

RECOMMENDATION ITU-R SA.1016

SHARING CONSIDERATIONS RELATING TO DEEP-SPACE RESEARCH

(Question ITU-R 210/7)

(1994)

The ITU Radiocommunication Assembly,

considering

a) that the feasibility of frequency sharing between deep-space research stations and stations of other services is presented in Annex 1,

recommends

1. that, with coordination, deep-space research can share frequency bands in the Earth-to-space direction with stations in other services except:

- receiving aeronautical mobile stations, receiving satellite stations, and microwave sensor satellites, when any of these may come within line-of-sight;
- receiving mobile stations that come within the separation distance required for interference protection;
- transmitting terrestrial stations having an average e.i.r.p. exceeding 81 dBW in the bands near 2 GHz and 84 dBW in the bands near 7 GHz;

2. that, with coordination, deep-space research can share frequency bands in the space-to-Earth direction with stations in other services except:

- the radioastronomy service;
- transmitting aeronautical mobile stations, transmitting satellite stations, and active microwave sensor satellites, when any of these may come within line-of-sight;
- transmitting mobile stations that come within the separation distance required for interference protection.

ANNEX 1

Sharing considerations relating to deep-space research

1. Sharing considerations: deep-space Earth-to-space bands

Table 1 and the following paragraphs consider the possibility of interference in the deep-space research Earth-to-space bands.

TABLE 1

Potential interference in Earth-to-space bands

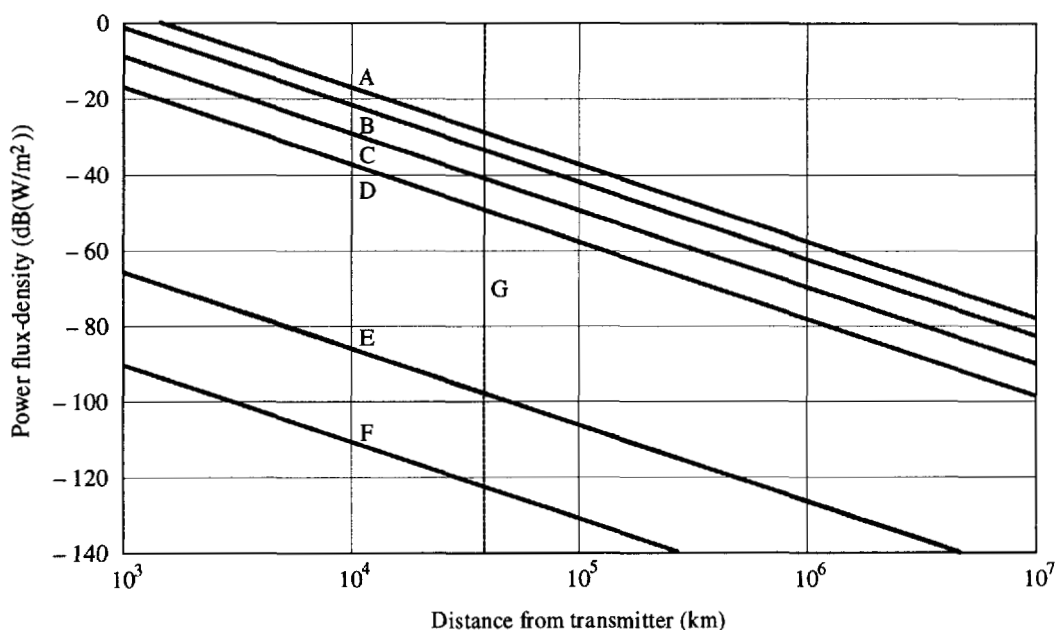
Source	Receiver
Deep-space earth station	Terrestrial or earth station
Deep-space earth station	Earth orbiting satellite
Terrestrial or earth station	Deep-space station
Near-earth station	Deep-space station

1.1 Potential interference to terrestrial or earth station receivers from deep-space earth station transmitters

The normal maximum total power for current deep-space earth stations is 50 dBW. For a minimum elevation angle of 10° , the e.i.r.p. directed towards the horizon does not exceed 57 dB(W/4 kHz), assuming the reference earth station antenna radiation pattern of Recommendation ITU-R SA.509. For spacecraft emergencies, the maximum total power may be increased to 56 dBW, giving not more than 63 dB(W/4 kHz) at the horizon. These values of e.i.r.p. meet the requirements of No. 2540 of the Radio Regulations (RR).

Aircraft stations within line-of-sight of a deep-space earth station may encounter total power flux-densities as shown in Fig. 1. For an aircraft altitude of 12 km, the maximum line-of-sight distance to an earth station is 391 km and the total power flux-density at the aircraft can never be lower than -83 dB(W/m²), again assuming the antenna pattern of Recommendation ITU-R SA.509. Depending on distance and earth station antenna direction, the aircraft station may experience much higher flux densities and interference levels. Coordination with airborne stations is generally not practicable.

FIGURE 1
Power flux-density vs. distance from earth station



Transmitter: Deep-space earth station 100 kW, 70 m diameter antenna

- A: main beam, 34.5 GHz
- B: main beam, 17 GHz
- C: main beam, 7 170 MHz
- D: main beam, 2 115 MHz
- E: 5° off main beam axis (14.5 dBi gain, Recommendation ITU-R SA.509)
- F: $> 48^\circ$ off main beam axis (-10 dBi gain, Recommendation ITU-R SA.509)
- G: geostationary orbit altitude: 35 800 km

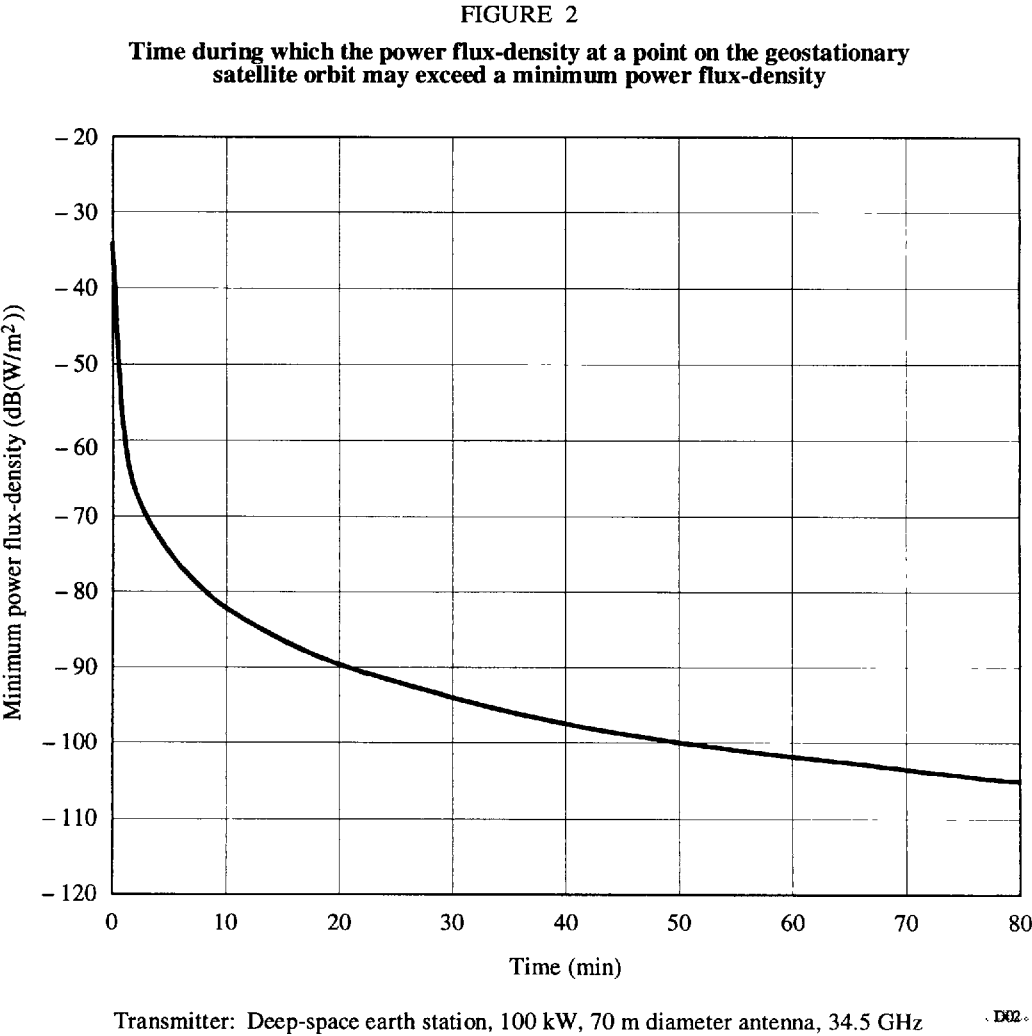
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Super refraction, ducting, and precipitation scatter may couple emissions from deep-space earth station transmitters into terrestrial receivers, and receivers of other earth stations. Except for airborne terrestrial receivers, coordination for these conditions is generally practicable. See § 2.3 for discussion of interference from airborne transmitters, and § 3 for coordination considerations.

1.2 Potential interference to satellite receivers from deep-space earth station transmitters

Satellites that come within the deep-space earth station beam will encounter power flux-densities as shown in Fig. 1. When the earth station is tracking a spacecraft whose direction is such that the antenna beam passes through the geostationary satellite orbit (GSO), the power flux-density at that point on the orbit will vary with time as shown in Fig. 2. For example, the total power flux-density will be $-95 \text{ dB(W/m}^2\text{)}$ or more for 32 min. The figure assumes a transmitter power of 50 dBW, a 70 m antenna, and the reference earth station antenna pattern of Recommendation ITU-R SA.509. An important observation is that the minimum power flux-density at the GSO within line-of-sight of a deep-space earth station is at least $-122 \text{ dB(W/m}^2\text{)}$, regardless of antenna pointing direction.

The duration and magnitude of signals from deep-space earth station transmitters which may interfere with satellites in non-geostationary orbits depends upon those orbits and the direction in which the earth station antenna is pointing.



1.3 Potential interference to deep-space station receivers from terrestrial or earth station transmitters

Terrestrial or earth station transmitters within sight of a deep-space station are potential sources of interference. Figure 3 shows the space station distance at which the interference power density from such a transmitter equals the receiver noise power density. For example, a trans-horizon station with 93 dB(W/10 kHz) e.i.r.p. in the 2.1 GHz band could interfere with a space station receiver at ranges up to $4.1 \times 10^9 \text{ km}$ (600 K noise temperature, 3.7 m