

RECOMMENDATION ITU-R SA.609-2*

**Protection criteria for radiocommunication links for manned
and unmanned near-Earth** research satellites*****

(1986-1992-2006)

Scope

This Recommendation specifies the protection criteria needed to successfully control, command and operate manned and unmanned near-Earth research satellites.

The ITU Radiocommunication Assembly,

considering

- a) that limiting interference criteria for radiocommunication links for near-Earth space research are determined by the technical considerations examined in Annex 1;
- b) that, based on past experience, it is expected that up to 100 or more active near-Earth space research spacecraft may be in orbit simultaneously;
- c) that there is an increasing use of near-Earth space by both manned and unmanned space research missions;
- d) that two-way radiocommunication is required for many near-Earth missions, and is vital for manned missions;
- e) that typical operating noise temperatures of earth stations can be as low as 70 K (equivalent to -210 dB(W/Hz)) in the 1-30 GHz frequency range;
- f) that typical operating noise temperatures of space stations are near 600 K (equivalent to -171 dB(W/kHz)) in the frequency range below about 30 GHz;
- g) that link margins for typical space-to-Earth or space-to-space links are small, typically between 3 and 6 dB;
- h) that a 1 dB increase in overall system noise due to interference is considered harmful;
- j) that a noise to interference ratio of about 6 dB results in a 1 dB increase in overall system operating temperatures;
- k) that technical limitations may restrict increases in spacecraft power as a means of minimizing interference;
- l) that difficulties can be expected when frequencies are shared between near-Earth spacecraft in the space research service and stations in other services,

* This Recommendation should be brought to the attention of Radiocommunication Study Groups 1, 4, 6, 8, and 9.

** Near-Earth is the volume of space around the Earth out to a distance of 2×10^6 km.

*** Protection criteria for space research (deep space) can be found in Recommendation ITU-R SA.1157.

recommends

1 that protection criteria for earth stations in the space research service (see Annex 1) should be established as follows:

1.1 -216 dB(W/Hz) at the input terminals of the receiver, for bands in the 1-20 GHz frequency range and -156 dB(W/MHz) for bands in the 20-30 GHz frequency range. For frequencies below 1 GHz, the permissible interference may be increased at the rate of 20 dB per decreasing frequency decade;

1.2 calculation of interference that may result from atmospheric and precipitation effects should be based on weather statistics for 0.001% of the time for manned missions and for 0.1% of the time for unmanned missions¹;

2 that protection criterion for space near-Earth (see Annex 1) research space stations should be established as follows: -177 dB(W/kHz) at the input terminals of the receiver, for 0.1% of the time for both manned and unmanned spacecraft, for bands in the 100 MHz-30 GHz frequency range;

3 that frequency sharing should be accomplished to the maximum extent feasible among near-Earth spacecraft in the space research service;

4 that note should be taken of the potential difficulties to be expected in frequency sharing between near-Earth spacecraft in the space research service and certain types of stations in other services;

5 that note should be taken of the difficulties to be expected in frequency sharing between near-Earth and deep-space stations in the space research service.

Annex 1

Protection criteria relating to near-Earth space research systems

1 Introduction

Much of the spectrum suitable for space research is also allocated to one or more other services and consequently frequency sharing between the services is required. This Annex discusses factors which affect the susceptibility of systems in the space research service to interference, and specifies appropriate protection criteria for the service in the frequency bands up to about 30 GHz. The protection criteria are for use in interference analyses when actual system data are unavailable.

2 General considerations

Space research radiocommunications are required for four types of functions: telecommand, maintenance telemetering, stored scientific data and real-time scientific data.

¹ In case of pulsed transmissions, the duty cycle of the transmitter should not be considered in calculating the percentage of time the interference level is exceeded.