

RECOMMENDATION ITU-R SF.1719

Sharing between point-to-point and point-to-multipoint fixed service and transmitting earth stations of GSO and non-GSO FSS systems in the 27.5-29.5 GHz band

(Questions ITU-R 237-2/4 and ITU-R 206-2/9)

(2005)

Scope

This Recommendation examines sharing as described in the title. The Annex provides various methodologies of interference analysis to support the *recommends* that administrations avoid the deployment of FS receiver stations and large numbers of FSS transmitting earth stations with overlapping frequencies within the band 27.5-29.5 GHz in the same geographical area.

The ITU Radiocommunication Assembly,

considering

- a) that the band 27.5-29.5 GHz is allocated to both the fixed service and the FSS (Earth-to-space), as well as the mobile service on a primary basis in the Radio Regulations (RR);
- b) that the use of the band 28.6-29.1 GHz by FSS systems is subject to RR No. 5.523A;
- c) that individual FSS earth stations can be coordinated within the whole band 27.5-29.5 GHz;
- d) that some FSS systems intend to deploy a small number of large antenna earth stations on a coordinated basis;
- e) that applications in the high density FSS (HDFSS) employ a large number of small aperture ubiquitously deployed user terminals;
- f) that conventional methods to coordinate such a large number of ubiquitously deployed FSS earth stations may imply a large burden for administrations;
- g) that administrations wishing to avoid interference potential between FSS earth stations described in *considering* f) and stations in the fixed service may employ some form of band segmentation either over their entire territory or on a geographic basis,

recognizing

- a) that notwithstanding band segmentation within an administration, coordination under the RR is still required with other administrations,

recommends

- 1** that, taking into account the results of studies given in Annex 1, the deployment of fixed service receiver stations and large numbers of FSS transmitting earth stations with overlapping frequencies within the band 27.5-29.5 GHz in the same geographical area should be avoided.

Annex 1

Sharing between point-to-point (P-P) and point-to-multipoint (P-MP) fixed service and transmitting earth stations of GSO and non-GSO FSS systems in the 27.5-29.5 GHz band

1 Introduction

Frequency bands have been allocated and identified for use by GSO and non-GSO FSS systems in the 28 GHz bands shared on a primary basis with the fixed service. WRC-95 and WRC-97 facilitated the use of the bands 18.8-19.3 GHz and 28.6-29.1 GHz for non-GSO FSS systems within the FSS allocations. The interference from a GSO and non-GSO FSS earth station transmitting in the band 27.5-29.5 GHz into a fixed service receiver is addressed in this Annex.

Co-frequency operation of multipoint distribution systems (MDSs) (e.g. local multipoint communication/distribution systems (LMCS/LMDS)) or P-P systems of the fixed service and earth stations of the FSS (Earth-to-space) in the same geographical area would be difficult and would severely constrain the development of both types of services. Any fixed service system receivers can suffer long-term and significant short-term interference from FSS uplinks as shown in Fig. 1. The severity of this interference is a function of terminal separation, terrain and man-made obstacles, antenna discrimination, FSS earth station output power, and fixed service systems interference allowance.

This Annex contains the description and results of two analyses. One of these is the deterministic approach, the other is statistical.

2 MDS description

A generic description of an MDS system has been developed using parameters consistent with Recommendation ITU-R F.758. The applicability of these parameters in the band 27.5-29.5 GHz has been confirmed by current manufacturers and operators of MDS equipment. The representative RF receiver characteristics of Recommendation ITU-R F.758 which were used in the deterministic analyses are shown in Table 1 for five hub stations and four subscriber stations.

MDS networks comprise one or more hub stations serving multiple subscriber stations. Subscribers are assigned to one hub station, based on proximity. Hub stations employ an omnidirectional or sectorized antenna, while the subscriber stations typically use a much higher-gain dish antenna. Service path links will typically be around 5 km. Depending on modulation and access methods, a hub station can potentially accommodate a large number of users.

Characteristics of fixed service links are also provided by the Recommendation ITU-R F.758 and manufacturers have confirmed their validity in the 27.5-29.5 GHz band. Antenna gains are usually higher for fixed service P-P links than for MDS and can reach 46 dBi.

FIGURE 1
FSS/fixed service sharing environment

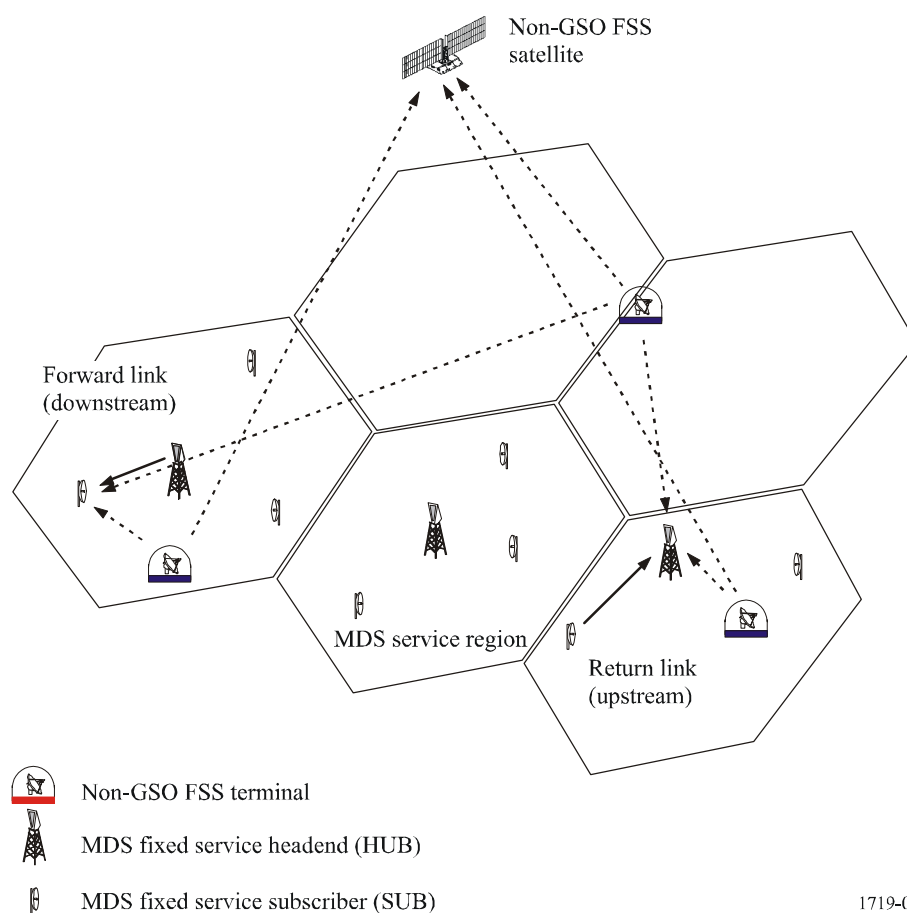


TABLE 1
Generic MDS system receiver description

Parameter	Hub systems				
<i>Hub receiver</i>	HUB 1	HUB 2	HUB 3	HUB 4	HUB 5
Receive gain (dBi)	20 (90° sector)	15 (90° × 15°)	15 (90° × 15°)	24 (45° × 3°)	24 (45° × 3°)
IF bandwidth (MHz)	16.4	1.36	2.50	1.36	2.50
Receiver noise figure (dB)	10	7.5	7.5	7.5	7.5
Noise power (dBW)	−121.8	−135.1	−132.5	−135.1	−132.5
Long-term interference (dBW)	−131.8	−144.3	−141.6	−144.3	−141.6
	Subscriber systems				
<i>Subscriber receiver</i>	SUB A	SUB B	SUB C	SUB D	
Receive gain (dBi)	47	36	36	36	
IF bandwidth (MHz)	16.4	40	1.36	50	
Receiver noise figure (dB)	8	7	7	7	
Noise power (dBW)	−123.8	−121.0	−135.6	−120.0	
Long-term interference (dBW)	−133.8	−130.1	−144.8	−129.1	

3 FSS uplink descriptions

Previous studies of coordination distances and required separation distances between fixed service and FSS earth stations have shown that results are similar whether the FSS earth station is communicating with a GSO or a non-GSO satellite. These analyses examine both non-GSO FSS earth stations and GSO FSS earth stations.

3.1 Generic non-GSO FSS systems

Several different non-GSO FSS systems have been proposed with a variety of uplink characteristics. Table 2 provides an abbreviated summary of several non-GSO uplink parameters useful in assessing potential interference into an MDS receiver. The LEOSAT-1 system specifies a clear-sky transmit power of -0.7 dBW in 3.1 MHz. The far-side lobe for a small 0.3 m antenna would be -3.8 dBi. Reduced distances would result if FSS antennas with improved side-lobe performance were to be used. One USAMEO-1 uplink specifies a clear sky power of approximately 11.3 dBW in 2.8 MHz using a 90 cm antenna. Based on Recommendation ITU-R S.465, the far side-lobe level would be -9.6 dBi.

TABLE 2
Examples of non-GSO FSS system uplink parameters

System	Gain (dBi)	Bandwidth (MHz)	e.i.r.p. density (dB(W/Hz))
USAMEO-4	41.9	1.445	-21.4
USAMEO-1 65 cm	44.16	0.562	-6.06
USAMEO-1 90 cm	46.98	2.812	-6.25
USAMEO-3 32 cm	38.8	2.628	-26.90
USAMEO-3 52 cm	44.0	13.142	-26.89
USAMEO-2 KSL	55.2	250.0	-17.27
LEOSAT-2 DTH	35.6	4.244	-33.08
LEOSAT-2 LB	48.4	97.421	-31.39
LEOSAT-2 SB	45.9	20.31	-33.28
USAKA-L1 FWD	56.0	22.6	-21.31
USAKA-L1 RTN	39.8	2.93	-26.15
LEOSAT-1 TST	35.2	3.1	-30.41

4 Analysis for non-GSO FSS and P-MP fixed service systems

Any transmitting FSS earth station can contribute to the short and long-term interference levels of the MDS hub and subscriber stations.

4.1 Deterministic analysis

Separation distances required to avoid harmful interference between an FSS earth station transmitter and a fixed service receiver can be calculated using the simplified link equation procedure described in Appendix 1 to this Annex. The calculations assume line-of-sight propagation mechanisms in clear sky conditions and an additional transmission loss due to diffraction over a spherical Earth for transhorizon paths. The attenuation due to rain has not been taken into account. Advantages in

terrain blockages and additional fixed service terminals antenna discrimination (arising from different elevations) were not included in this analysis because their effects cannot be guaranteed in any scenario. Although such effects can result in improvements in the interference, these would tend to be offset by three other factors that would increase the interference in a detailed analysis:

- the present analysis makes the conservative assumption of the FSS earth station transmit antenna only interferes via the back-lobes whereas real implementations would sometimes have the earth station antenna pointed closer to the fixed service receiver main beam but for a short time due to the nature of the FSS system;
- the present analysis assumes only a single FSS transmit channel is active whereas in reality there might be multiple FSS channels transmitting in the fixed service receiver passband; and
- there could be multiple earth stations in the same location operating co-frequency simultaneously with different FSS satellites of the same network and/or multiple networks.

By repeating the separation distance calculation for fixed service receiver azimuth angles from 0° to 360°, a two-dimensional contour results, known as a “separation zone”. These separation zones represent regions around a fixed service receiver where operation of FSS earth stations may be precluded in order to assure proper operation of the fixed service receiver.

4.1.1 Potential interference from non-GSO FSS systems

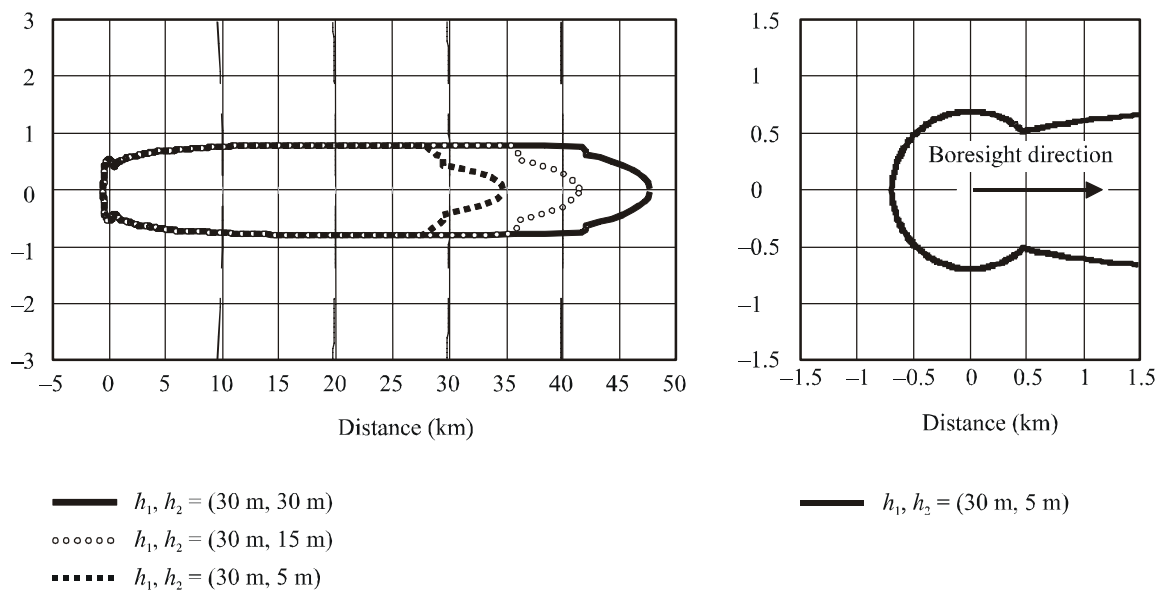
For an initial assessment of the interference potential from non-GSO FSS earth stations, the far side-lobe (back-lobes) levels are used. This provides the lowest level of unobstructed interference as a function of relative orientation. Although the interference levels may periodically increase depending on the servicing satellite location, interference from the far side-lobe is expected to occur most frequently.

Figure 2 presents an example non-GSO FSS earth station separation zone around an MDS subscriber station (SUB A) based on the LEOSAT-1 uplink characteristics. The maximum required separation distance (in the main receive beam) ranges from 35 to 50 km, where the upper value corresponds to both subscriber and earth station antenna heights of 30 m and no terrain and building blockage considered. This clearly represents a worst-case scenario but in situations where building and terrain block the interfering signal, these distances are greatly reduced; the far-lobe-to-far-lobe separation is 700 m. This zone is based on interference power overlapping 19% of the SUB A receiver bandwidth (= 3.1/16.4 MHz). Separation distances computed for the four different subscriber stations resulted in the main-beam boundary being between 29 and 47 km, with the maximum occurring with SUB A (highest receive gain). The back-lobe separation distances ranged from 0.7 to 2.0 km, with the maximum occurring for SUB C (smallest bandwidth). Table 3 provides a summary of the calculated separation distances for LEOSAT-1 and the various subscriber stations.

Separation distances computed for the five different hub stations show that the boundary varies with the type of HUB between 15 km (HUB 1) to a distance ranging from 35 to 50 km (HUB 5), where the upper value corresponds to both HUB and earth station antenna heights of 30 m and no terrain and building blockage considered (highest receive gain, similar bandwidth to interference signal). This upper value of 50 km distance corresponds to the worst-case scenario. Table 4 provides a summary of the calculated separation distances between LEOSAT-1 and the various hub stations. Figure 3 shows an example LEOSAT-1 separation zone associated with a hub station (HUB 5). The separation between an FSS terminal far-lobe and the hub station main-lobe is significantly larger than most typical MDS service cells.

FIGURE 2

Example LEOSAT-1 separation zone around subscriber station (SUB 1)



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TABLE 3

LEOSAT-1 user terminal/MDS subscriber station separation distances

MDS system	Main beam separation ⁽¹⁾ (km)	Back-lobe separation (km)
SUB A	34.01-46.39	0.71
SUB B	29.21-41.52	0.87
SUB C	31.67-44.00	2.04
SUB D	28.90-41.20	0.78

⁽¹⁾ Range of separations based on station height combinations of (30 m, 5 m) and (30 m, 30 m).