RECOMMENDATION ITU-R S.1780*

Coordination between geostationary-satellite orbit fixed-satellite service networks and broadcasting-satellite service networks in the band 17.3-17.8 GHz

(2007)

Scope

This Recommendation addresses the issue of inter-system coordination between broadcasting-satellite service (BSS) networks serving Region 2 and fixed-satellite service (FSS) networks serving Regions 1 and/or 3 in all or part of the frequency band 17.3-17.8 GHz. This issue arises as a consequence of the introduction of the primary BSS allocation in Region 2 as of 1 April 2007, and the existing primary space-to-Earth FSS allocation in Region 1 (17.3-17.8 GHz) and Region 3 (17.7-17.8 GHz). Representative FSS and BSS system characteristics are considered in order to perform a technical analysis of the coordination requirements.

The ITU Radiocommunication Assembly,

considering

a) that, per No. 5.517 of the Radio Regulations (RR), as of 1 April 2007 the broadcasting-satellite service (BSS) allocation in Region 2 in the band 17.3-17.8 GHz is in effect;

b) that there is a requirement for identifying the need for coordination between fixed-satellite service (FSS) networks serving Regions 1 and/or 3, and BSS networks serving Region 2;

c) that simple methods for identifying the need to coordinate between FSS and BSS networks would accelerate the coordination process, in fulfilment of the objectives of Resolution 86 of the Plenipotentiary Conference (Marrakesh, 2002);

d) that typical network characteristics of BSS and FSS networks can be assumed for the RR establishment of a coordination arc to be applied between such networks;

e) that, when a coordination arc applies for the determination of coordination requirements, administrations can request, under the provisions of RR No. 9.41, to be included in the coordination process for networks outside the established coordination arc defined in RR Appendix 5;

f) that, in the cases referred to in *considering* e), administrations requesting to be included in the coordination process may need some information in order to help them in conducting this coordination,

noting

a) that, per RR No. 5.517, starting from 1 April 2007 the FSS (space-to-Earth) in Region 2 in the band 17.7-17.8 GHz shall not cause harmful interference to, nor claim protection from, the BSS in this band,

---

* This Recommendation should be brought to the attention of Working Party 6S.

recommends

1 that administrations, when conducting coordination under the provisions of RR No. 9.7, between assignments pertaining to a GSO BSS network serving Region 2 in the frequency band 17.3-17.8 GHz and assignments pertaining to a GSO FSS network serving Regions 1 and/or 3 in the same frequency band, take into consideration the material provided in Annex 1 in order to facilitate this coordination.

Annex 1

Coordination between Region 2 GSO BSS networks (space-to-Earth) and GSO FSS networks (space-to-Earth) in the band 17.3-17.8 GHz

Pursuant to Resolution 901 (WRC-03), ITU-R reviewed the possible coordination arc value in the band 17.3-17.8 GHz. This band is totally or partially allocated, *inter alia*, to the BSS in Region 2 and to the FSS in the space-to-Earth direction. RR No. 5.516B applies with regard to the FSS downlink allocation in Region 1.

This Annex gathers the results of the studies conducted on the coordination of Region 2 GSO BSS networks with regard to FSS networks whose service areas are limited to Region 1 (reciprocal studies were also conducted within ITU-R and reached the same conclusion as in this Annex). The results given in this Annex are a consequence of the natural geographical isolation between land masses of both Regions. The conclusions of this Annex may be extended to FSS networks in Region 3, taking into account the geographical isolation between Regions 2 and 3.

1 Methodology

The methodology to study the appropriate possible coordination arc value was derived from the method described in RR Appendix 8 as prescribed by RR Appendix 5 for requests for coordination under RR No. 9.7.

The purpose of the study was:

– to assess the e.i.r.p. which could be radiated over Region 1 by a BSS network without triggering coordination with an FSS network depending on the orbital separation between the two networks;

– to compare the values found in the studies described in the above paragraph with technical parameters of BSS systems intended to be deployed in the band 17.3-17.8 GHz.

1.1 Derivation of maximum e.i.r.p. radiated without triggering coordination

From the receiving system noise temperature and the interference criterion, an interference density was computed. The e.i.r.p. density towards a Region was then computed from this interference density taking into account only free space loss:

$$e.i.r.p.(density) = 10 \log \left(\frac{T_{ES} \dfrac{\Delta t}{t} k l_d}{g_{ES}(\theta_t)} \right)$$

where:

e.i.r.p.(density):	e.i.r.p. density radiated by a satellite towards a Region (dB(W/Hz))
T_{ES}:	receiving earth station system noise temperature at antenna output (K)
$\Delta t/t$:	interference criterion
k:	Boltzmann's constant (1.38 × 10^{-23} J/K)
l_d:	downlink free space loss
$g_{ES}(\theta_t)$:	receiving earth station antenna gain towards the interfering satellite
θ_t:	topocentric angle between wanted and interfering satellites.

The free-space loss was computed assuming a distance of 38 650 km and a frequency of 17.3 GHz. It was further assumed that the topocentric angle is 10% larger than the geocentric angle. No polarization advantage was taken into account.

2 Technical parameters of BSS and FSS networks

2.1 BSS networks

This section presents BSS parameters (mainly maximum satellite e.i.r.p. and geographic separation) of systems intended to be deployed in the band 17.3-17.8 GHz. Thus a comparison can be drawn between these parameters and the ones found in § 3, that will not trigger coordination between BSS and FSS networks.

2.1.1 Maximum satellite e.i.r.p. density

Appendix 1 indicates that, for one system, the maximum satellite e.i.r.p. will be 57.2 dBW/25 MHz (i.e. −16.8 dB(W/Hz) if an evenly spread power distribution is assumed) and, for the second one, the maximum satellite e.i.r.p. ranges from 64.2 dBW to 68.5 dBW (the associated channel bandwidths range from 25 MHz to 500 MHz). For this second network, it is not clear whether the higher e.i.r.p. relates to the larger channel: in such a case, the e.i.r.p. densities vary from −9.8 dB(W/Hz) to −18.5 dB(W/Hz) if an evenly spread power distribution is assumed.

Other studies within ITU-R included the following examples of BSS maximal e.i.r.p. values:

– for a general coverage beam, a peak e.i.r.p. of 58 dBW/27 MHz (−16.3 dB(W/Hz));

– for a spot beam, a maximum e.i.r.p. of 70 dBW/27 MHz (−4.3 dB(W/Hz)).

2.1.2 Geographical isolation

Appendix 2 contains representative BSS satellite footprints (or envelopes). From these examples, it can be seen that the geographical isolation between Region 2 and Region 1 ranges from a little more than 10 dB to as much as 35 dB. For the purpose of this study, a parametric assessment was therefore made by using values of 10 dB, 15 dB and 20 dB as geographical isolation.

2.2 FSS networks

2.2.1 Interference criterion

The criterion was derived from the section of RR Appendix 5 dealing with RR No. 9.7 under which FSS systems in the band 17.3-17.8 GHz are coordinated:

$$\frac{\Delta T}{T} = 6\%$$

2.2.2 Receiving earth station characteristics

This section presents FSS receiving earth station characteristics which are representative of those planned to be deployed in adjacent bands (namely 17.7-20.2 GHz). The following was thus assumed:

– antenna diameter: 45, 60, 90 and 120 cm[1];

– antenna radiation pattern: four antenna patterns were considered, namely Annex III of Appendix 8, Recommendation ITU-R S.465 (complemented by Appendix 8 for the main beam), Recommendation ITU-R S.580 (complemented by Appendix 8 for the main beam) and Recommendation ITU-R BO.1213;

– receiving system noise temperature at the output of FSS earth station antenna: 140 K.

3 Interference from GSO BSS networks into GSO FSS networks

Section 2.1 presented some typical e.i.r.p. densities which would be radiated by BSS networks over Region 2. Table 1 summarizes the minimum orbital separation required to transmit a certain e.i.r.p. density without triggering coordination depending on FSS antenna patterns.

---

[1] Larger antennas may be used for gateways. Nevertheless, as the band is identified for HDFSS (see RR No. 5.516B), small antennas were primarily considered.

TABLE 1

Orbital separation required for not triggering coordination with FSS networks

		Geographical isolation								
		10 dB	10 dB	10 dB	15 dB	15 dB	15 dB	20 dB	20 dB	20 dB
		BSS satellite e.i.r.p. over Region 2								
		−5 dB(W/Hz)	−10 dB(W/Hz)	−15 dB(W/Hz)	−5 dB(W/Hz)	−10 dB(W/Hz)	−15 dB(W/Hz)	−5 dB(W/Hz)	−10 dB(W/Hz)	−15 dB(W/Hz)
FSS antenna patterns	RR Appendix 8	19.4°	12.2°	7.7°	12.2°	7.7°	4.8°	7.7°	4.8°	2.7°
	Recommendation ITU-R S.465	11.3°	7.1°	4.5°	7.1°	4.5°	3.4°	4.5°	3.4°	2.6°
	Recommendation ITU-R S.580	8.6°	5.4°	3.4°	5.4°	3.4°	3.4°	3.4°	3.4°	2.6°
	Recommendation ITU-R BO.1213	8.6°	5.4°	3.4°	5.4°	3.4°	2.8°	3.4°	2.8°	2.3°

1.4 Conclusion

This Annex shows that a coordination arc value of ±8° would generally suffice to trigger coordination of BSS networks serving Region 2 with FSS networks serving Region 1.

It should be noted that the same geographical discrimination between Regions 2 and 3 as for between Regions 2 and 1 can be assumed. Therefore, the same conclusion can be extended to the case of coordination between BSS networks serving Region 2 and FSS networks serving Region 3.

Appendix 1
to Annex 1

Examples of system parameters of unplanned BSS systems and associated feeder links in frequency bands 17.3-17.8 GHz and 24.75-25.25 GHz

The following table contains a summary of representative coordination information for Region 2 BSS systems submitted to the Radiocommunication Bureau. These systems are considered representative examples of the types of systems that can be expected to operate under the Region 2 BSS allocation.

System characteristics

		System A	System B
Orbit		GSO	GSO
Position		95.0° W	101.0° W
Frequency	Uplink	24.75-25.25 GHz	24.75-25.25 GHz
	Downlink	17.3-17.8 GHz	17.3-17.8 GHz
Broadcast			
Coverage		North America	North America
Assigned channel bandwidth		25 MHz	25-500 MHz
Uplink			
Satellite receive antenna gain		35 dBi	49.4 dBi
Earth station transmit antenna size		5.6 m, 3.5 m	5-13 m
Earth station transmit antenna gain (maximum)		61.1 dBi, 57.0 dBi	60.5-68.8 dBi
Receiving satellite system noise temperature		730 K	810 K
Earth station transmit antenna pattern		RR AP 4 A, B, C, D, φ parameters: 29, 25, 32, 25, 7°	Rec. ITU-R S.465
Polarization		Circular left	Circular left
Maximum power supplied to the input of Earth station transmitting antenna		22.2 dBW	21.2-29.5 dBW
Downlink			
Satellite transmit antenna gain		35 dBi	49.4 dBi
Earth station receive antenna size		0.45-1.4 m	0.45-1.2 m
Earth station receive antenna gain		36.1-46.0 dBi	36.5-45.0 dBi

	System A	System B
Broadcast (*cont.*)		
Polarization	Circular right	Circular right
Earth station receive noise temperature	170 K	140 K
Earth station receive antenna pattern	See detailed pattern following this table	Rec. ITU-R S.465
Maximum power supplied to the input of satellite transmitting antenna	22.2 dBW	14.8-19.1 dBW
E_b/N_0	6.5 dB	No Information
C/N threshold	6.6 dB	No Information
Required C/N (clear-sky)	9.0 dB	Uplink 17.4 dB, Downlink 6-17.6 dB
System A only **Forward link**		
Coverage	Visible Earth	
Channel bandwidth	25 MHz	
Uplink		
Satellite receive antenna gain	44.5 dBi	
Earth station transmit antenna size	5.6 m, 3.5 m	
Earth station transmit antenna gain (maximum)	61.1 dBi, 57.0 dBi	
Receiving satellite system noise temperature	730 K	
Earth station transmit antenna pattern	RR AP 4 A, B, C, D, φ parameters: 29°, 25°, 32°, 25°, 7°	
Polarization	Circular left	
Maximum power supplied to the input of Earth station transmitting antenna	18.0 dBW	
Downlink		
Satellite transmit antenna gain	44.5 dBi	
Earth station receive antenna size	0.45-1.4 m	
Earth station receive antenna gain	36.1-46.0 dBi	
Polarization	Circular right	
Earth station receive noise temperature	170 K	
Earth station receive antenna pattern	See detailed pattern following this table	
Maximum power supplied to the input of satellite transmitting antenna	21.0 dBW	
E_b/N_0	6.5 dB	
C/N threshold	6.6 dB	
Required C/N (clear-sky)	11.0 dB	
Return link		
Coverage	Visible Earth	
Channel bandwidth	55 MHz, 113 MHz	

	System A	System B
Return link (*cont.*)		
Uplink		
Satellite receive antenna gain	44.5 dBi	
Earth station transmit antenna size	0.45-1.4 m	
Earth station transmit antenna gain (maximum)	39.2-49.1 dBi	
Receiving satellite system noise temperature	730 K	
Earth station transmit antenna pattern	Rec. ITU-R S.465	
Uplink polarization	Circular left, circular right	
Maximum power supplied to the input of Earth station transmitting antenna	36.4 dBW, 39.7 MHz	
Downlink		
Satellite transmit antenna gain	44.5 dBi	
Earth station receive antenna size	5.6 m, 3.5 m	
Earth station receive antenna gain	58.0 dBi, 54 dBi	
Downlink polarization	Circular right, circular left	
Earth station receive noise temperature	185 K	
Earth station receive antenna pattern	RR AP 4 A, B, C, D, φ parameters: 29°, 25°, 32°, 25°, 7°	
Maximum power supplied to the input of satellite transmitting antenna	21.2 dBW	
E_b/N_0	6.5 dB	
C/N threshold	6.6 dB	
Required C/N (clear-sky)	10.0 dB	

System A earth station receive antenna pattern

Earth station receiving antenna pattern:

$$G_{co}(\varphi) = G_{max} - 2.5 \times 10^{-3} \left(\frac{D}{\lambda} \varphi \right)^2 \quad \text{for} \quad 0 \leq \varphi < \varphi_m \quad \text{where } \varphi_m = \frac{\lambda}{D} \sqrt{\frac{G_{max} - G_1}{0.0025}}$$

$$G_{co}(\varphi) = G_1 = 29 - 25 \log_{10} \varphi_r \quad \text{for} \quad \varphi_m \leq \varphi < \varphi_r \quad \text{where } \varphi_r = 95 \frac{\lambda}{D}$$

$$G_{co}(\varphi) = 29\text{-}25 \log_{10} \varphi \quad \text{for} \quad \varphi_r \leq \varphi < 7°$$

$$G_{co}(\varphi) = 7.9 \text{ dBi} \quad \text{for} \quad 7° \leq \varphi < 9.2°$$

$$G_{co}(\varphi) = 32\text{-}25 \log_{10} \varphi \quad \text{for} \quad 9.2° \leq \varphi < 48°$$

$$G_{co}(\varphi) = -10 \text{ dBi} \quad \text{for} \quad 48° \leq \varphi < 180°$$

where:

G_{co}: co-polar gain (dBi)

G_{max}: maximum isotropic gain of the antenna (dBi)

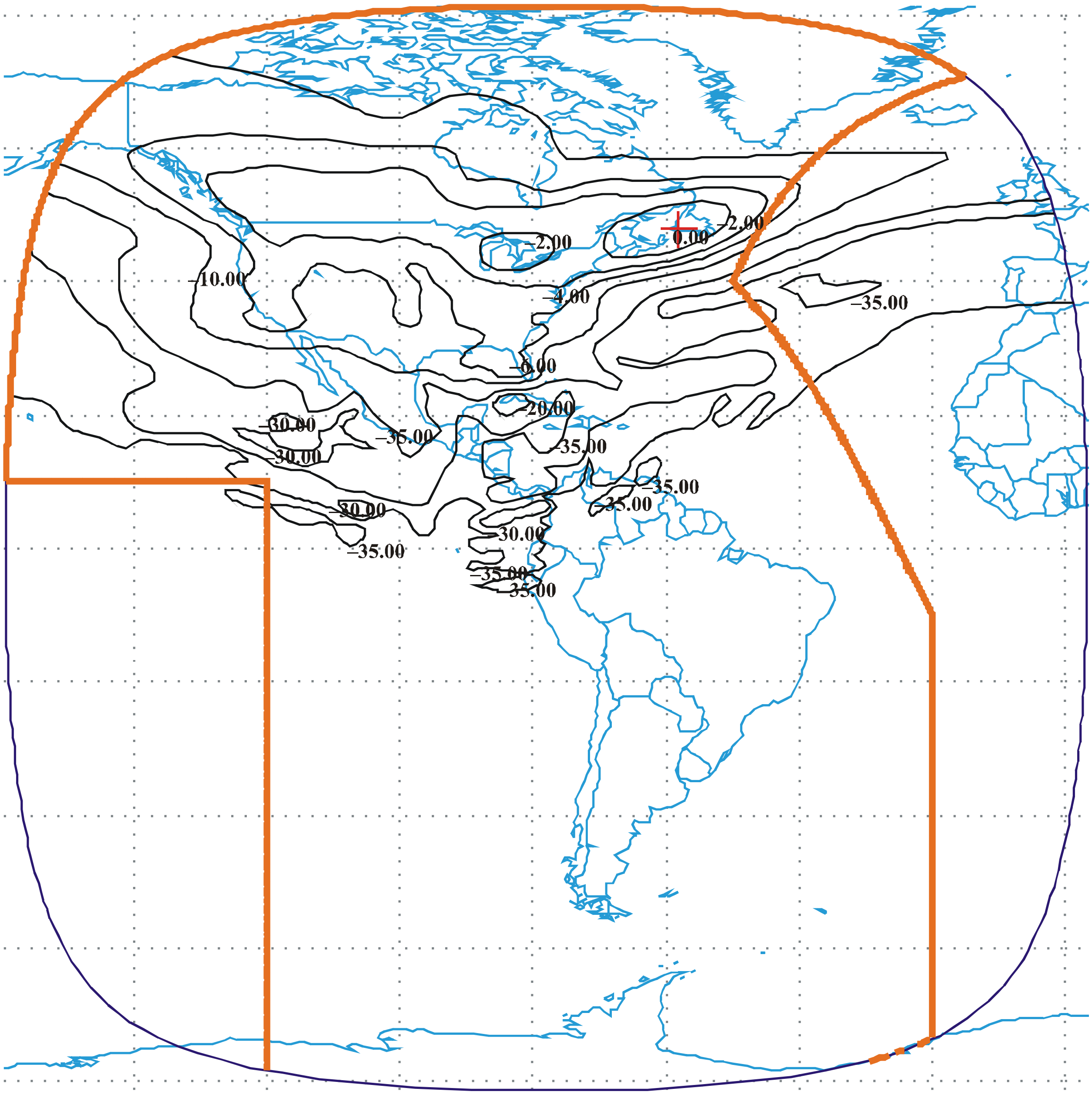
φ: off-axis angle (degrees)

D: antenna diameter (m)

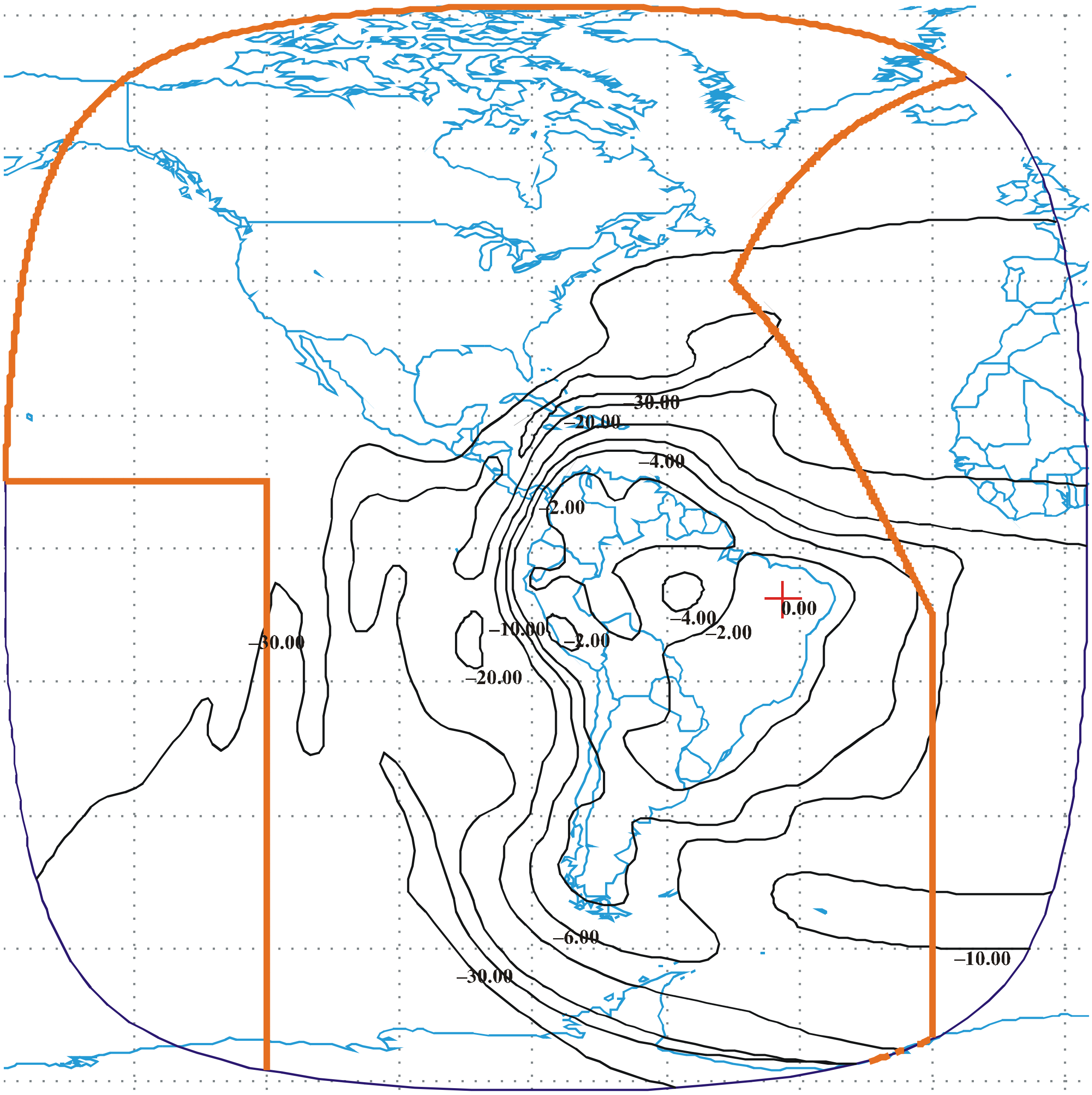
λ: wavelength (m).

Appendix 2
to Annex 1

Examples of BSS satellite antenna patterns



1780-01



1780-02