

RECOMMENDATION ITU-R SA.1025-3*

**PERFORMANCE CRITERIA FOR SPACE-TO-EARTH DATA TRANSMISSION
SYSTEMS OPERATING IN THE EARTH EXPLORATION-SATELLITE
AND METEOROLOGICAL-SATELLITE SERVICES
USING SATELLITES IN LOW-EARTH ORBIT**

(Questions ITU-R 139/7 and ITU-R 141/7)

(1994-1995-1997-1999)

The ITU Radiocommunication Assembly,

considering

- a) that the hypothetical reference system specified in Recommendation ITU-R SA.1020 defines space-to-Earth links for direct readout of data and acquisition of recorded data;
- b) that the performance objectives for these transmissions must be consistent with the attendant functional requirements and with the performance limitations associated with the systems and frequency bands in which the requirements will be fulfilled;
- c) that performance objectives for representative systems operating in the Earth exploration-satellite and meteorological-satellite services are intended to provide guidelines for the development of actual systems;
- d) that performance objectives may be determined using the methodology of Recommendation ITU-R SA.1021;
- e) that performance objectives for Earth exploration-satellite and meteorological-satellite services are a prerequisite for the establishment of the associated interference criteria,

recommends

- 1** that space-to-Earth data transmissions in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit have the performance objectives specified for the frequency bands in Table 1.

* This Recommendation should be brought to the attention of the World Meteorological Organization (WMO).

TABLE 1
Performance objectives for space-Earth links in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit

Frequency band	Satellite service	Modulation	Applicable elevation angles (degrees)	Minimum C/N or maximum BER	Percentage of time (%)	Function and type of earth station
137-138 MHz	Meteorological	Analogue	≥ 25	12 dB $C/N^{(1)}$	99.9	Direct data readout, low gain antenna
	Meteorological	Digital	≥ 5	10^{-6} BER	99.9	Direct data readout, tracking antenna
400.15-401.00 MHz	Meteorological	Digital	≥ 5	10^{-6} BER	99.9	Direct data readout, low gain antenna
1 670 ⁽²⁾ -1 710 MHz	Meteorological and Earth exploration	Digital	≥ 5	10^{-3} BER	99.99	Direct data readout and recorded data acquisition, tracking antenna
		Digital	≥ 5	10^{-6} BER	99.9	
7 750-7 850 MHz	Meteorological	Digital	≥ 5	10^{-3} BER	99.99	Recorded data acquisition, tracking antenna
	Meteorological	Digital	≥ 5	10^{-6} BER	99.9	
8 025-8 400 MHz	Earth exploration	Digital	≥ 5	10^{-3} BER	99.99	Direct data readout and recorded data acquisition, tracking antenna
		Digital	≥ 5	10^{-6} BER	99.9	Recorded data acquisition, tracking antenna
		Digital	≥ 5	10^{-5} BER	99.0	Direct data readout, tracking antenna
25.5-27.0 GHz	Earth exploration	Digital	≥ 5	10^{-5} BER	99.9	Recorded data acquisition and direct data readout

⁽¹⁾ A 10 dB C/N is more appropriate for receivers constructed after the mid-1970s.

⁽²⁾ The Earth exploration-satellite service is only allocated in the 1 690-1 710 MHz portion of the band.

NOTE 1 – Performance objectives for specific systems may differ from the objectives presented in this Recommendation; however, the objectives defined herein are used as a basis for deriving permissible levels of interference that are the minimum of interference thresholds to be accepted by specific systems.

NOTE 2 – The performance objectives associated with an availability of 99.99% of the time relate to the need to synchronize the receiver to the data transmission frames and to avoid bit slips within a frame. For the purposes of deriving interference criteria, these objectives can be assumed to be met if the objectives associated with lower availability levels are met.

NOTE 3 – For the band 137-138 MHz, the elevation angle of 25° and other parameters for analogue receivers correspond with a level of performance that is guaranteed by designers of some systems. The parameters for the digital receivers correspond with user requirements.

NOTE 4 – In all cases in Table 1, it is assumed that earth station sites are selected to yield average levels of environmental radio-frequency noise within the band. For direct data readout stations, which may be deployed in large numbers by various operating entities, there is a risk that randomly selected sites will exhibit higher than average levels of environmental noise (especially man-made noise) that may hamper the ability to achieve the stated performance objectives. However, the variance of this noise over all locations is not large in relation to receiver thermal noise, even at frequencies as low as 137-138 MHz, such that the performance objectives can generally be met at over 95% of the possible locations given link power margins of a few decibels. In the case of recorded data acquisition stations, sites are carefully selected to avoid ambient noise levels that exceed the average level.