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Recommendation ITU-R SA.1027-5

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Sharing criteria for space-to-Earth data transmission systems in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit

SA Series

Space applications and meteorology

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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R SA.1027-5

Sharing criteria for space-to-Earth data transmission systems in the Earth exploration-satellite and meteorological-satellite services using satellites in low-Earth orbit

(1994-1995-1997-1999-2009-2017)

Scope

This Recommendation provides sharing criteria for space-to-Earth transmissions from satellites in low-Earth orbit applying to both the Earth exploration-satellite and meteorological-satellite services.

Keywords

EESS, METSAT, non-GSO satellites, single entry sharing criteria

Related Recommendations and Reports

Recommendations ITU-R SA.514, ITU-R SA.1020, ITU-R SA.1021, ITU-R SA.1022, ITU-R SA.1023, ITU-R SA.1026, ITU-R SA.1159.

The ITU Radiocommunication Assembly,

considering

a) that frequency bands allocated to the Earth exploration-satellite and meteorological-satellite services may be shared by several systems, including systems operating in other services;

b) that for the Earth exploration-satellite and meteorological-satellite services, Recommendation ITU-R SA.1026 specifies aggregate interference criteria for some frequency bands in the form of permissible levels of total interference to earth stations operating with satellites in low-Earth orbit;

c) that Recommendation ITU-R SA.1023 provides a methodology for deriving sharing criteria based on interference criteria, the anticipated spatial deployment of interfering stations and the associated temporal characteristics of interfering signals;

d) that the typical deployment of interfering stations may change over a period of several years as a result of growth in the number of systems and revisions to frequency band allocations that are adopted by world radio conferences;

e) that the interference environment encountered by shipborne earth stations in the meteorological-satellite service is unlikely to be worse than that encountered by earth stations operating on land;

f) that the potential interference received by the Earth exploration-satellite service (EESS) and meteorological-satellite earth stations is the aggregate effect of several sources, including systems from other services allocated in these frequency bands, and systems not being allocated within the same band,

recommends

1 that the single entry interference levels presented in Table 1 should be used as sharing criteria for the protection of earth stations operating in the Earth exploration-satellite and meteorological-satellite services;

2 that the deployment of interfering stations specified in Annex 1 is the basis for Table 1 should be reviewed periodically in order to determine whether the typical interference environment and consequential sharing criteria should be revised;

3 that system performance degradation due to emissions from stations in services with lower allocation status than that of the EESS or the meteorological-satellite service should not exceed 1% of the applicable interference criteria.

TABLE 1

Sharing criteria for Earth exploration-satellite and meteorological-satellite earth stations using spacecraft in low-Earth orbit (see Notes 1, 2, 3 and 4)

Frequency band (MHz)	Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than 20% of the time		Interfering signal power (dBW) in the reference bandwidth to be exceeded no more than p% of the time	
	Interfering signal path		Interfering signal path	
	Space-to-Earth	Terrestrial	Space-to-Earth	Terrestrial
137-138	–147 dBW per 150 kHz(1)	–146 dBW per 150 kHz(1)	–136 dBW per 150 kHz(1) p = 0.0031	–137 dBW per 150 kHz(1) p = 0.0063
400.15-401.00	–161 dBW per 177.5 kHz	–163 dBW per 177.5 kHz	–147 dBW per 177.5 kHz p = 0.0031	–147 dBW per 177.5 kHz p = 0.0063
1 698-1 700	–149 dBW per 2 668 kHz	–149 dBW per 2 668 kHz	–138 dBW per 2 668 kHz p = 0.0050	–138 dBW per 2 668 kHz p = 0.0025
1 700-1 710	–156 dBW per 2 668 kHz	–150 dBW per 2 668 kHz	–139 dBW per 2 668 kHz p = 0.0016	–138 dBW per 2 668 kHz p = 0.0094
7 750-7 900	–151 dBW per 10 MHz	–148 dBW per 10 MHz	–127 dBW per 10 MHz p = 0.0047	–127 dBW per 10 MHz p = 0.0016
8 025-8 400	–167 dBW per 10 MHz	–150 dBW per 10 MHz	–133 dBW per 10 MHz p = 0.0025	–133 dBW per 10 MHz p = 0.0050
25.5-27.0	–160 dBW per 10 MHz	–143 dBW per 10 MHz	–116 dBW per 10 MHz p = 0.0025	–116 dBW per 10 MHz p = 0.0050

(1) In this case, the interfering signal powers (dBW) in the reference bandwidths are specified for reception at elevation angles ≥ 25°; in all other cases the minimum elevation angle is 5°.

NOTE 1 – The single entry interfering signal power thresholds in the above table are the permissible levels of interfering signal power that fall within the specified reference bandwidth. Accordingly, the total power in interfering signals that are narrower than the reference bandwidth should be considered in frequency sharing analyses. In cases where the interfering signal bandwidth exceeds the reference bandwidth or does not fully overlap the passband of a specific receiver under study, the available frequency dependent rejection should be applied in conjunction with the specified permissible interference levels.

NOTE 2 – In deriving the above sharing criteria from permissible total levels of interfering signal power, no allowance has been made for interference from spurious emissions.

NOTE 3 – Both the long-term (20% of the time) and short-term (< p% of the time) sharing criteria must be met in order for interference to be at or below permissible levels.

NOTE 4 – Sharing criteria specified for terrestrial signal paths are applicable to transmitting stations in terrestrial services and transmitting earth stations.

Annex 1

Basis for sharing criteria

1 Introduction

The objectives of sharing criteria are, on the one hand, to ensure that interference from all sources will not exceed the applicable interference criteria (i.e. permissible levels of total interference) and, on the other hand, to enable efficient sharing by allowing the maximum possible number of systems to share a band in the same area of operation (preferably on a co-channel basis). This Annex presents the basis for subdividing the applicable aggregate interference criteria (as given in Recommendation ITU-R SA.1026) among the anticipated interferers. Table 2 presents the factors used in apportioning the total permissible interference for each relevant band between the categories of space-to-Earth and terrestrial interference paths as well as among the anticipated number of interferers in each of those categories. The following paragraphs discuss the interference environment in each band.

2 137-138 MHz band

The 137-138 MHz band is allocated to the space operation, meteorological-satellite and space research (space-to-Earth) services on a primary basis; the mobile-satellite (space-to-Earth) on a primary basis in parts of the band and with a secondary basis in other paths of the band; and the fixed and mobile (except aeronautical mobile (R)) services on a secondary basis (except in administrations where that allocation is primary).

For most of the time at typical meteorological-satellite earth station sites, space stations such as those in the mobile-satellite service could produce higher levels of interference than terrestrial stations. The meteorological-satellite earth stations using antennas with 10 dBic gain will provide greater discrimination against terrestrial station emissions than will the earth stations using lower antenna gains (2 dBic). In the short-term, propagation enhancements on terrestrial interfering signal paths and the location variability of mobile stations may result in similar interference levels from space-to-Earth and terrestrial stations.

3 400.15-401.00 MHz band

The 400.15-401.00 MHz band is allocated on a secondary basis to the space operation (space-to-Earth), but on a primary basis to the meteorological-satellite, space research and mobile-satellite (space-to-Earth) services, the space research (space-to-space) service and the meteorological aids service. In addition, the band is also allocated to the fixed and mobile services in some administrations on a primary basis.

For most of the time at typical meteorological-satellite earth station sites, space stations such as those in the mobile-satellite service could produce higher levels of interference than terrestrial stations. In the short-term, propagation enhancements on terrestrial interfering signal paths and the location variability of mobile and meteorological aids stations may result in similar interference levels from space-to-Earth and terrestrial stations.

4 1 698-1 710 MHz band

The 1 690-1 700 MHz band (of which the band 1 698-1 700 MHz is used for the non-geostationary meteorological satellites) is allocated to the meteorological-satellite (space-to-Earth) service on a primary basis and the Earth exploration-satellite (space-to-Earth) service on a secondary basis;

the meteorological aids service on a primary basis; and to the fixed and mobile (except aeronautical mobile) services in Region 1 on a secondary basis.

In addition, the 1 690-1 700 MHz band is also allocated to the fixed and mobile (except aeronautical mobile) services in some administrations on a primary basis.

The 1 700-1 710 MHz band is allocated to the meteorological-satellite (space-to-Earth) service and the fixed and mobile (except aeronautical mobile) services on a primary basis and the Earth exploration-satellite (space-to-Earth) service on a secondary basis.

The number of space stations operated in this band is assumed to produce about the same long-term interference levels as terrestrial systems.

5 7 750-7 900 MHz band

The 7 750-7 900 MHz band is allocated to the meteorological-satellite (space-to-Earth) service (limited to non-geostationary satellites) and the fixed and mobile (except aeronautical mobile) services on a primary basis. For long-term interference, it is expected that only a minor contribution will come from space-to-Earth links as the satellite passes rapidly through the antenna main beam. Consequently, a major contribution for short-term interference is then expected from space-to-Earth links. Interference on terrestrial signal paths may predominate for direct data readout earth stations which have less antenna discrimination (i.e. which have significantly smaller antennas) towards the horizon than recorded data acquisition stations.

6 8 025-8 400 MHz band

The 8 025-8 400 MHz band is allocated to the fixed-satellite (Earth-to-space) service, the Earth exploration-satellite (space-to-Earth) service, and the fixed and mobile services on a primary basis. Aircraft stations are not permitted to transmit in the band 8 025-8 400 MHz. In addition, the 8 175-8 215 MHz segment is allocated to the meteorological-satellite (Earth-to-space) service on a primary basis. Because the only sources of interference on space-to-Earth paths are from Earth exploration-satellite systems, no long-term interference is assumed to occur on space-to-Earth paths (i.e. for most of the time there is no interferer in view or high levels of earth station antenna discrimination are available). In the short-term, interference may occur among Earth exploration-satellite systems on space-to-Earth paths, although interference on terrestrial signal paths will predominate (especially for direct data readout earth stations, which have less antenna discrimination towards the horizon than recorded data acquisition stations). Regarding interference from FSS earth stations operating in the Earth-to-space direction, the sharing criteria specified for terrestrial signal paths should also be applicable to transmitting stations in terrestrial services and transmitting earth stations.

7 25.5-27.0 GHz band

The 25.5-27.0 GHz band is allocated to the Earth exploration-satellite and space research (space-to-Earth), fixed, mobile, and inter-satellite services on a primary basis. Potential sources of interference on Earth exploration-satellite space-to-Earth paths are other Earth exploration-satellite system satellites, inter-satellite service satellites and terrestrial fixed and mobile systems. No long-term interference is assumed to occur on the Earth exploration-satellite space-to-Earth path due to Earth exploration-satellite and inter-satellite service satellite emissions because of the constant movement of the satellites (i.e. for most of the time there is no interferer in view or high levels of earth station antenna discrimination are available).

In the short term, interference may occur between Earth exploration-satellite and inter-satellite service satellite systems on space-to-Earth paths, although interference on terrestrial signal paths will predominate.

TABLE 2

Parameters used to derive sharing criteria from interference criteria (using methodology in Recommendation ITU-R SA.1023)

Frequency band (MHz)	Long-term apportionment between categories of interferers		Short-term apportionment between categories of interferers		Equivalent number of long-term interferers		Equivalent number of short-term interferers	
	Interfering signal path		Interfering signal path		Interfering signal path		Interfering signal path	
	Space-to-Earth	Terrestrial	Space-to-Earth	Terrestrial	Space-to-Earth	Terrestrial	Space-to-Earth	Terrestrial
137-138	60%	40%	50%	50%	2	1	2	1
400.15-401.00	75%	25%	50%	50%	2	1	2	1
1 698-1 700	50%	50%	80%	20%	1	1	2	1
1 700-1 710	20%	80%	25%	75%	2	2	2	1
7 750-7 900	20%	80%	75%	25%	1	2	2	2
8 025-8 400	1%	99%	20%	80%	1	2	1	2
25 500-27 000	1%	99%	20%	80%	1	2	1	2