1.

The EESS satellite directs its maximum e.i.r.p. to the horizon of its coverage. The worst case occurs when this satellite, the horizon of its coverage and a geostationary satellite (FS or meteorological service) are in alignment as shown in Fig. 2.

According to RR No. S22.5 the pfd at the GSO shall not exceed -174 dB(W/m²) in any 4 kHz bandwidth. With typical EESS satellite characteristics, as given in Table 2, the actual pfd produced at GSO in the worst case is -183 dB(W/m²) in 4 kHz.

The effect of such pfd on the FSS and on the METSAT service is illustrated here below.

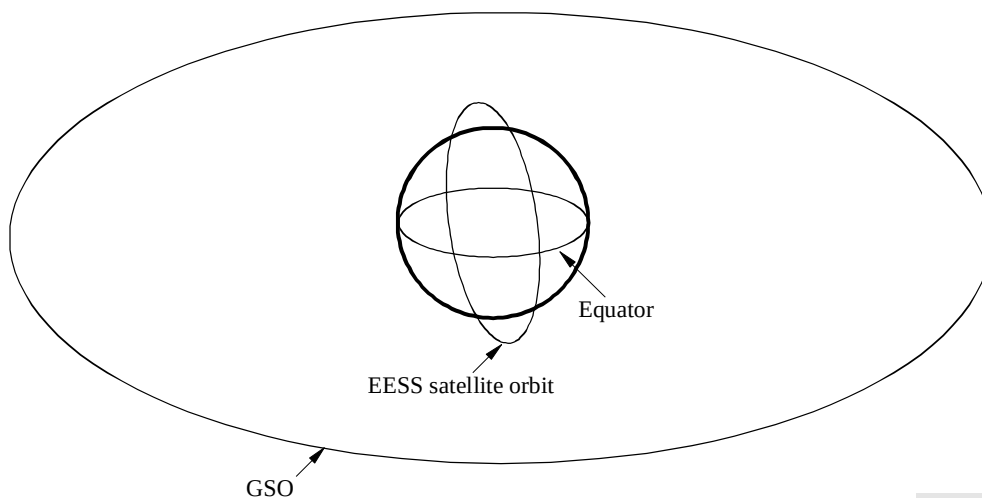
To estimate the worst-case interference from the EESS satellite to the geostationary-satellite receiver we can express the ratio between the received powers at the input of this receiver, from the earth stations transmitting to the geostationary satellite and the EESS satellite respectively:

$$C/I = (P_{tw} + G_{tw}) - (P_{tu} + G_{tu}) + \Delta L_p + 10 \log (B_u/B_w)$$

where:

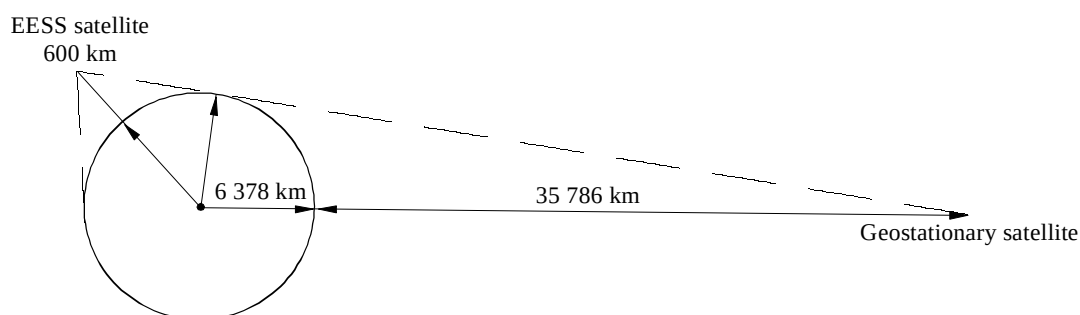
- P_{tw} : transmitter power of the earth station (dBW)
- G_{tw} : antenna gain of the earth station (dBi)
- P_{tu} : transmitter power of the EESS satellite (dBW)
- G_{tu} : antenna gain of the EESS satellite to the horizon of its coverage (dBi)
- ΔL_p : differential path loss between the desired and undesired signals (dB)
- B_u : emission bandwidth of the unwanted signal (Hz)
- B_w : emission bandwidth of the desired signal (Hz).

FIGURE 1
Relative positions of the GSO and the near-polar orbit
of an EESS satellite (100° retrograde)



1277-01

FIGURE 2
Representation of the worst case of interference from an EESS satellite
to a FS or a METSAT service



1277-02

In this formula it is assumed that the emission bandwidth of the unwanted signal is greater than or equal to the emission bandwidth of the desired signal and that the spectrum of the unwanted signal completely recovers the desired signal one. Then we can replace the previous formula by the formula below:

$$C/I = p_{tw} + G_{tw} - (p_{tu} + G_{tu}) + \Delta L_p$$

where:

p_{tw} : average transmitter power density of the desired signal (dB/Hz)

p_{tu} : average transmitter power density of the undesired signal in the band of the desired signal (dB/Hz).

We can evaluate the term ΔL_p for a worst case with an EESS satellite orbit altitude of 600 km and an earth station located at the nadir of the geostationary satellite:

$$\Delta L_p = 20 \log \left[\frac{\sqrt{(35\,786 + 6\,378)^2 - 6\,378^2} + \sqrt{(6\,378 + 600)^2 - 6\,378^2}}{35\,786} \right]$$

namely:

$$\Delta L_p = 1.9 \text{ dB}$$

Table 2 gives the technical characteristics of the EESS satellites SPOT 1/2/3/4. The spectral power density is the maximal density (i.e. at the centre of the QPSK signal) that represents the worst case of the interference.

TABLE 2

Main characteristics of the EESS satellites SPOT 1/2/3/4

Modulation	Bit rate (Mbit/s)	Power (dBW)	Maximal spectral power density (dB(W/Hz))	Maximal gain (dB)
QPSK	50	12.5	-61.5	6.2

Table 3 gives the technical characteristics of the earth stations transmitting to a governmental telecommunication satellite in the 8 025-8 400 MHz frequency band, as well the *C/I* ratios obtained for the telecommunication satellite with the characteristics of the EESS satellite given in Table 2.

TABLE 3

Main technical characteristics of earth stations transmitting to a governmental telecommunication satellite in the 8 025-8 400 MHz frequency band and *C/I* ratios obtained for the telecommunication satellite with the characteristics of the EESS satellite given in Table 2

Earth station category	Antenna diameter (m)	Maximum antenna gain (dBi)	Maximum power density (dB(W/Hz)) ⁽¹⁾	Bandwidth (MHz)	<i>C/I</i> (dB)
G	18	61	-43.5	60	74.7
H	8	54	-34	60	77.2
I	3	44.5	-44	40	57.7
J	1.5	39.5	-44	40	52.7
K	1.3	38.5	-38	40	57.7
L	0.9	35	-38.8	80	53.2
L'	0.9	34.5	-38.8	80	52.9

⁽¹⁾ In the worst case 4 kHz band.

Table 4 gives the main technical characteristics of the METSAT earth stations and the *C/I* ratios obtained for the meteorological satellite with the characteristics of the EESS satellite given in Table 2.

TABLE 4

Characteristics of a METSAT earth station and *C/I* ratios obtained for the meteorological satellite with the characteristics of the EESS satellite given in Table 2

Antenna gain (dBi)	Maximum transmitter power (dB)	e.i.r.p. (dBW)	Bandwidth (MHz)	power density (dB(W/Hz))	<i>C/I</i> (dB)
44	30	74	0.960	-29.6	71.6
44	20	64	0.018	-22.6	78.6
44	13	57	0.0024	-20.8	80.4
44	17	61	0.0004	-9.0	92.2

We conclude that there would not be interference from the EESS space stations with characteristics similar to those ones given in Table 2 to the fixed-satellite or METSAT receivers.

ANNEX 2

Analysis of interference to the EESS from other services in the frequency band 8 025-8 400 MHz

Method for calculating separation distances between earth stations of the EESS and terrestrial stations or earth stations of the other services

1 Introduction

This Annex concerns the *a priori* evaluation of the order of magnitude for acceptable separation distances between an EESS earth station on one hand and a fixed, fixed-satellite, METSAT or mobile station on the other hand, as a function of given parameters. It is precised that the following calculation does not replace the method given in Appendix S7 of the RR and it is not intended to use it for evaluation of coordination distances. The calculation of the attenuation over the interference path is not based on the worst case but on an average case, which only refers to diffraction caused by an obstacle located between the two stations. The separation distances calculated here gives a realistic idea of practical sharing possibilities between EESS and FS, FSS, METSAT or mobile services.

2 Interference from terrestrial fixed service transmitters to EESS earth station receivers

The sharing criterion for this interference path is a coordination distance required to ensure adequate separation between the terrestrial service transmitters and the EESS earth station receivers.

The minimum permissible basic transmission loss to protect the earth station can be stated as:

$$L_b(p\%) = P_t + G_t(\theta_t) - (P_i - G_r(\theta_r))$$

where:

P_t : terrestrial service transmitter power (dBW)

$G_t(\theta_t)$: terrestrial service antenna gain in the direction of the earth station (dBi)

$G_r(\theta_r)$: gain of the earth station antenna in the direction of the terrestrial station (dBi)

P_i : maximum permissible interference at the earth station receiver input (dBW)

θ_t : angle between the terrestrial service antenna axis and the interference path (degrees)

θ_r : angle between the EESS antenna axis and the interference path (degrees)

$L_b(p\%)$: the value of minimum acceptable basic transmission loss to be exceeded for all but $p\%$ of the time along the interference path between the terrestrial transmitter and the earth station receiver (dB).

The values of P_i and p are defined by Recommendation ITU-R SA.1027 and given in Table 5 for the 8 025-8 400 MHz frequency band.