

RECOMMENDATION ITU-R SA.1163-1

**INTERFERENCE CRITERIA FOR SERVICE LINKS IN DATA
COLLECTION SYSTEMS IN THE EARTH EXPLORATION-
AND METEOROLOGICAL-SATELLITE SERVICES**

(Question ITU-R 142/7)

(1995-1997)

The ITU Radiocommunication Assembly,

considering

- a) that the hypothetical reference system specified in Recommendation ITU-R SA.1020 defines links for data collection, and data collection platform interrogation;
- b) that interference criteria are needed to ensure that systems can be designed to achieve adequate performance in the presence of interference;
- c) that the interference criteria may be determined using the methodology described in Recommendation ITU-R SA.1022 and the performance objectives listed in Recommendation ITU-R SA.1162;
- d) that interference criteria assists in the development of criteria for sharing bands among systems, including those operating in other services;
- e) that systems in the Earth exploration-satellite (including meteorological-satellite) service must accept an interference threshold at least as high as the threshold of permissible interference;
- f) that Annex 1 presents the parameters of representative systems that provide the basis for permissible levels of interference for pertinent transmissions in the Earth exploration-satellite service,

recommends

- 1** that the interference levels specified in Table 1 be used as the permissible total levels of interfering signal power at the antenna output of stations operating for service links in the Earth exploration- and meteorological-satellite service.

TABLE 1

**Interference criteria for service links of stations in the Earth
exploration-and meteorological-satellite service**

Frequency band (MHz)	Function and type of earth station	Station subject to interference	Interfering signal power (dBW) in the reference bandwidth to be exceeded for no more than 20% of the time	Interfering signal power (dBW) in the reference bandwidth to be exceeded for no more than $p\%$ of the time
401-403 Earth-to-space	Non-geostationary (non-GSO) data collection, low-gain antenna	Space station	-178.6 dBW per 1 600 Hz during transmission at elevation angles $\geq 5^\circ$	-174.7 dBW per 1 600 Hz during transmission at elevation angles $\geq 5^\circ$ $p = 0.1$
	GSO data collection, low-gain antenna	Space station	-174.6 dBW per 100 Hz for transmission at elevation angles $\geq 3^\circ$	-168.8 dBW per 100 Hz for transmission at elevation angles $\geq 0^\circ$ $p = 0.1$
460-470 space-to-Earth	GSO data collection platform interrogation	Earth station	-180.5 dBW per 100 Hz for reception at elevation angles $\geq 3^\circ$	-178.2 dBW per 100 Hz for reception at elevation angles $\geq 0^\circ$ $p = 0.1$

NOTE 1 – The total interfering signal power level that may be exceeded for no more than $x\%$ of the time, where x is less than 20% but greater than the specified short-term time percentage ($p\%$ of the time), may be determined by interpolation between the specified values using a logarithmic scale (base 10) for percentage of time and a linear scale for interfering signal power density (dB).

NOTE 2 – Using the guidelines in Recommendation ITU-R SA.1022, the permissible levels of interference may be scaled for application to stations with antenna gain or bandwidth values that differ from the specified values.

NOTE 3 – Although the interference criteria are based on the systems described in Annex 1, the interference criteria apply to all systems that operate in the subject frequency bands and which provide the specified service functions.

NOTE 4 – The interference criteria are specified with respect to the percentage of time of reception by the earth station. Thus, receiver performance statistics associated with reception from or by one particular satellite (i.e., cumulative distribution of bit error-rate (BER)) are the same as the statistics for reception from several similar satellites. The total time of reception includes time periods associated with signal acquisition (i.e. before and during local ascension of the satellite), receiver synchronization to the data, and synchronized reception of data. Consequently, for interrogation by satellites in low-Earth orbit, the time required for initial signal acquisition and synchronization may constitute up to several tens of seconds out of total satellite visibility periods averaging on the order of 9 min. However, the analyses of short-term performance that are presented in Annex 1 (i.e., performance exceeded for all but a small percentage of time p , $p \leq 1\%$) assume that the satellite is located at the minimum elevation angle associated with the applicable performance objective. This yields the BER performance exceeded for all but $p\%$ of the time because E_b/N_0 and BER are monotonically related to elevation angle.

NOTE 5 – The elevation angle exceeded for all but 20% of the time during reception is well approximated by the angle exceeded for all but 20% of the time that the satellite is visible above the minimum elevation angle specified in the performance objective. This approximation is made in the performance analyses presented in Annex 1 because the underlying cumulative time error cannot exceed 1% (i.e. $p\%$ of the time) and the associated total error in satellite antenna gain, free space loss, excess path loss, and earth station parameter values are negligible. The resulting elevation angle that is exceeded for all but 20% of the time of reception yields the BER performance exceeded for all but 20% of the time because E_b/N_0 and BER are monotonically related to elevation angle.

NOTE 6 – Data collection platform interrogation from non-GSO satellites will be available in the near future.

ANNEX 1

Basis for interference criteria**1 Introduction**

This Annex presents the parameters used as inputs to the methodology described in Recommendation ITU-R SA.1022 to determine the interference criteria. Tables 2 to 4 summarize these parameters.

TABLE 2

**Uplink performance analysis used as a basis for interference criteria
of space stations on board of low orbiting satellites**

Performance factor	ARGOS DCS	
	Data	Data
Link function	Data	Data
Modulation type	PSK	PSK
Frequency range (MHz)	401-403	401-403
Time (%)	0.1	20
17. Received signal power (dBW)	-167	-161
Modulated power/total power (modulation index 1.1 rad) (dB)	-1.0	-1.0
18. Data rate (bit/s)	400	400
19. Reference bandwidth (Hz)	1 600	1 600
20. Data rate (dB (bit/s))	26.0	26.0
Demodulator implementation loss (dB)	2.0	2.0
21. Received energy/bit, E_b (dB(W/Hz))	-196	-190
22. Receiver system noise temperature (K)	600	600
23. Receiver noise spectral density (dB(W/Hz))	-200.8	-200.8
24. Adjacent channel interference power (dB(W/Hz))	-	-
25. Inter-system interference (dB(W/Hz))	-	-
26. Total system $I + N$ power density (dB(W/Hz))	-200.8	-200.8
27. E_b/N_0 (dB)	4.8	10.8
28. Link BER	1×10^{-5}	1×10^{-5}
29. Satellite data storage/handling error ratio	0	0
30. Total BER	1×10^{-5}	1×10^{-5}
31. Required E_b/N_0 (dB)	9.8	9.8
32. Margin (dB)	-5.0	1.0
33. Long-term or short-term margin (dB)	1.0	-5.0
34. Permissible degradation, I/N (dB)	-5.9	-9.8
35. Interference power (dBW)	-174.7	-178.6

NOTE 1 – Values on line 17 are derived from Fig. 1.

TABLE 3

**Uplink performance analysis used as a basis for interference criteria
of space stations on board satellites GSO**

Performance factor		
Link function	Data collection platform (DCP)	Data collection platform (DCP)
Modulation type	BPSK	BPSK
Frequency range (MHz)	401-403	401-403
Time (%)	0.1	20
1. DCP transmitter output power (dBW)	7	7
2. Filter/cable line losses (dB)	3	3
3. Impedance mismatch losses (dB)	0	0
4. Antenna pointing error (dB)	0	0
5. DCP antenna gain (dBi)	11	11
6. DCP e.i.r.p. (dBW)	15	15
7. Antenna elevation angle (degrees)	3	3
8. Satellite altitude (km)	35 880	35 880
9. Free space loss (dB)	177	177
10. Excess path loss including rain attenuation (dB)	1	0
11. Satellite antenna gain (dBi)	9.9	9.9
12. Antenna pointing error (dB)	0	0
13. Receiver line loss (dB)	1.9	1.9
14. Polarization mismatch loss (dB)	0.2	0.2
15. Downlink noise contribution (dB)	3	3
16. Residual carrier loss (dB)	1.2	1.2
17. Demodulator implementation loss (dB)	2	2
18. Received signal power (dBW)	-161.4	-160.4
19. Data rate (bit/s)	100	100
20. Reference bandwidth (Hz)	100	100
21. Data rate (dB (bit/s))	20	20
22. Received energy/bit, E_b (dB(W/Hz))	-181.4	-180.4
23. Receiver system noise temperature (K)	395.4	395.4
24. Receiver noise spectral density (dB(W/Hz))	-202.6	-202.6
25. Adjacent channel interference power (dB(W/Hz))	-	-
26. Inter-system interference (dB(W/Hz))	-	-
27. Total system $I + N$ power density (dB(W/Hz))	-202.6	-202.6
28. E_b/N_0 (dB)	21.2	22.2
29. Link BER	1×10^{-4}	1×10^{-4}
30. Satellite data storage/handling error ratio	-	-
31. Total BER	1×10^{-4}	1×10^{-4}
32. Required E_b/N_0 (dB)	8.4	8.4
33. Margin (dB)	12.8	13.8
34. Long-term or short-term margin (dB)	13.8	12.8
35. Permissible degradation, I/N (dB)	13.8	8.0
36. Interference power (dBW)	-168.8	-174.6

TABLE 4

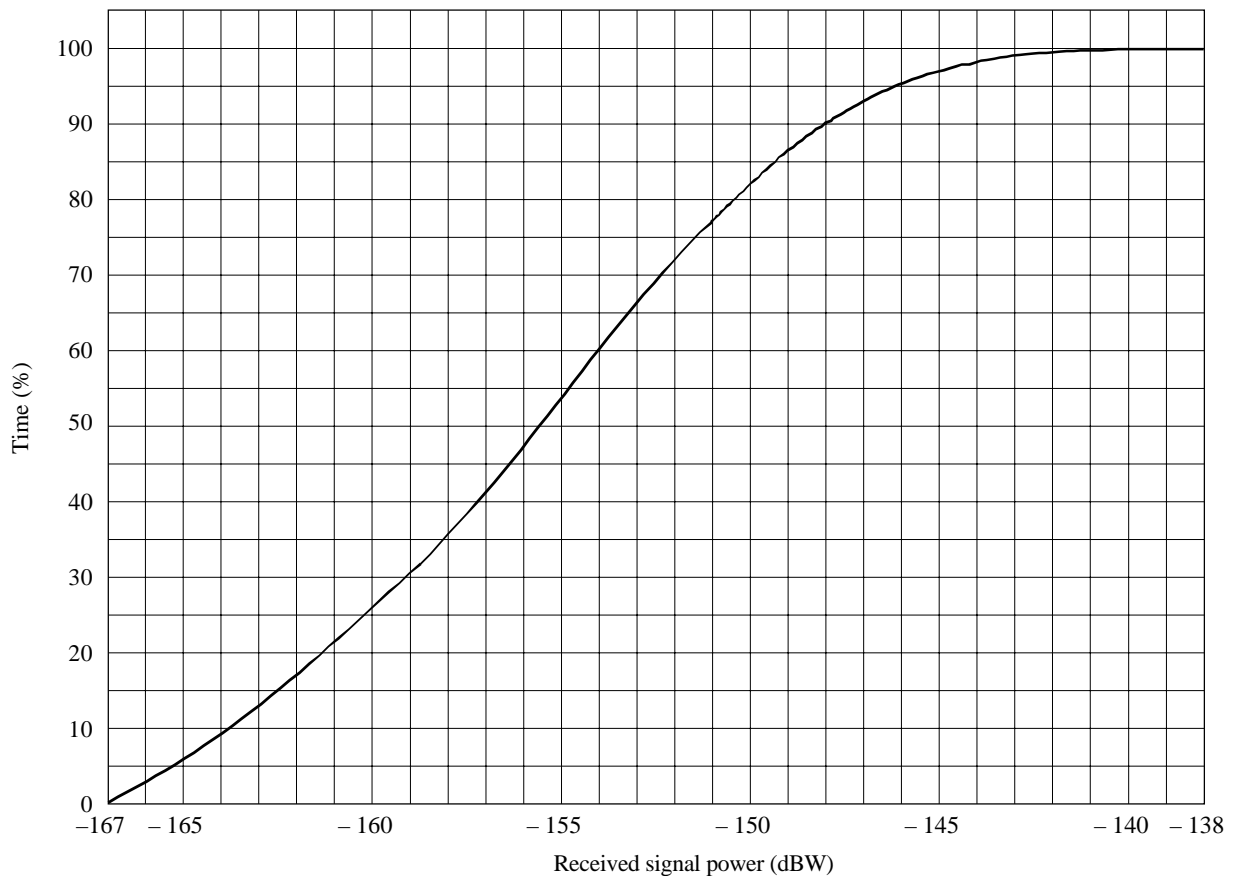
**Downlink performance analysis used as a basis for interference criteria
of earth stations operating with satellites GSO**

Performance factor		
Link function	DCP interrogation (DCPI)	DCP interrogation (DCPI)
Modulation type	BPSK	BPSK
Frequency range (MHz)	460-470	460-470
Time (%)	0.1	20
1. DCP transmitter output power (dBW)	6.2	6.2
2. Filter/cable line losses (dB)	1.5	1.5
3. Impedance mismatch losses (dB)	0	0
4. Antenna pointing error (dB)	0	0
5. DCP antenna gain (dBi)	10.3	10.3
6. DCP e.i.r.p. (dBW)	15.0	15.0
7. Antenna elevation angle (degrees)	3	3
8. Satellite altitude (km)	35 880	35 880
9. Free space loss (dB)	178.3	178.3
10. Excess path loss including rain attenuation (dB)	1	0
11. Satellite antenna gain (dBi)	3	3
12. Antenna pointing error (dB)	0	0
13. Receiver line loss (dB)	1	1
14. Polarization mismatch loss (dB)	0.5	0.5
15. Demodulator implementation loss (dB)	2	2
16. Data modulation loss (dB)	1.2	1.2
17. Received signal power (dBW)	-165.9	-164.9
18. Data rate (bit/s)	100	100
19. Reference bandwidth (Hz)	100	100
20. Data rate (dB (bit/s))	20	20
21. Received energy/bit, E_b (dB(W/Hz))	-185.9	-184.9
22. Receiver system noise temperature (K)	1 338.3	1 338.3
23. Receiver noise spectral density (dB(W/Hz))	-197.3	-197.3
24. Adjacent channel interference power (dB(W/Hz))	-	-
25. Inter-system interference (dB(W/Hz))	-	-
26. Total system $I + N$ power density (dB(W/Hz))	-197.3	-197.3
27. E_b/N_0 (dB)	11.4	12.4
28. Link BER	1×10^{-5}	1×10^{-5}
29. Satellite data storage/handling error ratio	-	-
30. Total BER	1×10^{-5}	1×10^{-5}
31. Required E_b/N_0 (dB)	9.8	9.8
32. Margin (dB)	1.6	2.6
33. Long-term or short-term margin (dB)	2.6	1.6
34. Permissible degradation, I/N (dB)	-0.9	-3.2
35. Interference power (dBW)	-178.2	-180.5

2 Meteorological-satellite service in the 401-403 MHz band

The ARGOS data collection system (DCS) uplink (see Fig. 1) transmits split-phase, Manchester-encoded, phase-shift keyed (PSK) signals through satellites in low-Earth orbit and operates at a 400 bit/s data transmission rate. The DCP typically uses a low-gain (5 dBi maximum at 20° elevation angle) antenna and can be a mobile or fixed platform.

FIGURE 1
ARGOS DCS uplink (measurements)



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3 Meteorological-satellite service in the 460-470 MHz band

In the 460-470 MHz band, the geostationary satellites transmit data collection platform interrogations (DCPI) using BPSK modulation.
