CHAPTER 3

Issues concerning fixed-satellite and broadcasting-satellite services

(WRC-03 agenda items 1.19, 1.27, 1.29, 1.30, 1.34, 1.35, 1.37, 1.39)

CONTENTS

		Page
3.1	Agenda item 1.19	5
3.1.1	Summary of technical and operational studies	5
3.1.3	Method to satisfy this agenda item	5
3.1.4	Regulatory and procedural considerations	5
3.2	Agenda item 1.27	5
3.2.1	Introduction and summary	6
3.2.1.1	Scope of invited studies	6
3.2.1.2	Summary	6
3.2.2	Sharing criteria	7
3.2.2.1	Technical assumptions for reviewing the sharing criteria in Appendix 30	7
3.2.2.2	Appendix 30 Criteria for intra-Regional BSS - BSS Sharing	12
3.2.2.3	Appendix 30 criteria for interregional sharing	16
3.2.2.4	Appendix 30 criteria for the protection of BSS earth stations from terrestrial stations or from FSS earth stations operating in the opposite direction of transmission	26
3.1.2	Propagation Mode 2 (Appendix 7: § 5, Annex 5)	33
3.2.2.5	Appendix 30A intra-Regional criteria for the protection of BSS feeder-link receiving space stations from BSS feeder-link transmitting earth stations	33
3.2.2.6	Appendix 30A criteria for the protection of BSS feeder-link receiving space stations from FSS or BSS transmitting space stations or from BSS feeder-link transmitting earth stations	34
3.2.3	Regulatory/procedural aspects	35
3.2.3.1	Review of §§ 4.1.18 to 4.1.20 of Appendices 30 and 30A	35
3.2.3.2	Application of the grouping concept for one orbital location in Appendices 30 and 30A with respect to Regions 1 and 3	39
3.2.3.3	Sharing criteria in Annexes 1, 3, 4 and 6 to Appendix 30 and Annexes 1 and 4 to Appendix 30A	41
3.2.3.4	Use of BSS feeder-link assignments for GSO FSS (Earth-to-space) in the bands 14.5-14.8 GHz and 17.3-18.1 GHz	41
3.2.3.5	5.2.1 *d)* of Article 5 of Appendix 30	43
3.2.3.6	Other provisions of Appendices 30 and 30A	44
3.2.3.7	Review of the provisions of footnote No. 5.491	47
3.3	Agenda item 1.29	86

3.3.1 Resolution 136 (WRC-2000) 86
3.3.1.1 Summary of technical studies, including a list of relevant ITU-R Recommendations 86
3.3.1.2 Analysis of the results of studies 87
3.3.1.3 Methods to satisfy the agenda item and their advantages and disadvantages 91
3.3.1.4 Regulatory and procedural considerations 91
3.3.2 Resolution 78 (WRC-2000) 93
3.3.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations 93
3.3.2.2 Analysis of the results of studies 93
3.3.2.3 Methods to satisfy this agenda item and their advantages and disadvantages 94
3.3.2.4 Regulatory and procedural considerations 96
3.4 Agenda item 1.30 102
3.4.1 Modification of Appendix 4 103
3.4.1.1 Summary of technical and operational studies 103
3.4.1.2 Analysis of the results of studies 103
3.4.1.3 Methods to satisfy the agenda item and their advantages and disadvantages 104
3.4.1.4 Regulatory and procedural considerations 106
3.4.2 Automation of examination of space filings for compliance with RR Article 5 148
3.4.2.1 Summary of technical and operational studies 148
3.4.2.2 Analysis of the results of studies 148
3.4.2.3 Regulatory and procedural considerations 148
3.4.3 FSS earth stations deployed in large numbers 148
3.4.3.1 Summary of technical and operational studies 148
3.4.3.2 Analysis of the results of studies 149
3.4.3.3 Methods to satisfy the agenda item and their advantages and disadvantages 150
3.4.4 BSS frequency bands not subject to Appendix 30 152
3.4.4.1 Summary of technical and operational studies 152
3.4.4.2 Analysis of the results of studies 152
3.4.4.3 Methods to satisfy the agenda item and their advantages and disadvantages 152
3.4.4.4 Regulatory and procedural considerations 153
3.4.5 Review of Resolution 49 153
3.4.5.1 Summary of technical and operational studies 153
3.4.5.2 Analysis of the results of studies 153
3.4.5.3 Regulatory and procedural considerations 154
3.4.6 Resolution 34 154
3.4.6.1 Summary of technical studies 154
3.4.6.2 Analysis of the results of studies 155
3.4.6.3 Methods to satisfy this agenda item 156

3.4.7 Rule of Procedure on No. 9.35 provisionally adopted to reduce the backlog in the processing of satellite filings under Article 9 of the RR 158
3.4.7.1 Summary of activities performed in relation to the reduction of the backlog 158
3.4.7.2 Analysis of the impact of the provisional application of the Rule of Procedure 158
3.4.7.3 Methods to satisfy this issue and their advantages and disadvantages 159
3.4.7.4 Regulatory and procedural considerations 161
3.5 Agenda item 1.34 162
3.5.1 Summary of technical and operational studies related to non-GSO BSS (sound), including a list of relevant ITU-R Recommendations 162
3.5.1.1 Non-GSO BSS (sound) system parameters 163
3.5.1.2 IMT-2000 system parameters 164
3.5.1.3 Fixed service system parameters 166
3.5.2 Analysis of the results of studies 167
3.5.2.1 Protection of terrestrial systems from non-GSO BSS (sound) systems 167
3.5.2.2 Impact on the non-GSO BSS (sound) systems 172
3.5.2.3 Impact on the IMT-2000 systems 174
3.5.2.4 Impact on both, the non-GSO BSS (sound) and the IMT-2000 system 175
3.5.2.5 Evaluation of the most adequate pfd thresholds 175
3.5.3 Methods to satisfy agenda item 1.34 for WRC-03 176
3.5.4 Regulatory aspects 179
3.6 Agenda item 1.35 190
3.7 Agenda item 1.37 190
3.7.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations 190
3.7.1.1 Characterization and typical examples of satellite systems using HEO 191
3.7.1.2 Operational features common to HEO satellite systems 191
3.7.2 Analysis of the results of studies 192
3.7.2.1 Sharing involving HEOs, other non-GSO systems, and GSO networks 192
3.7.2.2 Sharing between FSS systems using HEO satellites and the FS 193
3.7.2.3 Sharing involving HEO BSS systems and terrestrial services 197
3.7.2.4 Other frequency bands and radio services 198
3.7.3 Methods to satisfy the agenda item 198
3.7.3.1 Background 198
3.7.3.2 Definition of HEO systems in the Radio Regulations 198
3.7.3.3 Status of HEO systems in respect of GSO networks and other non-GSO systems 199
3.7.3.4 Data elements in Appendix 4 199
3.7.3.5 Sharing between HEO FSS systems and the fixed service 199
3.7.4 Regulatory and procedural considerations 199

3.7.4.1 HEO MSS systems below 3 GHz 199
3.7.4.2 HEO BSS systems below 1 GHz 199
3.7.4.3 Bands allocated to BSS (sound) between 1 and 3 GHz 200
3.7.4.4 HEO BSS (and not specifically BSS sound) or HEO FSS between 1 and 3 GHz 201
3.7.4.5 HEO FSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and no epfd limits are given in Article 22 202
3.7.4.6 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 9.11A applies 202
3.7.4.7 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and epfd limits are given in Article 22 202
3.7.4.8 Other combinations of radiocommunication services and frequency bands .. 204
3.7.5 General 204
3.8 Agenda item 1.39 207
3.8.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations 207
3.8.1.1 Technical and operational characteristics of FSS TT&C systems 207
3.8.1.2 Coordination of TT&C carriers 209
3.8.1.3 TT&C carrier bandwidths 209
3.8.1.4 TT&C spectrum requirements based on satellite network filings 210
3.8.2 Analysis of results of studies 211
3.8.3 Methods to satisfy the agenda item and their advantages and disadvantages 211
3.8.4 Regulatory and procedural considerations 211

3.1 Agenda item 1.19

"to consider regulatory provisions to avoid misapplication of the non-GSO FSS single-entry limits in Article **22** based on the results of ITU-R studies carried out in accordance with Resolution **135 (WRC-2000)**"

3.1.1 Summary of technical and operational studies

WRC-2000 established in Article **22** single-entry epfd limits to be met by non-GSO FSS systems in certain parts of the frequency range 10.7-30.0 GHz to protect GSO FSS and GSO BSS networks.

The verification of conformance with the single entry epfd limits contained in Tables **22-1** to **22-3** (inclusive) of Article **22** forms an important part of the regulatory examination of any notice for a non-GSO FSS system, performed by the Radiocommunication Bureau under No. **11.31**, as referenced in Sections 2.6 to 2.6.6 of the Rules of Procedure.

Thus, the only reason for misapplication of these single entry epfd limits by artificially splitting or combining non-GSO FSS systems, will be to lower the epfd levels and therefore to get a favourable finding status as a result of this regulatory examination.

3.1.2 Analysis of the results of studies

The regulatory examination of any notice for stations in space services performed by BR under No. **11.31** includes, *inter alia*, conformity with mandatory provisions in Articles **21** and **22**, most of which deal with pfd which could be misapplied by artificially splitting and combining systems.

Furthermore, a limit, similar to those given in Table **22-3**, applicable to non-GSO FSS systems is contained in No. **22.5A** also, but that has not attracted any such concerns on possible misapplication.

The problem covered by agenda item 1.19 is not new or specific to certain non-GSO FSS systems.

3.1.3 Method to satisfy this agenda item

The problem raised by Resolution **135** (**WRC-2000**) is not new or specific to certain non-GSO FSS systems. No difficulties have been experienced so far with similar limits, which could be similarly misapplied. The current Radio Regulations are adequate.

No further studies are required therefore insofar as *"invite ITU-R"* section of Resolution **135** (**WRC-2000**) is concerned the Resolution may be suppressed.

3.1.4 Regulatory and procedural considerations

No further specific regulatory action is required.

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3.2 Agenda item 1.27

"to review, in accordance with Resolutions **540 (WRC-2000)** and **735 (WRC-2000)**, the ITU-R studies requested in those resolutions, and modify, as appropriate, the relevant regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions"

Resolution **540 (WRC-2000)**

Application and study of the regulatory procedures and associated sharing criteria contained in Appendices **30** and **30A** and in the associated provisions of Articles **9** and **11**.

Resolution **735 (WRC-2000)**

Sharing procedures and criteria between receiving earth stations in the broadcasting-satellite service and transmitting earth stations or terrestrial stations in frequency bands allocated to the broadcasting-satellite service and the fixed-satellite service (Earth-to-space) or to terrestrial services.

3.2.1 Introduction and summary

3.2.1.1 Scope of invited studies

Resolution **540 (WRC-2000)** invited the ITU-R to undertake, as a matter of urgency, additional studies and complete them by WRC-03 on the sharing criteria in Annexes 1, 3, 4 and 6 to Appendix **30** and Annexes 1 and 4 to Appendix **30A,** except for:

- the sharing criteria in Annex 1 to Appendix 30 that identify whether terrestrial services may be affected by BSS (*considering b)*); and
- the replacement for the method that was contained in Section 3 of Annex 4 to Appendix 30; namely, the method contained in Appendix S7 (*considering c)*),

taking into account

- that the sharing criteria in Appendices **30** and **30A** should provide appropriate protection to the BSS, FSS and terrestrial services whilst not unduly constraining the services involved (*considering g)*);
- that, worldwide, in various sub-bands of the frequency range 11.7-12.7 GHz, FSS networks as well as BSS networks are in operation, and others will be operated in the near future and, consequently, difficulties may be experienced in modifying their characteristics (*considering h)*);
- that there are differing geographic situations between the ITU Regions and that this may have an impact on the sharing criteria … (*recognizing* a)),

i) In addition to studying the sharing criteria, Resolution 540 invited the ITU-R to undertake additional studies of the changes made by WRC-2000 to the regulatory procedures contained in:

   a) Articles 4 and 5 to Appendices **30** and **30A** with a view to establishing a list of additional uses for Regions 1 and 3 and providing for its implementation, including the implications of §§ 4.1.18 - 4.1.20 on the assignments in conformity with the Plan;

   b) Articles 6 and 7 to Appendices **30** and **30A**, including related modifications to Articles **S9** and **S11** and the associated provisions of Appendix **5**,

   with a view to ensuring consistency among these provisions, as appropriate, taking into account that WRC-2000 also revised the regulatory procedures contained in Appendices **30** and **30A**, and the associated provisions in Articles **9** and **11** and associated Appendices.

ii) Like Resolution 540, Resolution **735 (WRC-2000)** also invited the ITU-R to study both sharing criteria and sharing procedures; but only those related to the coordination required by the WRC-2000 revision of No. **9.19** of terrestrial transmitters and/or transmitting earth stations with BSS earth stations in both planned and unplanned frequency bands that are shared among these services.

3.2.1.2 Summary

The results of the studies of sharing criteria under both Resolutions **540 (WRC-2000)** and **735 (WRC-2000)** are presented in § 3.2.2 below. The results of the corresponding studies of the regulatory procedures are presented in § 3.2.3.

Some administrations are strongly of the view that any action on sharing criteria referred to in § 3.2.2 should remain in abeyance until the question is resolved, of whether or not Nos. **4.1.18**, **4.1.18*bis*** and network grouping should be deleted.

Tables 3.2-7 and 3.2-8 were prepared by the Rapporteur for Chapter 3 of the draft CPM Report to provide a compact overview of the results of the ITU-R studies invited in support of WRC-03 agenda item 1.27. (These tables are to be considered at CPM02-2, November 2002.)

Table 3.2-7 characterizes the sharing criteria contained in each of the five Annexes to Appendix **30** that were identified for ITU-R study in Resolutions **540** and **735** and indicates possible WRC-03 actions based on the results of these studies. In particular, columns 2 to 5 of the table indicate, in each case, the pair of services and the frequency band(s) involved, describe the type of limits used to trigger coordination, and indicate the pertinent provision of the regulatory procedures. Column 6 indicates the possible WRC actions and Column 7 identifies the subsection of section 3.2 where the details of the studies are presented. Column 7 also highlighted cases where no studies were undertaken.

Notes to the table explain cases where additional studies are required, or decisions are to be taken, before revised sharing criteria can be agreed.

In the same manner, Table 3.2-8 summarizes the results of the ITU-R studies on the sharing criteria contained in the Annexes of Appendix **30A**.

3.2.2 Sharing criteria

3.2.2.1 Technical assumptions for reviewing the sharing criteria in Appendix 30

Resolution **540** invited study, *inter alia*, of Annex 6 to Appendix **30**, titled "Criteria for sharing between services". This Annex includes data on the protection ratio requirements for sharing between various transmissions and services in the BSS bands, an FSS reference antenna diameter for calculating interference from BSS space stations into the FSS, and data on the use of energy dispersal in the BSS. However, Annex 6 provides data only on systems using analogue transmission and has not been revised since it was written at WRC-77. As a result, it is largely irrelevant to the review of sharing criteria for current and future digital BSS and FSS systems.

Annex 6 could be maintained for historical purposes with a new title and the addition of a note explaining its role in establishing the original WARC–77 Plan and the associated sharing criteria. However, it is considered essential that there be an Annex to Appendix **30** that reflects the results of current ITU-R studies on the technical bases for the sharing criteria to be adopted by WRC-03.

These studies focused on the antenna patterns, transmission characteristics (antenna sizes and associated noise temperatures) and the protection levels that these criteria are intended to provide to the services involved.

a) Reference antenna patterns

The ITU-R studies considered the reference antenna patterns currently applicable for the protection of FSS or BSS in the Radio Regulations (Annex 3 to Appendix **8**, Section 3 of Annex 3 to Appendix **7**, Figures 7, 7*bis*, and 8 of Annex 5 to Appendix **30**) and in the relevant ITU-R Recommendations S.465-5, S.580-5 and BO.1213.

The studies included a review of the measurement data collected in the 1999-2000 time frame on small aperture receive earth station antennas ranging in size from 45 cm to 150 cm for the purpose of developing a suitable antenna pattern for protection of the BSS from interference received from non-GSO FSS systems (see Recommendation ITU-R BO.1443 and Report ITU-R BO.2029). Detailed analysis was performed on the measurement data relevant to the GSO-GSO sharing situation, including not only the data for the 0º scan plane, corresponding approximately to the GSO

orbital plane, but also data for the 22.5º and 157.5º offset scan planes. The studies also included recent additional measurements provided by administrations on small BSS antennas and on small FSS antennas used simultaneously for transmission and reception.

Comparison of these data to the Recommendation ITU-R BO.1213 reference pattern indicated that more than 99% of the side lobe data complied with the Recommendation ITU-R BO.1213 pattern. On this basis, it could be concluded that the antenna reference patterns specified in the following Recommendation and Radio Regulations would serve as a basis to develop appropriate pfd masks for the protection of FSS and BSS:

- Recommendation ITU-R BO.1213 for FSS or BSS antennas with diameters between 45 cm and 240 cm.
- Recommendation ITU-R S.580-5, with 29-25logθ side lobe envelope, complemented in the main lobe by Annex 3 to Appendix **8** for FSS earth station antennas with diameters greater than 240 cm, which is equivalent to Section 3 of Annex 3 to Appendix **7** (WRC-2000).

Additional ITU-R studies, which are based on the results of two independent sets of measurements carried out by Canada and France for duplex feed antennas ranging from 0.75m to 1.2 m, confirm the above conclusions.

b) Antenna sizes and noise temperatures

It was concluded that any pfd mask intended for the protection of FSS or BSS needs to reflect current and future uses in the FSS or in the BSS, including the assignments using the nominal parameters of the Plans, and modifications of assignments of the Region 2 Plan and Region 1 and 3 lists in accordance to Article 4 of Appendices **30** and **30A**.

Table 3.2-1 provides the range of FSS or BSS receive antennas and associated noise temperatures which have been considered appropriate for this purpose. These are the same as retained by WRC-2000 in adopting the pfd mask contained in the Annex to Resolution **540 (WRC-2000)**. The total system receive noise temperature was calculated from the receive earth station noise temperature (which includes the antenna temperature, the receive amplifier temperature and the noise increase resulting from feeder losses), and adding 2 dB for all other sources of noise (uplink noise, GSO interference, cross polarization isolation and frequency reuse interference). Implicit in Table 3.2-1 is the fact that, as a result of the convergence between the technical parameters of BSS and FSS for smaller antennas, both services can be assumed to have the same characteristics in the common range of antenna diameters (0.45 m to 2.4 m).

TABLE 3.2-1

Range of antenna sizes and noise temperatures considered for the protection of FSS and for the protection of BSS in addition to nominal assignments in the Plans

Receive earth station antenna diameter (m)	0.45*	0.60	0.80	1.20	2.4	5.0	8.0	11.0
Receive earth station noise temperature (K)	110	110	125	150	150	200	250	250
Total link noise temperature (K)	174	174	198	238	238	317	396	396
* The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases (see Table 3.2-3), since Regions 1 and 3 BSS Plan is based on 60 cm antennas, and since the use of smaller antennas in the FSS is generally constrained by the use of 2 or 3° orbital spacing.								

c) Protection criteria

ΔT/T approach

This approach determines an allowable interfering pfd limit (pfd_{all}) by specifying an allowable percentage increase in the receive link noise temperature due to interference. It is an attractive approach as it requires a minimum number of system parameters to be specified and is particularly appropriate in the case of digital systems where interference is noise-like in terms of its impact on system performance. The allowable interfering pfd is given by:

$$pfd_{all}(\theta) = 10Log(\Delta T/T) + 10Log(kT\, b_{rf}) + G_m - G_a(\varphi)$$

where:

$pfd_{all}(\theta)$ = allowable level of interfering pfd for an orbital separation of θ degrees

$\Delta T/T$ = allowable relative increase in receiver link noise

k = Boltzmann's constant (1.38×10^{-23} watt·sec/°K)

T = Total link noise temperature (K; see Table 3.2-1)

b_{rf} = Reference bandwidth (27 MHz in Regions 1 and 3; 24 MHz in Region 2)

G_m = Gain of a 1 m^2 effective aperture (dBi/m^2)

$G_a(\varphi)$ = Receive antenna gain (dBi) for topocentric angle φ

φ = Topocentric angle (in degrees) between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations)

Note that for a specified ($\Delta T/T$), b_{rf} and T the allowable interfering pfd is only a function of the earth station receive antenna gain which is a function of satellite orbital separation. Furthermore in these studies, it was assumed that $\varphi = 1.1\ \theta$.

The approach that was taken at WRC-2000 when developing the pfd mask in the Annex to Resolution **540 (WRC-2000)** to protect the FSS from BSS in another Region was to determine the pfd levels required to provide a maximum of 4% relative noise increase ($\Delta T/T$) into the range of representative FSS earth station antennas given in Table 3.2-1 above, assuming however antenna diagrams as per Annex 3 of Appendix 8.

C/I (Protection Ratio) approach

This approach determines an allowable interfering pfd_{all} level based on meeting a Protection Ratio (PR) objective, which translates into a Carrier-to-Interference ratio (C/I), at the receiver. This Protection Ratio, when combined with the Carrier-to-total Noise $(C/N)_T$, determines the quality of the received television signal which was one of the fundamental criteria when the BSS Plans were developed. The approach is useful for establishing allowable interference levels in systems where interference does not have the same impact as noise on the signal quality such as the case of analogue television transmission. The allowable interfering pfd level (pfd_{all}) can be determined from the following equations:

$$(C/I) = PR$$

$$pfd_{all}(\theta) = pfd_W - PR + D_a(\varphi)$$

where:

PR = protection ratio required to meet picture quality objective (dB)

$pfd_{all}(\theta)$ = allowable interfering pfd at orbital separation of θ degrees

pfd_W = wanted signal pfd

$D_a(\varphi)$ = receive antenna discrimination (dB) for off-axis angle φ

φ = topocentric angle between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations)

This approach was taken at WARC-77 and later at RARC-83 for establishing the BSS Plans. It was also used in developing the pfd masks included in Annexes 4 and 1 to Appendix **30** to protect the BSS in one Region from the FSS or BSS in another Region respectively, assuming a single entry C/I criterion equal to the nominal C/(N+I) aggregate level in the Plan, plus 5 dB, assuming a nominal assignment in Regions 1 and 3 BSS Plan (e.g. a wanted pfd of –103 dB(W/(m^2 · 27 MHz)) and a 90 cm antenna with a pattern as given in Figure 7 of Appendix **30**).

The same approach was adopted by WRC-2000 when developing the pfd mask, which is now in Section 1 of Annex 1 of Appendix **30**, to protect the BSS Plan and List in Regions 1 and 3 from new assignments in the Regions 1 and 3 List. In adopting this approach, WRC-2000 took into account the changes which had occurred since 1977 in the characteristics of the Plan, i.e. a reduced C/(N+I) aggregate level, a reduced wanted pfd of –108 dB(W/(m^2 · 27 MHz)), a reduced antenna diameter (60 cm) and an improved antenna radiation pattern as given in Figure 7*bis* of Annex 5 to Appendix **30** (also Recommendation ITU-R BO.1213). This pfd mask also takes into account a range of BSS antenna sizes from 60 cm to 240 cm, under the assumption that the satellite e.i.r.p. is adjusted so that the link quality is the same for all diameters. Table 3.2-2 provides a summary of the nominal parameters of the Plans including, for Region 2, subsequent modifications to the Plans, with the associated protection requirements used under this approach.

TABLE 3.2-2

Summary of nominal characteristics and co-channel C/I protection requirements in Appendix 30 (using Annex 6 of Appendix 30 (WRC-2000)*

	Regions 1 and 3 WARC-77 Plan, individual reception	**Regions 1 and 3 WARC-77 Plan, community reception**	**Regions 1 and 3 "new" Plan (WRC-2000) (digital to digital interference)**	**Region 2 Plan (Original) (Overall protection)**	**Region 2 Plan Modifications (Overall protection)**
BSS receive antenna diam (m)	0.9	1.8	0.6	1.0	0.45 to 2.4
BSS receive antenna pattern	Fig. 7 of Annex 5 of App. **30**	Fig. 7 of Annex 5 of App. **30**	Fig. 7*bis* of Annex 5 of App. **30**	Fig. 8 of Annex 5 of App. **30**	Fig. 7*bis* of Annex 5 of App. **30**
Pfd wanted dB(W/m^2)	–103	–111	–108	–107	–116 to –107
Bandwidth (MHz)	27	27	27	24	24
C/I aggregate (dB)	31	31	21	28	28
C/I single entry[1] required (dB)	36	36	26	33	33

[1] The $(C/I)_{\text{single entry}}$ parameter was used mainly as a planning tool in synthesizing the Plans and is not necessarily an appropriate criterion to consider for modifying the assignments in accordance to Article 4.

* Other values of parameters can also occur in the assignments of Appendix **30.**

Approach selected

The ITU-R studies concluded that either approach used by WRC-2000 (ΔT/T or C/I) may be used in arriving at suitable pfd masks to protect the BSS or the FSS, also taking into account the need to extend these two approaches to cover a range of advanced digital modulations and coding rates that may be used in the future for both BSS and FSS. These studies also concluded that the ΔT/T approach, using a 6% noise increase criterion for the range of antennas provided in Table 3.2-1, would be appropriate, and that it led to results very similar to those of the C/I approach, taking into account advanced digital modulations.

Assessment of the aggregate interference

Both approaches considered above rely on a single-entry criterion. Concern was expressed during the studies that these approaches may not provide sufficient protection against potentially unlimited aggregation of interference from multiple networks, each being allowed to produce the specified single-entry level, in particular for large orbital separations corresponding to the plateau region of the masks, e.g. greater than 10°, where most of interferers are expected to be located.

One way of addressing this concern would be the use of an aggregate interference criterion, such as the criterion used in Annex 1 of Appendix **30** to protect Region 2 Plan assignments from proposed modifications to that Plan or to protect Regions 1 and 3 Plan assignments from proposed additions/modifications to the Regions 1 and 3 List. This criterion is based on limiting the degradation caused to the Equivalent Protection Margin (EPM) for Regions 1 and 3, or to the Overall Equivalent Protection Margin (OEPM) for Region 2. Although this may be suited for the

protection of the BSS within the same Regional Plan (i.e. intra-Plan protection), it raises difficulties for inter-Plan, or inter-service application, due to its complexity, its time-varying nature and the use of different protection criteria for intra-Plan protection of assignments.

Another way of addressing the concerns in respect of the aggregate interference is to limit the single-entry interference allowance for large orbital separations. This approach was the basis for the WRC-2000 decision to limit the pfd mask included in the Annex to Resolution **540 (WRC-2000)** to a plateau of –111 dB(W/(m^2 · 27 MHz)) and –115 dB(W/(m^2 · 27 MHz)), for the protection of the FSS in Region 2 and in Region 3 respectively, against BSS interference. However, a plateau limit of –103.6 dB(W/(m^2 · 27 MHz)) was also adopted by WRC-2000 in Section 1 of Annex 1 of Appendix **30 (WRC-2000)**, for the protection of Regions 1 and 3 BSS Plan assignments against new or modified entries in the List.

Further detailed studies concluded that this plateau of –103.6 dB(W/(m^2 · 27 MHz)) should provide sufficient protection against aggregation of interference by multiple networks, for both BSS and FSS considering that, for satellite orbital separations greater than 15º, this value provides a 5 to 10 dB margin for practically all antennas of 45 cm diameter or greater.

3.2.2.2 Appendix 30 Criteria for intra-Regional BSS - BSS Sharing

This section concerns BSS/BSS sharing between assignments:

A. within the Regions 1 and 3 Plan,

B. of the Regions 1 and 3 Plan and the Regions 1 and 3 List,

C. within the Region 2 Plan.

The current criteria for these intra-service sharing situations are specified in various sections of the Annexes of Appendix **30**, as follows:

a) **Section 2 of Annex 1 to Appendix 30** provides the criterion for case C, specifying an OEPM degradation threshold limit of 0.25 dB, for the protection of BSS assignments within the Region 2 Plan against proposed modifications of that Plan.

There was a consensus among Region 2 administrations participating in the ITU-R studies, that the current OEPM degradation limit of 0.25 dB was appropriate and should be maintained.

It was considered that there would be a need, in the case where a BSS assignment in the Region 2 Plan contained in Appendix **30** is used in conjunction with a feeder-link assignment which is not using the 17.3-17.8 GHz band subject to Appendix **30A**, to calculate the OEPM degradation by assuming no degradation due to the feeder link (i.e. the OEPM would consist only of the downlink EPM). It was also considered that this issue is a conference issue and is outside the mandate of Study Groups.

b) **Section 1 of Annex 1 to Appendix 30**, as revised by WRC-2000, provides the criteria for cases A and B:

- the pfd cannot exceed –103.6 dB(W/(m^2 · 27 MHz))
- an administration is considered affected if the minimum orbital spacing is less than 9° and if the EPM degradation exceeds 0.45 dB and the pfd within the service area exceeds the following values (for the protection of digital transmissions):

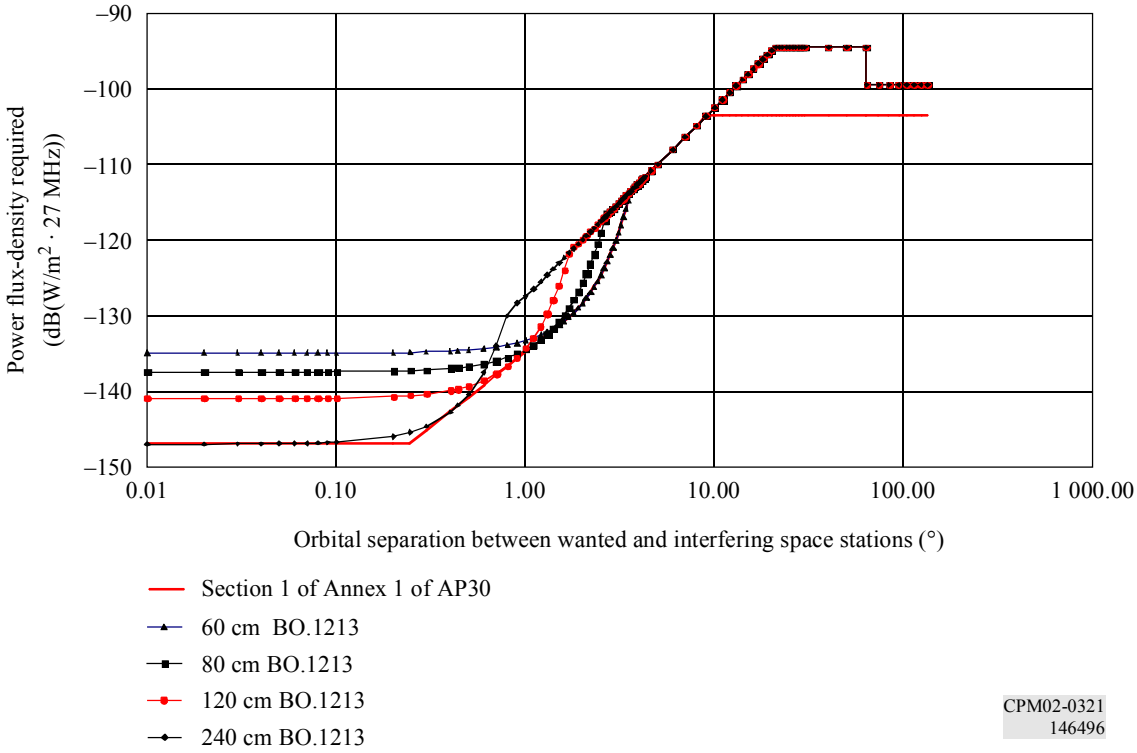
–147	dB(W/(m^2 · 27 MHz))	for	0°	$\leq \theta <$ 0.245°
–134.8 + 20 log θ	dB(W/(m^2 · 27 MHz))	for	0.245°	$\leq \theta <$ 1.7°
–135 + 1.66 θ^2	dB(W/(m^2 · 27 MHz))	for	1.7°	$\leq \theta <$ 3.6°

$$-127.5 + 25 \log \theta \qquad \text{dB}(\text{W}/(\text{m}^2 \cdot 27\ \text{MHz})) \qquad \text{for} \qquad 3.6° \leq \theta < 9°$$

This pfd mask is shown in Figure 3.2-1. It was generated at WRC-2000 with the aim of protecting the nominal characteristics of the Regions 1 and 3 Plan, as well as a range of antennas from 60 cm to 240 cm, that may be used for community reception or for assignments in the Regions 1 and 3 List.

FIGURE 3.2-1

Protection requirements for 60 cm to 240 cm antennas
(*C/I* requirement = 27 dB, reference –108 dB(W/m² · 27 MHz), 60 cm)*



* In this figure and subsequent figures, the actual mask in each case is the lower bound of the group of curves.

The protection of these antennas is based on the assumption that the wanted pfd is reduced dB per dB with increasing receive antenna gain, in such a way that the performance of the link is maintained constant corresponding to that using the nominal Plan transmission parameters; hence the protection criterion is the same, i.e. a C/I single- entry of 27 dB[1]. The permissible interfering pfd limit is calculated with the same formula in all cases:

$$\text{Interfering pfd limit } (\theta) = \text{pfd wanted} - 27 + \Delta G\ (\theta)$$

Where $\Delta G\ (\theta)$ is the off-axis angular discrimination for the corresponding topocentric angle for the antenna size considered, assumed to be compliant with Recommendation ITU-R BO.1213 (or Figure 7*bis* of Annex 5 of Appendix **30**).

In adopting the mask contained in Section 1 of Annex 1 of Appendix **30 (Rev.WRC-2000)**, the following objectives were considered:

---

1 This value of 27 dB was taken at WRC-2000 under the assumption of a wanted aggregate downlink C/I of 22 dB, which was subsequently modified by WRC-2000, to 21 dB.

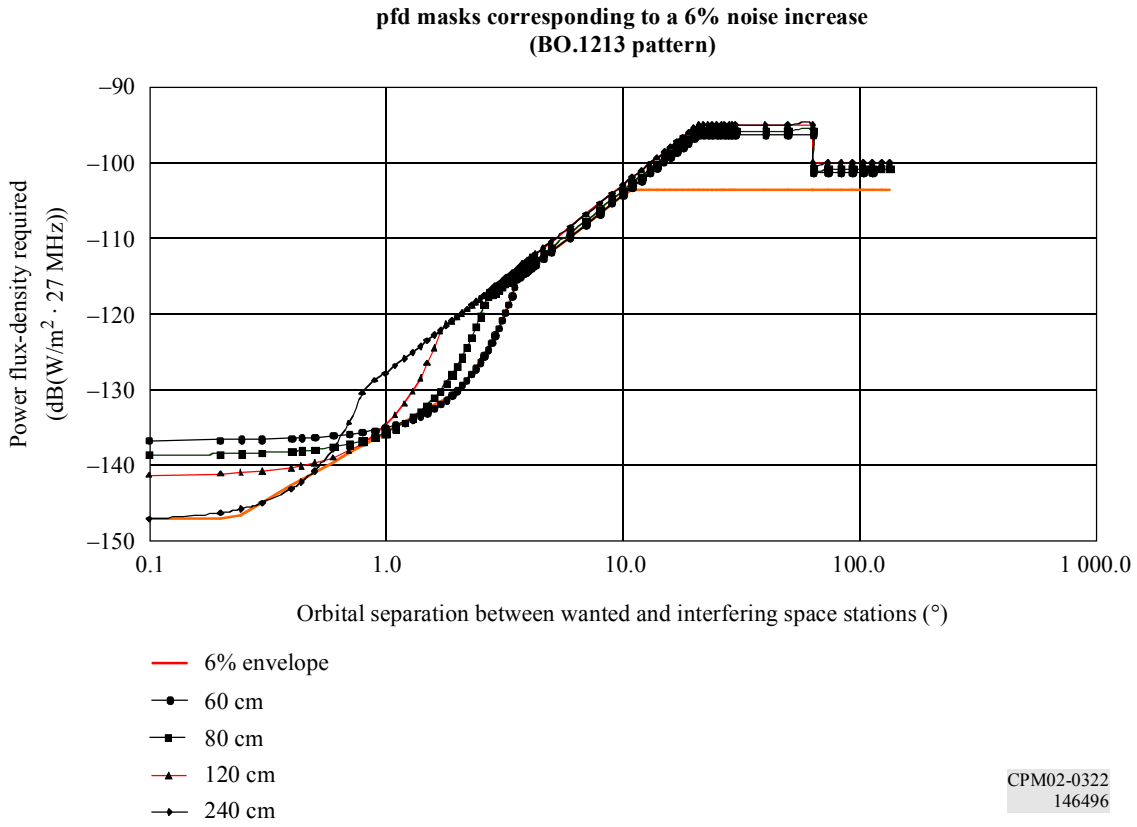
- to avoid providing assignments in the List with a protection level different from that of the Plan. The main concern was that the use of non-standard parameters for assignments included in the List may unduly constrain the entry into the List of future assignments, even if the former assignments have obtained all the agreements necessary to enter in the List. In particular, it was agreed not to protect antennas smaller than 60 cm;
- to avoid unnecessary coordinations by limiting the range of orbital separations in which coordination may be required. This was accomplished by limiting the maximum value of pfd of –103.6 dB(W/(m^2 · 27 MHz)) which corresponds to the value of the pfd mask in Section 1 of Annex 1 to Appendix **30 (Rev.WRC-2000)** for the orbital separation of 9°. Selecting this value ensures that in all cases the interference outside the 9° arc will not exceeed the permissible values, hence no coordination is required outside this arc;
- in order to maintain efficient use of spectrum, an off-axis antenna gain pattern corresponding to that specified in Recommendation ITU-R BO.1213 was adopted;
- in order to avoid entries in the List that would prevent the use of the same orbital position by future entrants, a maximum antenna diameter was used. The value of 2.4 m was selected for consistency with the mask in Annex 4 to Appendix **30**, which uses the same on-axis pfd level of –147 dB(W/(m^2 · 27 MHz)). This does not preclude the use of larger antennas, but only means they will be protected only to this level;
- in order to avoid entries in the List that would prevent the use of adjacent orbital locations, the protection of antenna sizes smaller than 60 cm was avoided. This does not preclude the use of smaller antennas, but only means they will be protected only to the level afforded to the 60 cm antenna.

Concern was expressed during WRC-2000 that the way in which the pfd mask of Section 1 of Annex 1 of Appendix **30 (Rev.WRC-2000)** was developed, i.e. scaling down the BSS pfd requirement from a reference set corresponding to a satellite e.i.r.p. of 56 dBW and a receive antenna of 60 cm, may not be adequate, since current systems use 60 cm with e.i.r.p. levels close to 50 dBW.

Discussions carried out by the ITU-R since WRC-2000 have shown that adequate protection may be given to assignments in the List by adopting the pfd mask given in Section 3.2.2.3 a) (BSS protection), which is based on a 6% noise increase criterion, and on the protection of a range of antennas from 60 cm to 240 cm associated to receive noise temperatures given in Table 3.2-1.

Figure 3.2-2 illustrates that this mask is the envelope of pfd masks corresponding to various antenna diameters.

FIGURE 3.2-2

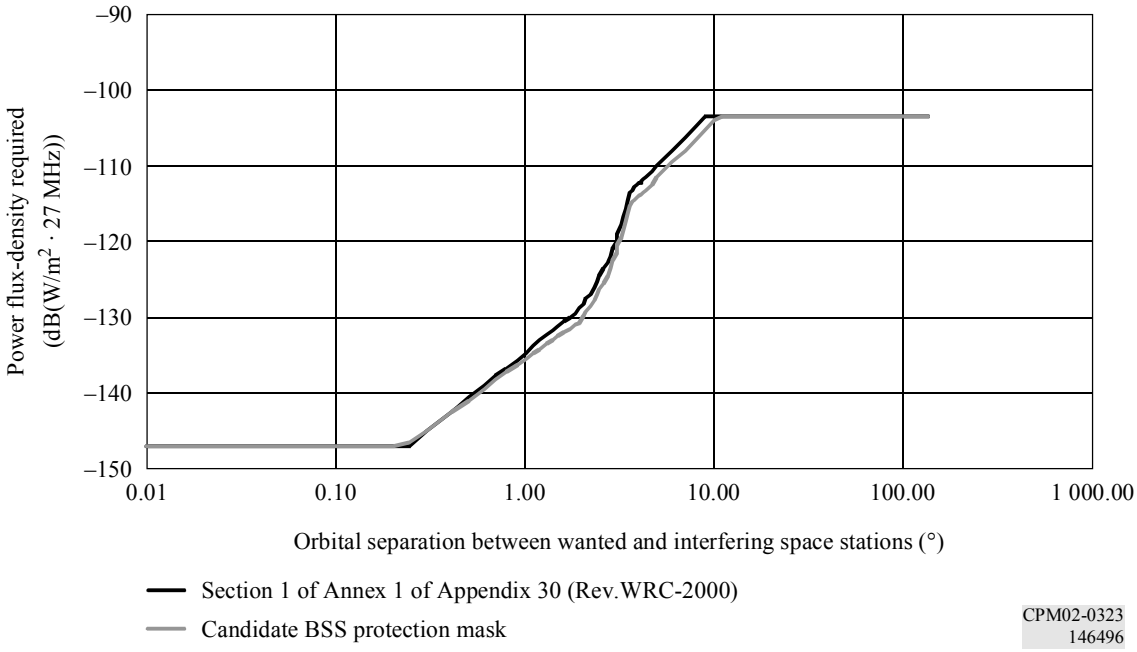


As can be seen from Figure 3.2-3, which compares the masks in Figures 3.2-1 and 3.2-2, the pfd mask under consideration provides up to 1.7 dB better protection to the nominal assignments in the Plan (60 cm antenna, –108 dB(W/(m^2 · 27 MHz)) wanted pfd) than the pfd mask adopted by WRC-2000 in Section 1 of Annex 1 to Appendix **30 (WRC-2000)**. It could therefore be advantageous to adopt this mask as a replacement for that in Section 1 of Annex 1 of Appendix **30**.

Some countries in Region 3 also consider that the protection of 45 cm antennas for the BSS is necessary, because of the large number of such antennas currently deployed in these countries. This could be incorporated in the above mask as indicated in the equations given section 3.2.2.3 b) (BSS protection) and shown in Figure 3.2-5, based on a 6% noise increase and Recommendation ITU-R BO.1213 antenna pattern.

FIGURE 3.2-3

Comparison of current and candidate pfd masks protection of BSS for Regions 1



3.2.2.3 Appendix 30 criteria for interregional sharing

The current criteria for interregional sharing in Appendix **30** are specified in various sections of the Annexes to Appendix **30**:

a) Annex 1, Section 3 specifies a pfd mask for the protection of the BSS subject to one of the Regional Plans from BSS Plan modifications or proposed new or modified assignments in the List in another Region (interregional sharing between planned bands including the 12.5–12.7 GHz band sharing between Region 2 plan and Region 3 un-planned band).

b) Annex 1, Section 6 (provisionally replaced by the Annex to Resolution **540 (WRC-2000)**) specifies a pfd mask for the protection of the FSS in one Region from BSS Plan modifications or proposed new or modified assignments in the List in another Region (interregional sharing between FSS downlinks and BSS).

c) Annex 1, Section 7 specifies a $\Delta T/T$ limit of 4% to protect FSS receive space stations in Region 1 from BSS Plan modifications in Region 2 (interregional sharing between FSS uplinks and BSS in the 12.5–12.7 GHz band).

d) Annex 4 specifies a pfd mask to protect the BSS in one Region from FSS or non-planned BSS in another Region (interregional sharing between BSS and FSS downlinks).

The ITU-R studies reviewed the protection criteria contained in these Sections of Appendix **30**, taking into account:

- the changes which occurred to the parameters and protection objectives of Plans since 1977;
- the need to protect BSS transmissions that may be entered in the Region 2 Plan or in the Regions 1 and 3 List, while ensuring efficient use of spectrum/orbit resources;
- that WRC-2000 requested in Resolution **540 (WRC-2000)** for the ITU-R to conduct this review considering that the sharing criteria in Appendices **30** and **30A** should provide

appropriate protection to the BSS, FSS, and terrestrial services whilst not unduly constraining the services involved;

- the desirability, in order to facilitate the coordination where Annex 4 protection levels are exceeded, to have an ITU-R Recommendation for use by administrations in their bilateral coordination, that would contain guidelines and methodology on power flux-density levels for the protection of individual BSS systems when the Annex 4 limits are exceeded. Such a Recommendation is also being developed.

  The impact of Nos. 4.1.18 and 4.1.18*bis* of Art. 4 of **AP30** and the need to avoid monopolization of orbital and spectrum resources, in particular by grouping of multiple networks on one orbital position is addressed in Section 3.2.3 and requires further study.

- with respect to the criterion in Section 7 of Annex 1 to Appendix **30**, the studies concluded that the current $\Delta T/T$ limit of 4% to protect FSS receive space stations in Region 1 against BSS Plan modifications in Region 2 could be relaxed to 6%.

With respect to the pfd masks contained in the other Sections of Appendix **30**, in view of the conclusions reported in the previous Section, possible alternatives to these pfd masks were developed, on the basis of a protection criterion of 6% noise increase, the antenna reference patterns given in Section 3.2.2.1 above, and the range of antennas and associated noise temperatures given in Table 3.2-1, as follows:

- For the protection of BSS: antenna diameters from 45/60 cm to 240 cm
- For the protection of FSS: antenna diameters from 45/60 cm to 11m.

Selection of the minimum antenna size to be included in the pfd mask

Depending on whether 45 cm or 60 cm is taken into account as the minimum antenna size, the corresponding pfd masks only differ in the range 2.0-5.0° of orbital separations, with a maximum difference of 7.2 dB for an orbital separation of 3.6° between the interfering and wanted space stations, as shown in Figure 3.2-1. Selection of the 45 cm antenna size would therefore translate into a reduction of up to 7.2 dB in permissible FSS/BSS interfering space station pfd in this range of orbital separation, compared with the selection of the 60 cm mask.

Differing views emerged as to the appropriateness of selecting 45 cm or 60 cm as the minimum size of antenna to be taken into account in deriving possible alternatives to the relevant pfd masks:

- Some administrations from Region 2 considered that the protection of the 45 cm antenna was essential for the protection of the Region 2 original BSS Plan assignments and their modifications including implemented systems where this size antenna is widely used. These administrations are also of the view that application of interregional reciprocity without an operational or technical basis may lead to unnecessary constraints on services.
- Some countries in Region 3 considered that the protection of 45 cm antennas for Region 3 BSS was necessary provided that the BSS is limited to national service area only, because the Regions 1 and 3 Plan was basically designed with 6° spacing, hence the protection of 45 cm antennas is ensured from the other assignments in the Regions 1 and 3 BSS Plan.
- Some countries in Region 3 considered that the protection of 45 cm antennas for the FSS in Region 3 was necessary. These countries also consider that the 45 cm pfd mask will satisfactorily reduce the number of "unnecessary" coordinations from the current pfd mask in Annex 1 of Appendix 30, as illustrated in Table 3.2.4 of this Report and selecting the 60 cm pfd mask would result in serious difficulties for their existing FSS networks in Region 3. These countries do not consider that interregional reciprocity should be applied.

- Some Regions 1 and 3 countries considered that the mutual protection of BSS and FSS within Regions 1 and 3 would need to be based on the 60 cm mask. Whilst recognizing that antenna sizes as small as 45 cm are currently used in some Region 3 countries, these countries noted that in practice, the protection given to these antennas either within the BSS or within the FSS was much smaller than what would be afforded by taking this size into account in the pfd mask. This is shown in Figure 3.2-2 for BSS (where going to the 45 cm mask could only increase the difference between the two curves) and in Figure 3.2-3 for FSS. These countries therefore considered that selection of the 45 cm size would make access to orbit/spectrum resources more difficult for future comers in both services, and result in less efficient use of these resources and unnecessary coordination requirements on both the FSS or the BSS. These countries also consider that interregional reciprocity should be applied.
- Some administrations of Region 1 do not agree on the principle of interregional reciprocity unless operational and technical bases for such reciprocity are identified.

FIGURE 3.2-1

Difference between the pfd masks based on 45 cm and 60 cm

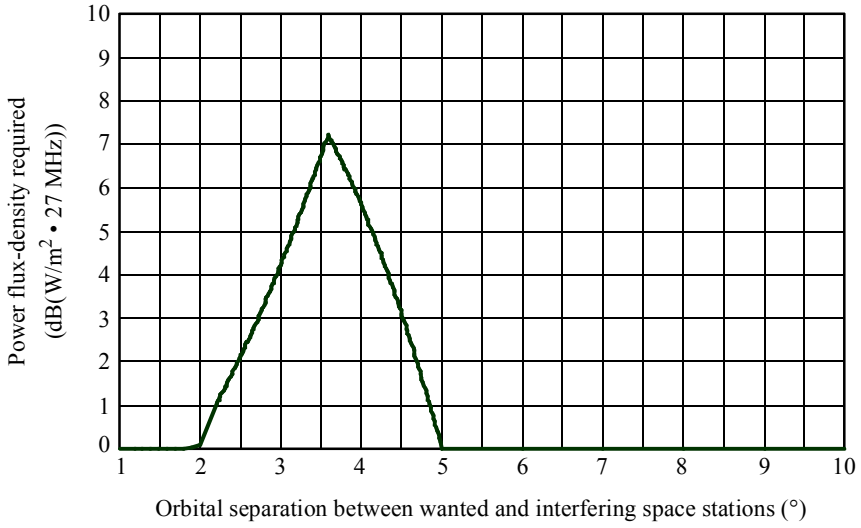


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FIGURE 3.2-2

Example of permissible single entry C/I into assignments in the Plan (left hand) and in the List or under the Article 4 process (right-hand part) for angular separations 2-5°

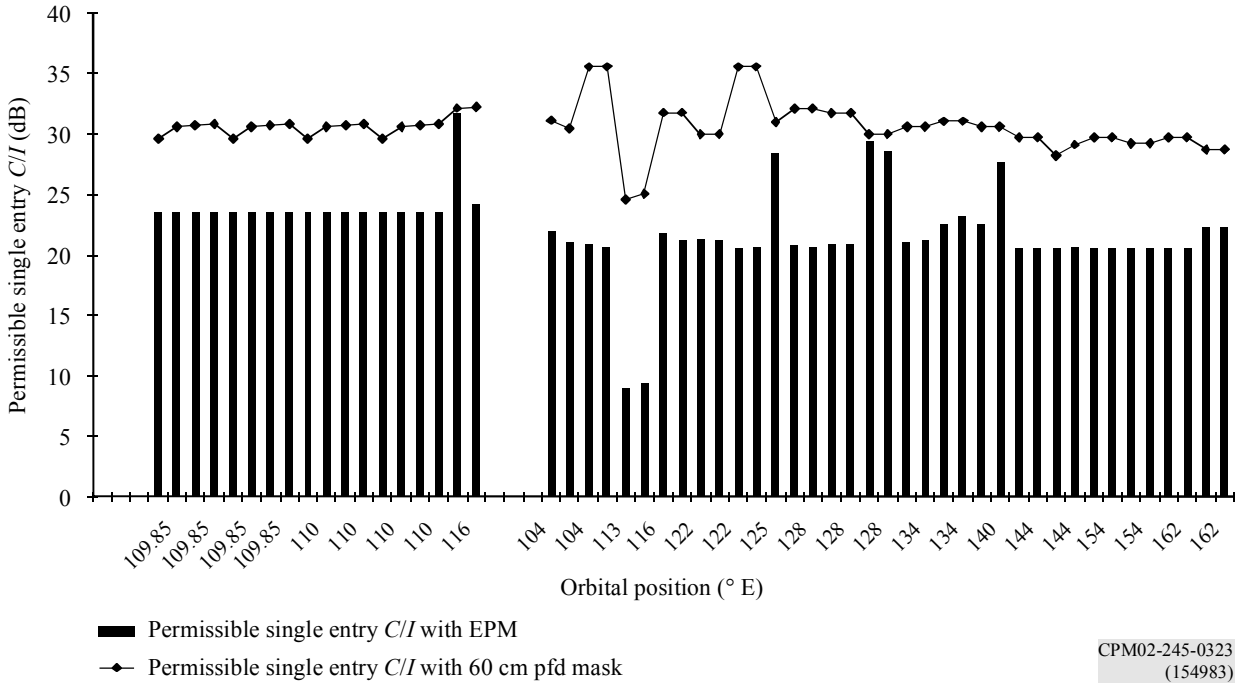
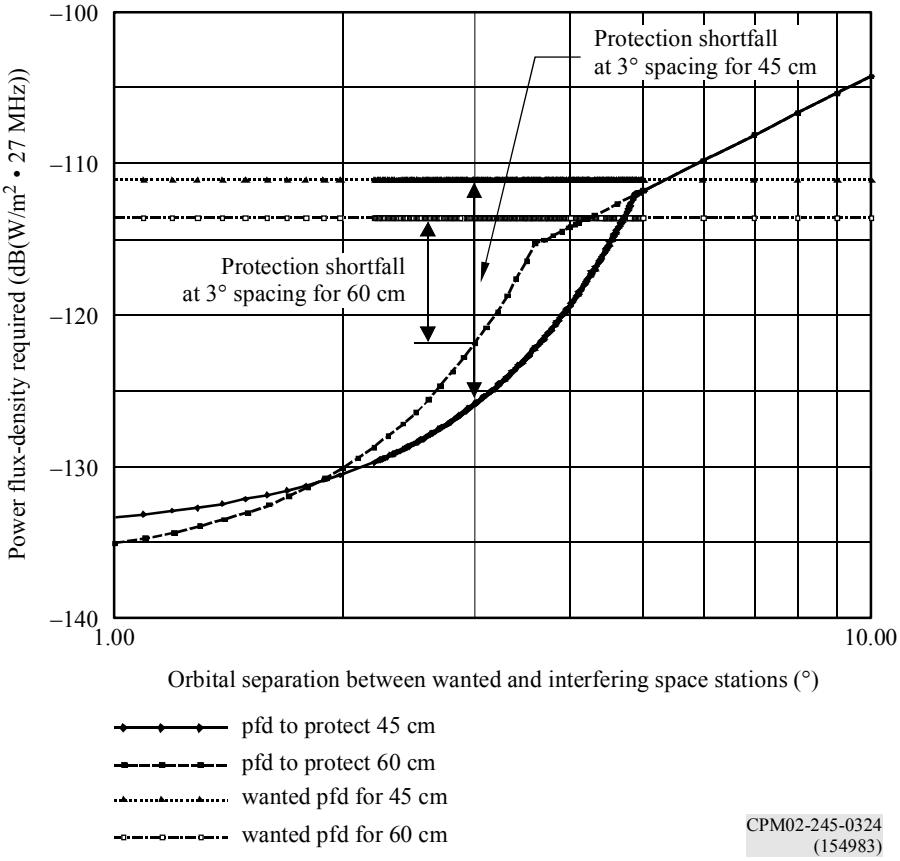


FIGURE 3.2-3

Pfd reqiured to protect 45/60 cm FSS antennas (BO1213, 6% noise increase) and to provide service to them



Another aspect to consider as a possible means of reducing the number of masks to be specified, is the sensitivity of the power flux-density limit on frequency. Considering the expression that determines the maximum allowable power flux-density (pfd_{all}) for a specified value of ($\Delta T/T$) (see Section 3.2.2.1 above) the only frequency-dependent terms are G_m, the gain of 1 m^2 effective aperture and $G_a(\varphi)$, the antenna gain in the main-lobe region only (note that the gain in the side-lobe and back-lobe regions are not frequency dependent). Hence in the main-lobe region, the frequency-dependent term cancels and pfd_{all} is independent of frequency. In the side-lobe and back-lobe regions, the pfd_{all} varies with frequency according to the G_m term. Therefore in these regions the difference in pfd_{all} between 12.2 GHz and 11.7 GHz is less than 0.4 dB. Also, considering the proposed pfd masks, this variance in pfd_{all} . only occurs in the side-lobe region of the smallest antenna being considered (i.e. between 5.0º-10.57º for the proposed 45 cm mask and between 3.59º-10.57º for the 60 cm proposed mask). For these reasons, and considering the expressed desire to converge towards a common mask, or minimum number of variations, only one frequency will be considered for generating the masks, i.e. 11.7 GHz.

Pending a decision on the minimum-size antenna that may be protected, the ITU-R studies concluded that the current pfd masks related to interregional sharing appearing in Sections 3 and 6 of Annex 1 and in Annex 4 to Appendix **30** may be replaced by one or both of the following masks (see Figures 3.2-4 and 3.2-5):

a) Proposed pfd mask for protection of BSS/FSS antennas down to 60 cm (protection: FSS antenna 0.6 m ≤ D ≤ 11 m; BSS antenna 0.6 m ≤ D ≤ 240 cm)

For FSS protection only[3]:

–158.2 dB(W/(m^2 · 27 MHz))	for	0° ≤ θ < 0.054°
–135.7 + 17.74 log θ dB(W/(m^2 · 27 MHz))	for	0.054° ≤ θ < 0.23°

For FSS and BSS protection:

–147 dB(W/(m^2 · 27 MHz))	for	0° ≤ θ < 0.23°
–135.7 + 17.74 log θ dB(W/(m^2 · 27 MHz))	for	0.23° ≤ θ < 2.0°
–136.7 + 1.66 θ^2 dB(W/(m^2 · 27 MHz))	for	2.0° ≤ θ < 3.59°
–129.2 + 25 log θ dB(W/(m^2 · 27 MHz))	for	3.59° ≤ θ < 10.57°
–103.6 dB(W/(m^2 · 27 MHz))	for	10.57° ≤ θ

where θ is the minimum geocentric orbital separation between the wanted and interfering space stations taking into account the respective East-West station keeping accuracies.

Figure 3.2-4 shows the proposed 60 cm FSS/BSS masks and demonstrates that it consists of the envelope of the masks required to protect a range of antenna sizes from 11 metres down to 60 cm.

b) Proposed pfd mask for protection of BSS/FSS antennas down to 45 cm (protection: FSS antenna 0.45 m ≤ D ≤ 11 m; BSS antenna 0.45m ≤ D ≤ 240 cm) For FSS protection only[3]:

–158.2 dB(W/(m^2 · 27 MHz))	for	0° ≤ θ < 0.054°
–135.7 + 17.74 log θ dB(W/(m^2 · 27 MHz))	for	0.054° ≤ θ < 0.23°

For FSS and BSS protection:

–147 dB(W/(m^2 · 27 MHz))	for	0° ≤ θ < 0.23°
–135.7 + 17.74 log θ dB(W/(m^2 · 27 MHz))	for	0.23° ≤ θ < 1.8°
–134.0 + 0.89 θ^2 dB(W/(m^2 · 27 MHz))	for	1.8° ≤ θ < 5.0°
–129.2 + 25 log θ dB(W/(m^2 · 27 MHz))	for	5.0° ≤ θ < 10.57°
–103.6 dB(W/(m^2 · 27 MHz))	for	10.57° ≤ θ

where θ is the minimum geocentric orbital separation between the wanted and interfering space stations taking into account the respective East-West station keeping accuracies.

[3] As the FSS also uses narrow-band transmissions the pfd should be expressed in units of dB(W/(m^2/40 kHz)). This requires reducing the pfd value by 10Log(27000/40) = 28.3 dB.

FIGURE 3.2-4

Proposed pfd mask for inter-regional FSS/BSS protection
(60 cm - 11 m)

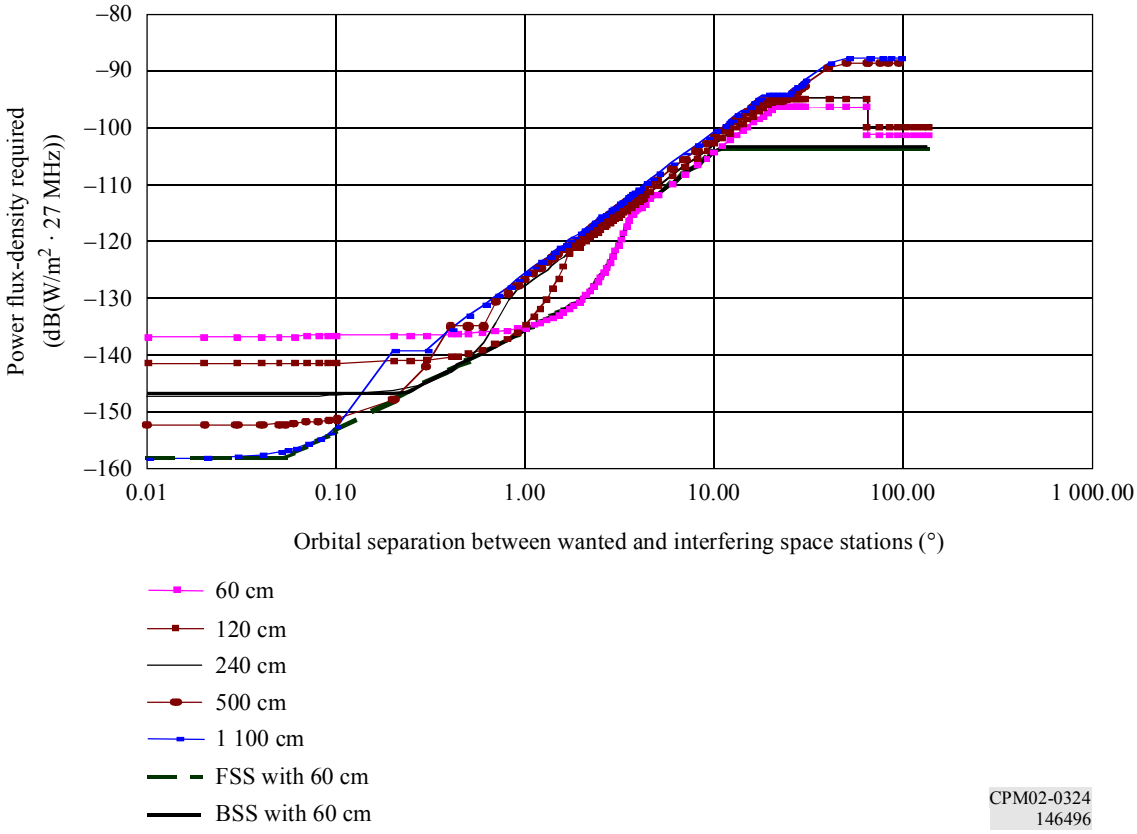


FIGURE 3.2-5

Proposed pfd mask for inter-regional FSS/BSS protection (45 cm - 11 m)

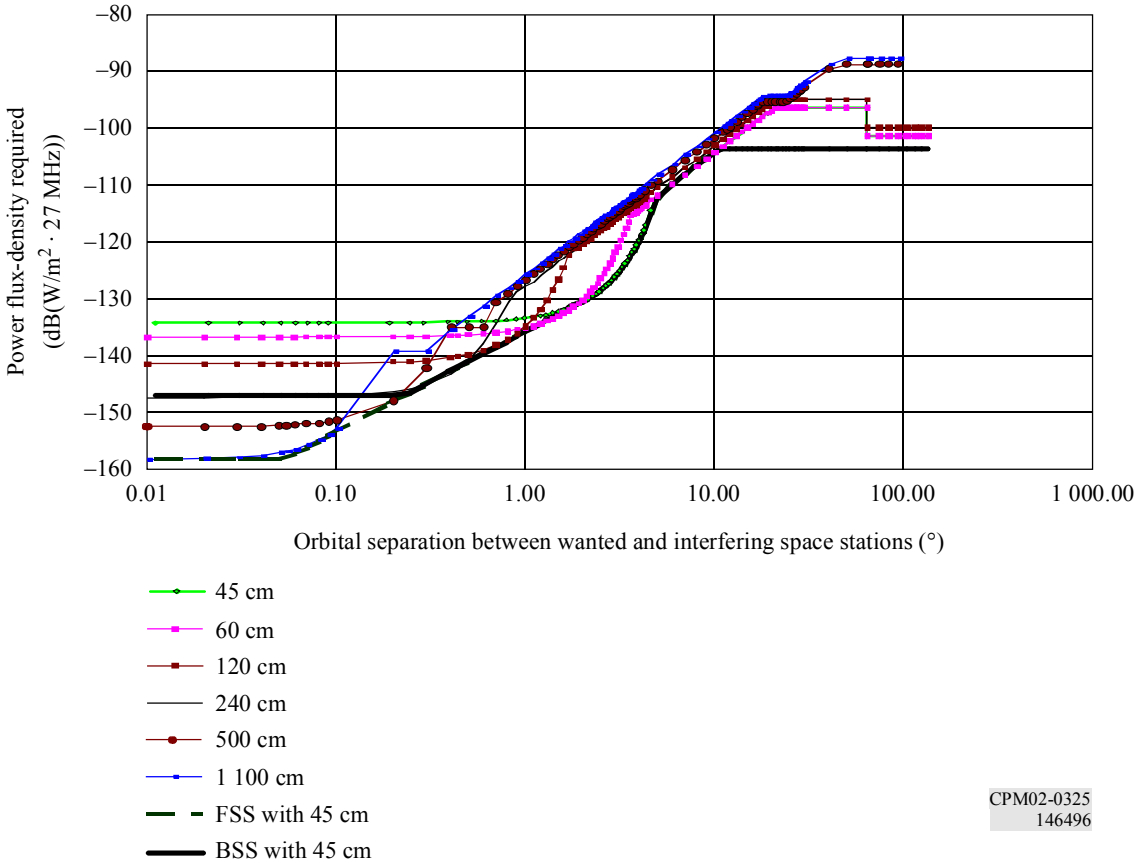


Figure 3.2-5 shows the 45 cm FSS/BSS masks and demonstrates that it consists of the envelope of the masks required to protect a range of antenna sizes from 11 metres down to 45 cm.

These proposed masks would provide for the protection of transmissions in the Regions 1 and 3 Plan, in the Regions 1 and 3 List and in the Region 2 Plan and its modifications, from interference caused by FSS or by the other Regional BSS Plan.

Also, the ITU-R studies concluded that there would be a need for grandfathering of certain types of transmissions brought into service prior to certain dates.

Some administrations are of the view that further studies are needed because the pfd mask in §§ 3.2.2.3 a) and b) only apply for a particular range of latitudes for which the assumption that "the topocentric angle is equal to 1.1 times the geocentric angle" is valid.

Some administrations considered that another possibility would be to retain the existing pfd masks in Appendix **30**, noting in particular that the current mask in Annex 4 of Appendix **30** would provide a better protection for the BSS Plan than the alternative masks proposed above. It was noted however, that this would have several disadvantages:

- Keeping the current masks for the BSS protection would, protect assignments using antennas down to 10 cm in diameter, a situation which would clearly not represent efficient use of orbit/spectrum resources and would encourage monopolization of resources by non-standard uses in the List.

- Keeping the current masks would maintain undue constraints on both the FSS and the planned and non-planned BSS, and would make the use of the assignments in conformity with the Plan very difficult for many countries. As an illustration of that, Table 3.2-1 highlights the benefit that the adoption of the proposed masks would provide on reducing the number of coordinations required in bringing the assignments of the Regions 1 and 3 Plan into service. It should be noted that this issue is also connected to agenda item 1.35.

TABLE 3.2-1

Impact of the adoption of alternative relaxed sharing criteria on the evaluation of the coordination requirements of the new Appendix 30 Plan for Regions 1 and 3 with the FSS

Sharing criteria	Article 11 of AP 30 (current pfd masks in Annex 1 of Resolution 540) (WRC-2000)	Proposed pfd mask (with 45 cm FSS minimum antenna size)	Proposed pfd mask (with 60 cm FSS minimum antenna size)
Number of Region 2 FSS networks identified as affected by the Regions 1 and 3 Plan (WRC-2000)	**796**	**164**	**160**
Number of Region 3 FSS networks identified as affected by the Regions 1 and 3 Plan (WRC-2000)	**2 100**	**207**	**205**

Table 3.2-2 provides the result of a similar study in the other direction of operation, i.e. from FSS and non-planned BSS into BSS Plan and the List, in order to evaluate the impact of candidate sharing criteria in terms of coordination requirements.

TABLE 3.2-2

Impact of the adoption of alternative relaxed sharing criteria on the evaluation of the coordination requirements of FSS/non-planned BSS with the Appendix 30 Plans and List

Sharing Criteria		Annex 4 of Appendix 30	Proposed pfd mask (with 45 cm BSS minimum antenna size)	Proposed pfd mask (with 60 cm BSS minimum antenna size)
R1	Number of coordinations required with BSS beams in the Region 1 Plan	4	2	2
	Number of coordinations required with BSS beams in the Region 1 List	264	198	184
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by the BR	643	543	490
R2	Number of coordinations required with BSS beams in the Region 2 Plan	519	428	N/A
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by BR	56	54	N/A
R3	Number of coordinations required with BSS beams in the Region 3 Plan	0	0	0
	Number of coordinations required with BSS beams in the Region 3 List	160	123	117
	Number of coordinations required with BSS beams, whose Appendix 4 data have been published by BR	398	360	326

The numbers of BSS beams mentioned in Table 3.2-2 represent the numbers of MSPACE beams from SPS database identified as affected by FSS networks. The same beam can be identified multiple times for coordination with different FSS networks.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3.2.2.4 Appendix 30 criteria for the protection of BSS earth stations from terrestrial stations or from FSS earth stations operating in the opposite direction of transmission

Protection of receive BSS earth stations in the band 11.7-12.5 GHz against interference caused by terrestrial or FSS transmit earth stations operating in the opposite direction of transmission is ensured by No. **9.19** and its associated method for determining the need for a coordination (i.e. Annex 3 of Appendix **30**).

Considering that Appendix **7** and Annex 3 to Appendix **30** provide sharing criteria that may be reviewed and adjusted in order to cover both sharing situations (terrestrial and FSS earth station interference into BSS), Resolution **735 (WRC-2000)** invites the ITU-R to undertake, as a matter of urgency, and complete in time for consideration by WRC-03, the appropriate regulatory, operational and technical studies in the bands allocated to the BSS and the FSS (Earth-to-space) or to terrestrial services, consistent with the decisions of WRC-2000 concerning No. **9.19**, in order to enable WRC-03 to review, and if appropriate revise, the regulatory and technical sharing conditions between these services, with a view to enabling equitable access to spectrum by these services in these bands and ensure their harmonious development.

Resolution **735 (WRC-2000)** was motivated by the fact that, as originally adopted at WRC-97, No. **9.19** dealt only with the need for transmitting terrestrial stations to coordinate with respect to receiving earth stations in the unplanned BSS bands. WRC-2000 modified No. **9.19** to extend its applicability to include transmitting earth stations, as well as terrestrial stations, and to include BSS earth stations in the planned BSS bands, as well as in the unplanned bands.

Annex 3 provides the current criteria for the protection of BSS earth stations from interference caused by terrestrial stations, as specified in the Appendix **30** regulatory procedures for this type of coordination (see Section 6.2.2 of Article 6 of Appendix **30**). It provides a simple method for determining each of two relevant pfd:

a) the limiting pfd not to be exceeded at the edge of a BSS service area in order to protect the BSS earth stations located there, and

b) the interfering pfd produced at any point on the edge of the BSS service area by a given transmitting terrestrial station, under worst-case propagation conditions.

Coordination is required if the pfd calculated in b) exceeds the pfd calculated in a). The same criteria and calculation method could also be applied to determining the need for coordination of a transmitting earth station.

The pfd calculation of a) takes into account the wanted pfd of the BSS at the edge of the service area, the protection ratio between the wanted and interfering signals, the angular discrimination provided by the BSS receiver antenna radiation pattern and the polarization discrimination between the wanted and the interfering signal. These parameters were established by WARC-77 for the Regions 1 and 3 Plan and by RARC-83 for the Region 2 Plan. In order to continue to use this Annex in the framework established by WRC-2000, there is a need to update the parameters taking into account the updated Plan parameters in Regions 1 and 3, and the case of interference from FSS transmitting earth stations in the band 12.5-12.7 GHz. The pfd calculation of b) takes into account the e.i.r.p. of the terrestrial station in the direction of the point concerned on the edge of the BSS service area, and the total path loss. The propagation information for calculating the latter should also be updated to align with the most recent propagation models developed by the ITU-R.

Appendix **7 (WRC-2000**) addresses the determination of the coordination area (see No. **1.171**) around a transmitting or receiving earth station that is sharing spectrum in frequency bands between 100 MHz and 105 GHz with terrestrial radiocommunication services or with earth stations operating in the opposite direction of transmission. The coordination area represents the area

surrounding an earth station sharing the same frequency band with terrestrial stations, or the area surrounding a transmitting earth station that is sharing the same bidirectionally allocated frequency band with receiving earth stations, within which the permissible level of interference may be exceeded and hence coordination is required. The coordination area is determined on the basis of known characteristics for the coordinating earth station and on conservative assumptions for the propagation path and for the system parameters for the unknown terrestrial stations, or the unknown receiving earth stations, that are sharing the same frequency band.

For the purpose of calculating the coordination area, the location of the transmitting or receiving earth station may be represented by a single point or by a service area. In the case of protecting a service area, the coordination area is determined by extending the periphery of the specified service area within which the earth stations are operating by the calculated coordination distance. In the case of interest here and with respect to transmitting terrestrial stations, Appendix 7 could be used to determine the coordination area around BSS earth stations referred to in Section 1.4.5 of Appendix **7**. In particular, ITU-R studies have shown that this method could be used as an alternative to that of Annex 3 of Appendix **30** for the identification of administrations with which coordination is to be effected or agreement sought under No. **9.19**.

Where two earth stations are operating in opposite directions of transmission it is only necessary to establish the coordination area for the transmitting earth station, as receiving earth stations will automatically be taken into consideration. Hence, a receiving earth station operating in a bidirectionally allocated frequency band will only be involved in coordination with a transmitting earth station if it is located within the transmitting earth station's coordination area. In the case of interest here and with respect to transmitting earth stations in the fixed-satellite service (Earth-to-space), Appendix **7** could also be used to determine the coordination area around these FSS earth stations.

In order to respond to Resolution **735**, the ITU-R has identified the two following options, the merits of which are discussed below:

Option 1: to maintain Annex 3 of Appendix **30** with appropriate revisions of the BSS parameters to reflect changes made to the technical parameters in the plans since Annex 3 was developed at WARC-77, but retaining the existing propagation model. This option is referred to hereafter as "**Annex 3(Rev.1)**".

ITU-R also recommends that the propagation model used in Annex 3 be updated to reflect the most recent ITU-R model. This option is referred to hereafter as "**Annex 3(Rev.2)**";

Option 2: to replace Annex 3 of Appendix **30** by use of Appendix **7** with the addition of the appropriate BSS parameters to be included in Table 8 of Annex 7 of this Appendix.

Option 1

In comparing the two types of sharing criteria, Annex 3 provides an arguably more straightforward and readily understood way for an administration to determine whether coordination is required when it wishes to deploy transmitting terrestrial or earth stations outside the BSS service area of another administration. Annex 3 is also somewhat simpler to use than Appendix **7** because it determines the need to coordinate based directly on parameters that are typically used in the coordination of BSS stations and uses BSS systems parameters that are familiar to BSS operators, e.g., power flux densities, protection ratios, angular discrimination of a receiver antenna. Therefore, if the results show that coordination is required, administrations can fully appreciate the protection being afforded and hence negotiate the appropriate values for these well-known parameters and assess the impact on system performance. In contrast, Appendix **7** parameters such as NL, Ms, and W, have not been used when the coordination process involves BSS stations.

Another positive aspect of Annex 3 is that it is wholly self-contained within Appendix **30**. This aspect has long been recognized as a positive feature since administrations are accustomed to finding all of the regulations covering use of the 12 GHz planned BSS bands in Appendix **30**. To replace Annex 3 by a reference to Appendix **7** would be to make the corresponding sharing criteria the only ones for protecting the BSS that are not available in their entirety within Appendix **30**.

If Annex 3 is maintained, the ITU-R believes that the updates to the parameters provided in Table 3.2-3 are appropriate. Also the propagation model should be updated to reflect the most recent ITU-R model.

TABLE 3.2-3

Updated Annex 3 parameters

Annex 3 Parameter	**Updated Value**
For Regions 1 and 3	
R	30 dB
P	0 dB
Fo	-108 dB(W/(m^2·27 MHz))
D	$0.0025((d/\lambda)*\varphi)^2$ dB for $0° \leq \varphi \leq \varphi_m$ $G_{max}-(29-25\log(\varphi_r))$ dB for $\varphi_m \leq \varphi \leq \varphi_r$ $G_{max}-(29-25\log(\varphi))$ dB for $\varphi_r \leq \varphi \leq 14.45°$ G_{max} dB for $14.45° < \varphi$ Where: $\varphi_m = (\lambda/d)((G_{max}-G_1)/(0.0025))^{(0.5)}$ deg. $\varphi_r = 95(\lambda/d)$ deg. $G_{max}= 35.5$ dB $G_1 = 29-25\log\varphi_r$ dB d = 60 cm λ = wavelength in centimetres
For Region 2	
R	30 dB
P	0 dB
Fo	-115 dB(W/(m^2·24 MHz))
D	$0.0025((d/\lambda)*\varphi)^2$ dB for $0° \leq \varphi \leq \varphi_m$ $G_{max}-(29-25\log(\varphi_r))$ dB for $\varphi_m \leq \varphi \leq \varphi_r$ $G_{max}-(29-25\log(\varphi))$ dB for $\varphi_r \leq \varphi \leq 14.45°$ G_{max} for $14.45° < \varphi$ dB Where: $\varphi_m = (\lambda/d)((G_{max}-G_1)/(0.0025))^{(0.5)}$ deg. $\varphi_r = 95(\lambda/d)$ deg. G_{max}=33.5 dB (45 cm)

	$G_1 = 29–25\log\varphi_r$ dB d = 45 cm λ = wavelength in centimetres
NOTE 1 – The proposed value for D is updated based on ITU-R BO.1213. NOTE 2 – The current values contained in Annex 3 should be maintained for the analogue BSS assignments in the Region 2 Plan which are in conformity with Appendix **30** and which have been brought into use and for which the date of bringing into use has been confirmed to the Bureau before 9 June 2003.	

Option 2

Appendix **7** takes advantage from a recent revision of propagation data (Recommendation ITU-R P.620-4) and takes account of the rain climatic zone. Thus it will provide a more accurate and realistic evaluation of the interference potential. It will also enable to correct several deficiencies identified in Annex 3 of Appendix **30** methodology (e.g. Annex 3 does not provide any criterion for short-term conditions of propagation; unexplained significant differences in propagation fading have been identified between Region 2 and Regions 1 and 3).

Replacing Annex 3 of Appendix **30** by Appendix **7** will also permit to simplify and harmonize the Radio Regulations in retaining a single methodology for determining the need for a coordination in all sharing situations. In that respect, WRC-2000 followed this direction in replacing the former Section 3 of Annex 4 to Appendix **30A** by Appendix **7** for the determination of the coordination area around a feeder-link transmitting earth station.

Table 3.2-4 provides the parameters, which have been considered appropriate by the ITU-R for this purpose. These proposed values allow higher terrestrial pfd levels than those, which would result from the application of the current Annex 3 method.

TABLE 3.2-4

BSS parameters for possible inclusion in Table 8 of Annex 7 of Appendix 7

Frequency band (GHz)		11.7-12.75	12.2-12.7	12.2-12.7
Region		R1 and 3	R2	R2
Modulation		N	A	N
p0 (%)	Percentage of the time during which the interference from all sources may exceed the permissible value	0.003	0.03	0.003
n	Number of expected entries of interference, assumed to be uncorrelated	1	1	1
p (%)	Percentage of the time during which the interference from one source may exceed the permissible value (p = p0/n)	0.003	0.03	0.003
NL (dB)	Link noise contribution	1	1	1
Ms (dB)	Link performance margin	4	7	4
W (dB)	Equivalence factor (dB) relating interference from interfering emissions to that caused by the introduction of additional thermal noise of equal power in the reference bandwidth	0	4	0
Te (K)	Thermal noise temperature of the receiving system at the output of the receiving antenna	120	120	120
B (Hz)	Reference bandwidth (bandwidth of the interfered with	2.7E+07	2.4E+07	2.4E+07

	system over which the power of the interfering emission can be averaged)			
Pr (p) (dBW in B)	Pr(p) = 10 log (k Te B) + NL + 10 log (10^(Ms/10) – 1) – W	–130.7	–131.0	–131.2
N = Digital modulation A = Analogue modulation				

Comparison of Annex 3 methodology and Appendix 7 methodology

The objective is to compare the protection provided to BSS receivers by the different methodologies used in Annex 3 and Appendix 7. First, it is necessary to find an equivalent parameter from the two methodologies to be able to perform the comparison. This section determines that equivalent parameter and shows that the parameter is independent of the specific propagation model. It also seeks to align the methodology used in Appendix 7 to be equivalent to the methodology used in Annex 3 which is based on a protection ratio criteria.

Table 3.2-5 below compares the maximum allowable interfering pfds at the coordination distance and their corresponding minimum protection ratios for six cases using Annex 3(Rev.1) and Appendix 7.

TABLE 3.2-5

Interfering pfd levels and corresponding (C/I) at BSS receiver

Region, type of path, modulation	Methodology	Interfering pfd at BSS receiver exceeded only for p% (see note) (dB(W/m^2))	(C/I) at BSS receiver ≥ (100-p)% (see note) (dB)	(C/I) at BSS receiver ≥ 99.7% of the time (dB)
R1 and R3 overland digital	Appendix 7	–87.6	15.3	29.11
	Annex 3(Rev.1)	–102.3	30	30
R1 and R3 oversea digital	Appendix 7	–87.6	15.3	24.53
	Annex 3(Rev.1)	–102.3	30	30
R2 overland analogue	Appendix 7	–84.85	21.05	29.24
	Annex 3(Rev.1)	–98.8	35	35
R2 oversea analogue	Appendix 7	–84.85	21.05	26.38
	Annex 3(Rev.1)	–98.8	35	35
R2 overland digital	Appendix 7	–87.6	6.1	19.85
	Annex 3(Rev.1)	–111.5	30	30
R2 oversea digital	Appendix 7	–87.6	6.1	15.22
	Annex 3(Rev.1)	–111.5	30	30

NOTE – In the case of Appendix 7, the value of *p*% corresponds to 0.003% for digital and 0.03% for analogue. In the case of Annex 3, the value of *p*% is 0.3%.

Table 3.2-5 contains the comparison of the interfering pfd levels at the BSS receiver, assumed to be located at the edge of the BSS service area, where the elevation angle is assumed to be 30°, that is exceeded for only *p*% of the time, using Appendix 7 and Annex 3 methodologies. This comparison is done for the three Regions using various propagation paths and for analogue and digital modulations. In the case of Appendix 7 methodology, the parameters assumed are given in Table 3.2-4 and for the case of Annex 3 in Table 3.2-3. The third column provides the resulting

interfering pfd levels that are only exceeded for *p*% of the time, where *p* corresponds to 0.3% in the case of Annex 3(Rev.1) and in the case of Appendix 7, p corresponds to 0.003%(for digital modulation) and 0.03% (for analogue modulation). The fourth column gives the corresponding values of C/I that are met or exceeded for all but *p*% of the time. Finally, the fifth column shows the corresponding values of C/I with *p*% adjusted to be the same, corresponding to 0.3%. As can be seen, from the fifth column, Annex 3(Rev.1) methodology results in a higher value of protection (i.e. C/I) in all cases for the same percentage of the time.

Table 3.2-6 compares the resulting coordination distances. For digital modulation in all Regions, it is observed that Appendix 7 provides a smaller coordination distance for an oversea path as compared to Annex 3(Rev.1) and a similar or larger coordination distance as provided by Annex 3(Rev.1) for an overland path. For analogue modulation, it is observed that Appendix 7 provides a larger coordination distance for an overland path and a similar coordination distance for an oversea path. Since Appendix 7 reflects the most recent ITU-R propagation model to determine the coordination distances, it is desirable to update the propagation model in Annex 3(Rev.1) with the propagation model of Appendix 7 as recommended in the draft CPM Report.

Table 3.2-7 provides the coordination distances obtained from various cases using the Appendix 7 propagation model. Column 2 contains the coordination distances obtained by Annex 3(Rev.2) option with a value for *p*% of 0.003% (N) and 0.03% (A) (the same as proposed for use in Appendix 7). Column 3 provides the coordination distances for the Annex 3(Rev.2) option using a value for *p*% of 0.3%, which is the value used in current Annex 3 propagation model. It was stated that the mitigation factor used in Appendix 7 propagation option be set to 0. This is due to the fact that the methodology of Annex 3 is based on a known geometry between the interfering terrestrial station or transmitting earth station and the receiving BSS earth stations as well as a known interfering transmitter power. Many of the assumptions on the mitigation factor are no longer valid since in the Annex 3 approach these parameters and geometry are known. However, this may not be valid for the case of coordinating mobile terrestrial transmitters. Column 4 provides the coordination distances for the option of Annex 3(Rev.2) using a value for *p*% of 0.3% and no mitigation factor (i.e. $C_{2i} = 0$). Setting mitigation factor to 0 resulting in increase of coordination distances of up to 12% for the examples considered. However, for certain cases such as coordination distances resulting from mode 2 propagation and overseas paths, this mitigation factor has no impact on the coordination distances. Column 5 provides the option of Appendix 7 using the proposed value for *p* of 0.003% (N) and 0.03% (A). It is noted that the coordination distances for Annex 3(Rev.2) option are greater than those for Appendix 7 option for all the examples. This is consistent with the results given in Table 3.2-4, which indicates that the Annex 3(Rev.2) option provides greater protection than the Appendix 7 option.

TABLE 3.2-6

Comparison of coordination distances* with respect to Annex 3(Rev.1)

Region, type of path, modulation	Method used	Coordination distance (km)	Coord. distance % difference, w.r.t. Annex 3(Rev.1)
R1 and R3 overland digital	Appendix 7	215	0.6
	Annex 3(Rev.1)	214	
R1 and R3 oversea digital	Appendix 7	324	–46.9
	Annex 3(Rev.1)	610	
R2 overland analogue	Appendix 7	181	23.2
	Annex 3(Rev.1)	147	

R2 oversea analogue	Appendix 7	277	0.4
	Annex 3(Rev.1)	276	
R2 overland digital	Appendix 7	214	12.1
	Annex 3(Rev.1)	191	
R2 oversea Digital	Appendix 7	319	–11.1
	Annex 3(Rev.1)	359	
* It should be noted that the calculation of the coordination distances in this study are based on the spread sheet provided in Document 6S/185.			

TABLE 3.2-7

Coordination distances (km) using Appendix 7 propagation model (for different values of *p* and mitigation factor, C_{2i})

Region, type of path, modulation	Annex 3(Rev.2) *p*%=0.003% (N); *p*%=0.03% (A)	Annex 3(Rev.2) *p*%=0.3%	Annex 3(Rev.2) *p*%=0.3% (C_{2i}=0)	Appendix 7 *p*%=0.003% (N); *p*%=0.03% (A)
R1 and R3 overland digital	284	218	249	215
R1 and R3 oversea digital	434	359	359	324
R2 overland analogue	266	206	230	181
R2 oversea analogue	372	330	330	277
R2 overland digital	324	289	289	214
R2 oversea digital	493	413	413	319

3.2.2.4.1 Additional ITU-R studies

Based on studies conducted by the ITU-R on Option 1 and Option 2 approaches, the following conclusions were reached:

- the value of 0.3%, may be used for *p*, the percentage of time, in the possible updating of the propagation model of Annex 3. This corresponds to the value used in the existing propagation model of Annex 3, hence providing a consistent level of protection;
- using the parameter values proposed in the draft CPM Report for Appendix 7 and Annex 3 and a value for *p* of 0.3% in the case of Annex 3 methodology, the Annex 3 methodology provides greater protection to BSS earth stations for 99.7% of the time;
- considering that the propagation model used in Appendix 7, which is based on Recommendation ITU-R P.620-4, represents the most recent published results of ITU-R studies, it should replace the current propagation model contained in Annex 3 to Appendix 30;
- regardless of which Option is adopted, further study is required to determine the applicability of Mode (2) propagation of Appendix 7 in coordination of BSS receive earth stations;

- regardless of which Option is selected, the following scenarios should be considered to determine an appropriate value(s) for the mitigation factor for terrestrial (fixed and mobile) transmitting stations and FSS transmitting earth stations:
  - for the case of coordinating with fixed terrestrial transmit stations and FSS transmit earth stations the mitigation factor should be set to zero;
  - if the interfering transmitting and/or the receiving stations' system parameters and path geometries are unknown (e.g. coordination of a typical terrestrial mobile transmitting stations), a mitigation factor is needed to compensate for the worst-case assumptions. Appendix 7 provides a basis for calculating the mitigation factor, however, further study is required to determine its applicability for coordination of BSS stations.

3.1.2 Propagation Mode 2 (Appendix 7: § 5, Annex 5)

Distance-dependent part of the losses (dB)

$$L_r = 146.27 + 20\log r_i - 13.2\log R - G_x + A_b - 10\log R_{cv} + \Gamma_2 + L_{ar} + 7.507\times 10^{-3} d_o + 0.0110 d_v$$

where:

r_i: path length considered, it lies within the range between a minimum calculation distance and a maximum calculation distance, which are given in § 4.1 of Appendix 7 and § 2 of Annex 2 to Appendix 7

R: rain fall rate (mm/h)

G_x: terrestrial network antenna gain (dB)

A_b: additional attenuation for the departure from Rayleigh scattering (dB)

R_{cv}: effective scatter transfer function

Γ_2: additional attenuation outside the common volume (dB)

L_{ar}: loss above the rain height (dB)

d_o: effective path length for oxygen absorption (km)

d_v: effective path length for water vapour absorption (km).

Path loss for Mode 2:

$$A_{mode2} = L_r(p) + G_r + G_t$$

where G_r is the gain (dB) of the antenna of the receiving earth station.

The minimum path loss, A_{min}, between interfering transmit site and edge of BSS service area is given by:

$$A_{min} = \text{Min}\ (A_{mode1},\ A_{mode2}) \quad \text{(dB)}$$

3.2.2.5 Appendix 30A intra-Regional criteria for the protection of BSS feeder-link receiving space stations from BSS feeder-link transmitting earth stations

Section 3 of Annex 1 of Appendix **30A** provides the intra-Regional BSS feeder-link Plan sharing criterion for Region 2. This criterion allows a degradation of the Overall Equivalent Protection Margin (OEPM) of 0.25 dB below 0 dB, or if already negative, of no more than 0.25 dB below the resulting value from the feeder-link Plan as established by the 1983 Conference; or a modification of the assignment in accordance with this Appendix; or a new entry in the feeder-link Plan under RR Article **4**; or any agreement reached in accordance with this Appendix except for Resolution **42 (Rev.Orb-88)**. It was considered that there would be a need, in the case where a BSS

assignment in the Region 2 Plan contained in Appendix **30** is used in conjunction with a feeder-link assignment which is not using the 17.3-17.8 GHz band subject to Appendix **30A**, to calculate the OEPM degradation by assuming no degradation due to the feeder link (i.e. the OEPM would consist only of the downlink EPM). It was also considered that this issue is a conference issue and is outside the mandate of Study Groups.

Section 4 of Annex 1 of Appendix **30A** addresses the intra-Regional BSS feeder-link Plan sharing for Regions 1 and 3. The current combination of three sharing criteria, as adopted by WRC-2000 are provided below:

- a power flux-density limit of −76 dB(W/(m^2 · 27 MHz)) at any point in the GSO arc;
- an administration in Region 1 or 3 shall not be considered as being affected if the minimum orbital spacing between the wanted and interfering space stations, under worst case station-keeping conditions, is more than 9 degrees;
- an administration in Region 1 or 3 shall not be considered as affected if the effect of a proposed new or modified assignment causes its feeder-link equivalent protection margin to fall no more than 0.45 dB below 0 dB, or if already negative, no more than 0.45 dB below the value from the Regions 1 and 3 Plan and List as established by WRC-2000, or a proposed new or modified assignment to the List, or a new entry in the Regions 1 and 3 List as a result of the successful application of Article 4.

The ITU-R studies concluded that these criteria are appropriate and there is no need for modification.

3.2.2.6 Appendix 30A criteria for the protection of BSS feeder-link receiving space stations from FSS or BSS transmitting space stations or from BSS feeder-link transmitting earth stations

The sharing criteria for the protection of BSS feeder-link receiving space stations from FSS/BSS transmitting space stations or from BSS feeder-link earth stations are contained in the following four sections of Appendix **30A**:

- Annex 1 Section 5 provides Appendix **30A** BSS feeder-link limits to protect a frequency assignment in the bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2) to a receiving space station in the FSS (Earth-to-space).
- Annex 1 Section 6 provides Appendix **30A** BSS feeder-link limits to protect a frequency assignment in the band 17.8-18.1 GHz (Region 2) to a receiving feeder-link space station in the FSS (Earth-to-space).
- Annex 4 Section 1 provides threshold values for determining when coordination is required between transmitting space stations in the FSS or the BSS and a receiving space station in the feeder-link Plans in the frequency bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2).
- Annex 4 Section 2 provides threshold values for determining when coordination is required between transmitting feeder-link earth stations in the FSS in Region 2 and a receiving space station in the Regions 1 and 3 feeder-link Plan or List in the frequency band 17.8-18.1 GHz.

The increase in noise temperature criterion ranges in value from a $\Delta T/T$ of 3% in Annex 1 to 4% in Annex 4. These criteria result in modifications to the feeder-link Plans providing slightly more protection to the unplanned services.

A recent ITU-R study provided interference analyses and discussion of the equatorial limb geometry necessary for dealing with transmitting Region 2 BSS satellites interfering with receiving Regions 1 and 3 BSS feeder-link satellites in the 17.3-17.8 GHz band. This case is currently

covered by Annex 4, Section 1 as described above. These studies, which have resulted in a draft new Recommendation, have shown that for the cases studied, the interference from transmitting BSS space stations in Region 2 into a receiving space station in the Regions 1 and 3 feeder-link Plan resulted in a ΔT/T of less than 4% (assuming a system noise temperature of 600 K), and are therefore consistent with the criterion contained in Annex 4.

The ITU-R agreed that it would be useful to harmonize the inter-Regional criteria contained in Annex 1 and Annex 4 of Appendix **30A**. The ITU-R considers that it may be appropriate to relax each of the four criteria mentioned in this section. However, further study is required to determine a baseline satellite system noise temperature and an allowed ΔT/T increase that would be equitable for all Regions.

3.2.3 Regulatory/procedural aspects

3.2.3.1 Review of §§ 4.1.18 to 4.1.20 of Appendices 30 and 30A

3.2.3.1.1 Review of these provisions with respect to Regions 1 and 3

In reviewing paragraphs 4.1.18 to 4.1.20 of Appendices **30** and **30A** (Regions 1 and 3), the following options were identified:

1) to suppress §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A**;

2) to maintain §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** without any change;

3) to maintain §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** with additional provisions in order to satisfactorily protect assignments in the Plan or in the List.

The rationale for these options and the reasons provided by administrations are reported hereafter.

Views expressed in support of Option 1

Background

WRC-2000, Istanbul/Turkey, in revising the Regions 1 and 3 downlink and feeder link of Appendices **30** and **30A**, introduced and incorporated several new and modified paragraphs, including §§ 4.1.18 to 4.1.20, in Section 4.1 of the above-mentioned Appendices. These paragraphs were included at the request of few European administrations to counterbalance the addition of, in general, five new channels for each Region 1 administration and seven new channels for each Region 3 administration. However, other administrations likewise added two more paragraphs, namely 4.1.24 and 4.1.25, on one hand to complement the previously-mentioned paragraphs and, on the other hand to inject, to some extent, the concept of de-monopolization of the spectrum utilization in the domain of these Appendices.

The incorporation of the above-mentioned paragraphs was done on the last day on which the draft revised Plans and List were presented to the Conference without leaving the Conference time to carefully examine the consequence of the application of some of the above-mentioned four paragraphs.

Administrations of Regions 1 and 3, in particular those of the developing countries of these Regions, who have reluctantly accepted the inclusion of paragraphs 4.1.18, 4.1.18*bis* and 4.1.20, later on found considerable difficulties if these paragraphs were to be implemented. These difficulties are highlighted below.

Origin of RR 11.41

In order to understand the issue, it might be useful to analyse how the case was evolved. The concept of paragraph 4.1.18 of the above Appendices is taken from that of provision 11.41 of Article 11 of non-planned services. It is worthwhile to mention the origin of RR 11.41, in order to

better understand the situation. In application of relevant provisions of Articles 9 and 11 of the Radio Regulations with respect to the non-planned services, should administration "B", in application of the above-mentioned Articles, not succeed to complete the required coordination procedure with respect to administration "A", who has successfully completed the relevant procedures of these Articles before administration "B" and recorded in the Master Register with Favourable Finding(s), notifies to the Bureau its assignments. The Bureau, in applying the relevant provisions of Article 11, would return the assignments in question to administration "B" on the grounds that coordination is not successfully completed. Administration "B" could then resubmit the assignments requesting the Bureau to examine them under RR 11.32A and/or RR 11.33, as appropriate. Should the results of the Bureau's examination be unfavourable, the assignments would be returned again to administration "B". Should administration "B" decide to resubmit the assignments in question again, it has to apply RR 11.41, in insisting upon its reconsideration. The Bureau shall enter the assignments provisionally in the Master Register with the indication of those administrations whose assignments were the basis of the unfavourable finding. The entry shall be changed from provisional to definitive recording in the Master Register only if the Bureau is informed that the new assignments have been in use together with the assignments, which were the basis of the unfavourable finding, for at least four months without any complaint of harmful interference being made. It should be noted that the above approach seems to be logical as it prevents that recorded assignments not yet brought into use block other assignments being brought into use be recorded in the Master Register, and thus being protected by subsequent assignments. The above arrangement is coupled with provision RR 11.42, which stipulates, "Should harmful interference be caused by an assignment recorded under No. 11.41 to any recorded assignment which was the basis of the unfavourable finding, the station using the frequency assignments recorded under No. 11.41 shall, upon receipt of advice thereof, immediately eliminate this harmful interference". The concept of the latter provision is similar to that of 4.1.20.

*Situation in Appendices **30** and **30A***

The way that the interference analysis is functioning in these Appendices is based on the cumulative effects of the interference on the existing assignments that consist of those already calculated plus the effect of an incoming assignment. In other words, there is no longer the one-to-one basis between the existing interfered assignment and the incoming interfering assignment. This is due to the fact that the Equivalent Protection Margin (EPM) is based on the cumulative effects of the aggregation of all interferences on an existing assignment. On the other hand, should the EPM value be reduced beyond certain level, as result of several interfering signals/assignments, that interfered assignment(s) whose EPM is degraded beyond a certain level, would no longer be identified as affected by the subsequent incoming assignment(s).

In this addition, the concept of harmful interference referred to in non-planned services is different from the concept of not causing interference above a certain level due to the fact that the harmful interference is a subjective issue whereas the permitted or acceptable interference is an objective matter, thus one which is used in case of non-planned services cannot be used for cases of Appendices **30**/**30A**.Discussion

Now, let us go back to the issue of how paragraphs 4.1.18 to 4.1.20 will be applied to the assignments of Appendices **30** and **30A**. First of all, as far as the number of interfering cases is concerned the situation is different in case of the Plan, on the one hand, and in case of the List, and other services covered by the Appendices **30** and **30A** frequency bands. In case of the Plan, the number of interfering cases which could apply paragraphs 4.1.18 to 4.1.20 are limited to three, whereas the number of interfering cases which could apply these paragraphs with respect to the List and other services using the frequency bands of these Appendices are unlimited. This is an

important matter to be carefully taken into account. A quick review of these paragraphs reveals the following.

With respect to their application to the Plan, a maximum of three interferences are allowed. In this case either one or all three interferences, which may come from one administration, or several administrations would reduce or degrade the EPM of the Plan's assignment(s). It may also degrade the assignment which was the basis of the disagreements to the extent that they would no longer be identified as affected by the subsequent incoming assignment(s), which put the assignment which was the basis of the disagreements in a position that its actual EPM would be degraded more and more without being demonstrated. It would therefore deprive the assignment which was the basis of the disagreement(s) to comment on its affected assignment(s). This would result that the Plan's assignment(s) although remain in the file or the Radio Regulation but with only the nominative existence and not a real value.

Moreover, once the victim Plan assignments are to be brought into use, in case that those three interferences which were the origin of degrading the EPM have to eliminate the interference as foreseen by paragraph 4.1.20, the administration responsible for the Plan's/assignment which was the basis of the disagreement does not know to which of these three interfering sources this administration should refer, as it is affected by the cumulative effect of these three interfering assignments (their aggregate effects) and not necessarily by their individual (single-entry effect). That administration would be stuck in the middle of nowhere. In case that its EPM was degraded to lower level than be identified as affected, even if these three sources of interference collectively and positively cooperate with each other and reduce the interferences to the acceptable level (which is almost improbable), the Plan's assignments still would suffer from the interference of those non-identified sources which caused interference to that assignment which was the basis of the disagreements as they were not identified by the Bureau as interfering sources due to the very low level of EPM.

It would be interesting to know whether or not the concept of eliminating interference has even been used. If yes, when, by whom, in relation with which networks? And if it is used, how an administration could eliminate the interference without closing down a particular transponder or without any, in orbit process modifications, since, the degree of such in-orbit process modification is very limited? In addition, there would be some negative consequence of such an in orbit process modification, from the viewpoint of customer requirements. Moreover, what guarantee will be given that, in real time, such an action would be taken by the notifying administration of the interfering assignments?

In other words, all these arrangements would remain to be theoretical and non-implementable.

It is very doubtful and impractical that any of the interfering operational BSS satellites, all of a sudden, could reduce its interference to the victim BSS Plan, due to the fact that there would be some operational constrains and consequences.

As for the assignments in the List, taking into account that the number of interferences is unlimited, the situation is worse and even catastrophic than what was explained in the above in case of the Plan assignments.

It should be noted that those administrations that are supporting the application of paragraphs 4.1.18 to 4.1.20, they know that the negative consequences of this application would also involve them in one way or another. In other words, the safety measures that they established in relation to the Plan's assignments to help them, now would cause more damage to their assignments in the List than those caused to the assignments of other administrations in the Plan. This is the fact that they have failed to realize when these administrations supported the inclusion of 4.1.18 and 4.1.20 in Article 4 of both Appendices.

For these reasons, some administrations are of the strong belief that paragraphs 4.1.18 to 4.1.20 of Article 4 of both Appendices must be suppressed.

Views expressed in support of Option 2

Some administrations were of the view that the provisions of 4.1.18 to 4.1.20 of AP30 and AP30A shall be retained in the Radio Regulations. These administrations are of the view that these provisions as well as the provisions 4.1.24 and 4.1.25 were an integral part of the compromise prior to the replanning of the BSS that took place during WRC-2000. Without infringing the individual administration's rights to protection of the Plan assignments these provisions provide a procedure for notification of frequency assignments in the AP30/AP30A bands in line with the procedure in the unplanned services. It is understood that, in applying provision 4.1.18, the reference situation of the assignment which is the basis of the disagreement shall not be updated in entering the proposed new network into the List, and the assignment against which 4.1.18 was used will thus retain their EPM and their original protection for subsequent modifications. Furthermore, the concept of "not causing harmful interference" has existed in the Radio Regulations for many years and has been applied by several conferences without problem. It should further be noted that any administration operating a satellite under 4.1.18-4.1.20 is obliged to follow the provisions in the Radio Regulations and shall immediately eliminate harmful interference caused to the assignment, recorded in the Master Register, that was the basis for disagreement, whenever this is brought into use. This clearly identifies the assignments entered into the List under 4.1.18 as having a lower status than the other entries in the Plan and the List. Similar provisions have been applied in the RR in the unplanned services and for other services for many years without any disadvantages experienced. Therefore the procedures of 4.1.18-4.1.20 ensure that the integrity of the Plan is guaranteed.

An assignment against which 4.1.18 is used will retain its original protection with the above measures. This will be the case regardless of how many times 4.1.18 is used. There is therefore no need to have a limitation on the number of times these provisions may be applied.

Views expressed in support of Option 3

In order to solve the concerns expressed by administrations of Region 1 and Region 3, in particular developing countries, on the provisions contained in Nos. 4.1.18 to 4.1.20 of Appendices **30** and **30A** (reported under Option 1), it is proposed to implement the following solutions.

Unlike in the case of non-planned services, when §§ 4.1.18 to 4.1.20 of Appendices **30** and **30A** are applied in respect of an assignment in the Plan or in the List, it may take many years before the assignment which was the basis of the disagreement is brought in service. This means that throughout this period, the Bureau will have to continue to protect the affected assignment to the level that it would have if its EPM was not degraded by more than the permissible level. This may be done by adding a new symbol in M-space to the effect that the EPM does not take into account the unaccepted excess interference into the assignment which was the basis of the disagreement in the Plan or in the List. However, the EPM should take into account the interference from these assignments which were the basis of the disagreement in the Plan or in the List into the assignment for which No. 4.1.18 is applied.

There appears to be a significant discontinuity between the protection which is afforded by the initial part of the procedure (if a given interference level, generally a pfd level, is exceeded, agreement must be sought), and the type of protection which is given in case of disagreement (no harmful interference shall be caused, i.e. the BSS space station shall not seriously degrade, obstruct, or repeatedly interrupt the affected service"). The procedure starts by offering a clear, quantified and verifiable level of protection, but when this level is exceeded, and this excess has not been accepted, it is replaced by a level of protection which is loose, non-quantified, subject to interpretation, not verifiable in practice, and in any case much less protective than at the beginning

of the procedure. This is compounded by the fact that harmful interference may result from the addition of several interfering sources, thus diluting the responsibility of the administrations which may be the source of the harmful interference. A possible solution to this problem may be to replace the words "cause harmful interference" by the words "exceed the levels given in Annex 1" in the provisions of §§ 4.1.18 to 4.1.20. This would mean that, once any of the assignments which was the basis of a disagreement is brought into service in conformity with the applicable provisions of the Radio Regulations, and a complaint for unacceptable interference is received, the characteristics of the interfering assignment recorded in the List after application of § 4.1.18, and which is the cause for this unacceptable interference has to be modified so that no excess interference is caused to the assignment which was the basis of the disagreement. If this is not the case, the assignment in question would be deleted from the List.

Limiting to three the number applications of § 4.1.18 appears to lead to a difference of treatment between the administrations which apply the procedure at the early stage and subsequent ones. If the solution proposed above is applied, this difficulty would disappear since there would be no need for such a limitation.

Further study is required for the implementation of Option 3.

3.2.3.1.2 Review of these provisions with respect to Region 2

Although paragraphs 4.1.18 to 4.1.20 and other associated paragraphs in the way they appear in Appendices **30** and **30A** might be interpreted by some administrations that they are equally applicable to Region 2, it is to be noted that the intent of WRC-2000 was not to affect the integrity of Region 2 services (see Resolutions 524 (WRC-92), 531 (WRC-95) and 532 (WRC-97).

3.2.3.2 Application of the grouping concept for one orbital location in Appendices 30 and 30A with respect to Regions 1 and 3

In reviewing the grouping concept as applied for one orbital location in Regions 1 and 3, the following options were identified:

A) to suppress the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3;

B) to maintain the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3 as it is applied today;

C) to maintain the grouping concept for one orbital location in Appendices **30** and **30A** for Regions 1 and 3, but to limit the maximum number of networks in the group.

The rationale for these options and the reasons provided by administrations are reported hereafter.

Views expressed in support of Option A

Network grouping means that a given administration submits to the Bureau several networks on a given orbital position but asks the Bureau to group them together.

Apart from those groups which are currently contained in the Appendices as a result of the decisions of previous Conferences, there are no regulatory provisions to allow that type of grouping application. In a simple language, the concept of grouping is that all grouped networks will be protected by the incoming assignments or networks, whereas the interference from the members of the group to other assignments outside the group would be the worst interference of any of the networks and not the combined interferences of all networks.

This necessitates that the grouped networks should not operate simultaneously, i.e. they could operate individually. This means that the responsible administration of these grouped networks establishes the maximum flexibility for itself to operate any of the grouped networks it so wishes.

However, this flexibility is at the expense of the inflexibility of other administrations. Moreover, the consequence of this grouping of networks is some sort of warehousing of the spectrum which is in total contradiction with the very principle of Article 44 of the Constitution and paragraph 3.3 of the Appendices.

For these reasons, some administrations are of the strong belief that the Rules of Procedure currently allowing the use of network grouping must be suppressed.

Views expressed in support of Option B

The protection of assignments in the Plan and the List against new entries in the List is based upon aggregate C/I (EPM) levels or degradation. If an administration requires to modify some characteristics of its assignment in the Plan or List, e.g. antenna diameter or modulation technique, a modification under Article 4 of AP30 and/or AP30A is required. Such a modification will capture an alternative way to operate the same capacity and thus cannot be operated simultaneously with the original assignment as these between themselves are incompatible. Such modifications are crucial for any administration that wants to be able to consider modification of some of the technical parameters of its assignment in the Plan or the List prior to, or after bringing this into use.

However, if interference is calculated between these assignments in updating the reference situation, this would lead to an over-conservative assessment of the interference inflicted upon other assignments in the Plan or List, as only one assignment will be active at any given time. More seriously, in calculating interference between these assignments, there will be a strong calculated interference between these networks that will totally dominate their EPM. Again, since the assignments will not be active at the same time, this interference is not real. Nevertheless, protection of these assignments is based upon degradation of the EPM, and with this artificial interference calculated between the assignment and its modification, any new modification can have a very high single entry C/I into these before degrading the aggregate C/I by more than the trigger limits.

For this reason, for an administration to be able to modify the technical characteristics of its assignment in the Plan or the List and retain protection for its assignment, interference cannot be calculated between them. The grouping of the assignments is the way this is achieved in the current Radio Regulations. In calculation of interference into the Plan and the List, by grouping assignments, interference is only calculated from the worst and interference is not calculated between the assignments, giving an accurate description of the actual operation.

It is noted that grouping a modification request under Article 4 with an existing entry in the Plan or the List, or with another modification request, in no way relieves administrations from the responsibility to ensure full protection from this new entry to all assignments in the Plan or the List. As such, assignments entered into the List, grouped with other assignments will have absolutely no impact on any assignment in the Plan or List. This will be the case, regardless of how many networks are grouped together. Any entry into the List, grouped or not grouped, will have an impact upon the flexibility of administrations to successfully coordinate subsequent modification requests under Article 4. This, however, is not a quality of the grouping concept and is completely in line with the "first come first served" principle, in line with coordination in the unplanned bands, as adopted for Article 4 modifications.

For these reasons, grouping of networks in one orbital location is a necessity to enable administrations to modify the technical parameters of their assignments in the Plan or List. Application of this concept will have no impact upon any assignment in the Plan or the List. Such grouping therefore needs to, and should, be retained.

Views expressed in support of Option C

Because of the aggregate EPM criteria used in Appendices **30** and **30A**, multiple filings in one orbital location could result in loss of protection for assignments involved. The grouping of multiple networks at the same orbital location could alleviate this difficulty and enable administrations to implement assignments of the BSS Plan or additional use more flexible.

However, there is a concern that usage of the grouping concept could unduly complicate access to spectrum resources for new administrations wanting to coordinate capacity in Region 1 or 3 to go into the List. There may therefore be merit in limiting the maximum number of networks that can go into a group as well as limiting the number of groups in one orbit location. Specific care has to be given to the definition of the "number of networks" as well as the definition of the "number of groups". Further studies are required to understand the mechanisms leading to the constraints that the grouping concept is intended to alleviate, in particular as a result of the use of the aggregate protection criteria (EPM degradation) and to determine the appropriate limits for number of networks in a group as well as number of groups at a given orbital location.

3.2.3.3 Sharing criteria in Annexes 1, 3, 4 and 6 to Appendix 30 and Annexes 1 and 4 to Appendix 30A

Section 3.2.2 of the CPM Report presents the results of ITU-R studies in response to Resolutions 540 (WRC-2000) and 735 (WRC-2000) with respect to sharing criteria between services in the band 11.7-12.7 GHz. Attachments 1 to 5 to this chapter are proposing draft examples of possible modification of Annexes 1, 3, 4 and 6 to Appendix **30** and Annexes 1 and 4 to Appendix **30A**, should WRC-03 decide to modify the sharing criteria of these annexes in accordance with the proposals developed in the draft CPM Report.

These draft examples take into account the experiences of BR in applying the Radio Regulations, including the difficulties and inconsistencies encountered in the application of the relevant provisions.

Generally speaking every effort should be made to avoid retroactive action as this would result in some degree of uncertainty in application of a given provision or use of a given service. It would also increase the workload of the administrations and the Bureau. Moreover, it is required to indicate the availability of the calculation method and the corresponding software to be applied by the administrations and the Bureau.

Concerning the draft example provided for Annex 6 to Appendix **30**, doubts were expressed by some administrations concerning the receive earth station noise temperature and total link noise temperature being identical for antenna having different diameters, in particular when the antenna diameters are doubled, the noise temperatures remain unchanged.

3.2.3.4 Use of BSS feeder-link assignments for GSO FSS (Earth-to-space) in the bands 14.5-14.8 GHz and 17.3-18.1 GHz

No. **5.492** authorizes the use by FSS (space-to-Earth) transmissions of BSS assignments which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30**, provided that such transmissions do not cause more interference, or require more protection from interference, than the BSS transmissions operating in conformity with the Plan or the List, as appropriate.

The conformity of an assignment with this provision is verified by the Bureau at the time of notification of the assignment, under paragraph 5.2.1 *d)* of Article 5 of Appendix **30**. ITU-R has studied the technical criteria under which such use satisfies the conditions stated in this provision (see Recommendation ITU-R BO.1373-1), which provides to the Bureau the necessary tools to verify that this provision is correctly applied.

However, No. **5.492** does not constitute an allocation to the FSS (space-to-Earth), but establishes conditions under which an assignment in the BSS allocation may be used for FSS transmissions. Consequently, when this provision is applied by an administration, the assignment which is made remains a BSS assignment from the point of view of the Radio Regulations.

Nos. **5.510** and **5.516** limit the use of the bands 14.5-14.8 GHz and 17.3-18.1 GHz by GSO FSS (Earth-to-space) to BSS feeder links.

The conformity of an assignment with one of these provisions is examined under Article 5 of Appendix **30A** from the point of view of its conformity with the Plan or List, as appropriate, and therefore may be used only if they do not cause more interference, nor require more protection than the BSS feeder links transmissions operating in conformity with the Plan or the List, as appropriate.

The conference may wish to further clarify and review where appropriate the possibility of using the bands 14.5-14.8 GHz and 17.3-18.1 GHz (Earth-to-space) for GSO FSS transmissions other than BSS feeder links. Two options were identified:

Option 1

Addition of two new footnotes to explicitly cover the possibility of using the bands 14.5-14.8 GHz and 17.3-18.1 GHz (Earth-to-space) for GSO FSS transmissions other than BSS feeder links, and revision of paragraph 5.2.1 *d)* of Article 5 of Appendix **30A** accordingly. Example of regulatory texts is given hereafter:

ADD

5.510A In the band 14.5-14.8 GHz, assignments to feeder-link stations which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30A** may also be used for transmissions in the fixed-satellite service (Earth-to-space), other than feeder links for the broadcasting-satellite service, provided that such transmissions do not cause more interference or require more protection from interference, than the feeder-link transmissions operating in conformity with the Plan or the List, as appropriate.

5.516A In the band 17.3-18.1 GHz, assignments to feeder-link stations which are in conformity with the appropriate regional Plan or included in the Regions 1 and 3 List in Appendix **30A** may also be used for transmissions in the fixed-satellite service (Earth-to-space), other than feeder links for the broadcasting-satellite service, provided that such transmissions do not cause more interference or require more protection from interference, than the feeder-link transmissions operating in conformity with the Plan or the List, as appropriate.

An example of a possible revision of paragraph 5.2.1 *d)* of Article 5 of Appendix **30A** is given below:

MOD

5.2.1

d) with respect to its conformity with the appropriate Regional feeder-link Plan or the Regions 1 and 3 feeder-link Lists, however, having characteristics differing from those in this Plan or in the Regions 1 and 3 feeder-link Lists in one or more of the following aspects:

- use of a reduced e.i.r.p.,
- use of a reduced coverage area entirely situated within the coverage area appearing in the Plan or in the Regions 1 and 3 feeder-link Lists,
- use of other modulating signals in accordance with the provisions of § 3.1.3 to Annex 5 of Appendix **30**,
- use of the assignment for transmission in the fixed-satellite service in accordance with Nos. **5.510A** and **5.516A**,
- in the case of Region 2, use of an orbital position under the conditions specified in § B of Annex 7 to Appendix **30**,
- in the case of Regions 1 and 3, use of an orbital position under the conditions specified in § 3.15 of Annex 3[12]

Recommendation ITU-R BO.1373-1 would need to be updated in order to provide to the Bureau the necessary complementary tools to verify that this provision is correctly applied.

It was also noted that, with respect to the coordination of a transmit FSS earth station with a receive FSS earth station or a terrestrial station, the current procedure of Appendix **30A** applicable to BSS feeder-link earth stations continues to apply.

Option 2

No change to the Radio Regulations.

3.2.3.5 5.2.1 *d)* of Article 5 of Appendix 30

It should be clarified that, as a general principle, any changes to the Plans and List assignments under Article 5 are not protected in application of Article 4.

It is also proposed to clarify that when administrations are implementing satellite networks under Article 5, the pfd limit may be exceeded on the territory of the notifying administration, as long as the pfd of the original Plan assignments at each test point of that assignment is not exceeded. It is to be noted that, under such conditions, the assignments for which the pfd exceed should in no way require more protection than that afforded to them under application of Article 4 or under the Plan and List.

An example of possible modification to Article 5 of Appendix **30** is given hereafter.

[12] The Bureau shall also apply this provision to § 5.2.1 *d)* of Appendix **30** for Regions 1 and 3.

MOD

ARTICLE 5

Notification, examination and recording in the Master International Frequency Register of frequency assignments to space stations in the broadcasting-satellite service[2]

MOD
5.2.1

d) with respect to its conformity with the appropriate Regional Plan or the Regions 1 and 3 List, however, having characteristics differing from those in the appropriate Regional Plan or in the Regions 1 and 3 List, in one or more of the following aspects:

- use of a reduced e.i.r.p.,
- use of a reduced coverage area entirely situated within the coverage area appearing in the appropriate Regional Plan or in the Regions 1 and 3 List,
- use of other modulating signals in accordance with the provisions of § 3.1.3 of Annex 5,
- use of the assignment for transmission in the fixed-satellite service in accordance with No. **5.492**,
- in the case of Region 2, use of an orbital position under the conditions specified in § B of Annex 7; ~~*or*~~
- in the case of the notification of the Plan, the pfd limit of –103.6 dB(W/m^2/27 MHz) given in Section 1 of Annex 1 to Appendix **30** may be exceeded on the territory of the notifying administration under the condition that the pfd on all the test points of the satellite networks in question are equal or below those of the associated Plan assignments; *or*

3.2.3.6 Other provisions of Appendices 30 and 30A

In reviewing the Preliminary Report of BR to WRC-03 under agenda item 7.1 (part dealing with the experiences of BR in applying the Radio Regulations, including the difficulties and inconsistencies encountered in the application of the relevant provisions), the Special Committee and the CPM reached the following conclusions and agreed on draft examples of possible modification of Appendices **30** and **30A** which are provided in Attachments 6 and 7 to this Chapter.

3.2.3.6.1 Annex 2A to Appendix 4

Recommendation ITU-R BO.1293-1 which is referred to in § 3.4 of Annex 5 to Appendix **30** and § 3.3 of Annex 3 to Appendix **30A** was updated by ITU-R on 30 April 2002. In Annex 3 of that new Recommendation the calculation of protection masks requires two additional parameters in addition to those currently in Appendix 4, namely, the relative levels of the first and second side lobes of digitally-modulated 12 GHz BSS transmit signals and the side lobe attenuation resulting from post-high power amplifier filtering.

Administrations may wish to consider reviewing Appendix 4 along one of the following approaches:

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[2] As a general principle, any changes to the Plans and List assignments under Article 5 are not protected in application of Article 4.

1) to delete current items C.9 b)9 and C.9 b)10 taking into account that Annex 3 of Recommendation ITU-R BO.1293-2 applies to bilateral coordination between administrations;

2) to include in Appendix 4, Annex 2A, item C.9 b) the above-mentioned parameters (i.e. the relative levels of the first and second side lobes of digitally-modulated 12 GHz BSS transmit signals and the side lobe attenuation resulting from post-high power amplifier filtering) on a non-mandatory basis, and make current items C9b9 and C9b10 non-mandatory, taking into account that Annex 3 of Recommendation ITU-R BO.1293-2 applies to bilateral coordination between administrations;

3) to include in Appendix 4, Annex 2A, item C.9 b) the above-mentioned parameters on a mandatory basis.

3.2.3.6.2 Article 2 of Appendices 30 and 30A

WRC-2000 added to Article 2 of Appendices **30** and **30A** a new § 2.2 which stipulates the conditions to use the guardbands of the Plans in those Appendices in order to provide space operations functions in accordance with No. 1.23 in support of GSO satellite networks in the BSS.

It is proposed to include additional text in § 2.2 of Article 2 of Appendices **30** and **30A** in order to clarify that:

– no API is required for such assignments, the coordination procedure under No. 9.7 is initiated by the submission of the coordination data;

– the applicable time limit for bringing into use those assignments is the same as for the planned BSS/feeder-link assignments, i.e. eight years counted from the date of receipt by the Bureau of the complete Appendix 4 information (plus a possible extension as indicated in Resolution 533).

3.2.3.6.3 Publication of comments under § 4.1.10 or § 4.2.14 of Article 4 of Appendices 30 and 30A

Contrary to the situation in Article 9 of the RR (see No. 9.53A), there is no specific provision in Article 4 of Appendices **30** and **30A** referring to the need for the Bureau to publish, upon expiry of the deadline for comments under § 4.1.10 or § 4.2.14 of Article 4, the list of administrations having submitted their disagreement or other valid comments within the four-month regulatory period stipulated in the above-mentioned paragraphs.

In order to provide to administrations a clear picture of the coordination requirements and to avoid any uncertainties in that respect, it is proposed to include additional text in § 4.1.10 and § 4.2.14 of Article 4 of Appendices **30** and **30A**, or new provisions in that article, as appropriate.

3.2.3.6.4 Resolution 42 (Rev.Orb-88)

It is proposed to align §§ 2 to 5 of the Annex to Resolution 42 (Rev.Orb-88) with the decisions established at WRC-2000, namely:

– inclusion of appropriate references to the Regions 1 and 3 Lists;

– replacement of references to Annex 2 to Appendices **30/30A** by references to Appendix 4 of the RR;

– inclusion of appropriate references to Article 4 submissions received by the Bureau;

– deletion or replacement of references to some former provisions of Articles 4 and 7 and Annex 1 of Appendices **30/30A** by the appropriate current ones;

– deletion of §§ 5.2 c) and 5.2 d) due to the fact that WRC-2000 has excluded from the procedure of Article 4 of Appendix **30A** the coordination of the transmitting feeder-link earth stations with respect to receiving earth stations operating in the opposite direction of transmission, as well as with respect to terrestrial stations.

3.2.3.6.5 Resolution 49 (Rev.WRC-2000)

Resolves 2 of Resolution 49 (Rev.WRC-2000) defines the deadlines before which "the complete due diligence information in accordance with Annex 2 to this Resolution" shall be submitted to the Bureau.

In the case of satellite networks received by the Bureau under the coordination procedure of Article 4 of Appendices **30/30A** before 22 November 1997, the applicable deadline defined in accordance with *resolves* 2 of Resolution 49 (Rev.WRC-2000) is the earliest date between 21 November 2003 and the expiry of the date afforded for the coordination of the satellite network before bringing it into use (i.e. eight years counted from the date of receipt of the complete Annex 2 to Appendices **30/30A** information).

It was noted that, for a satellite network submitted for coordination under Article 4 of Appendices **30/30A** and received by the Bureau from 22 November 1995 up to 21 November 1997 inclusive, the regulatory period afforded for submission of due diligence information would be less than eight years.

This situation, which might not have been intended, creates therefore some inconsistencies between the period afforded for submission of due diligence information of satellite networks received by the Bureau from 22 November 1995 up to 21 November 1997 inclusive and that afforded for other satellite networks.

In view of the above, administrations may wish to consider a possible revision of *resolves* 2 of Resolution 49 (Rev.WRC-2000).

3.2.3.6.6 §§ 4.1.10 and 4.2.14 of Article 4 of Appendices 30 and 30A

Considering the adverse effect of a no-reply within the four-month period for comments following the Part A publication of a network under Article 4 of Appendices **30** or **30A**, which means a tacit agreement, the RRB has adopted an appropriate Rule of Procedure (see Rule of Procedure relating to § 4.1.10) instructing the Bureau to send reminder telegrams 30 days before the expiry of the above four-month period.

Since this course of action has been implemented for a long time, it is proposed to convert this Rule of Procedure into regulatory provisions in §§ 4.1.10 and 4.2.14 of Article 4 of Appendices **30** and **30A**.

3.2.3.6.7 § 4.2.11 of Article 4 of Appendices 30 and 30A

Administrations of Region 2 may wish to consider the deletion of § 4.2.11 of Article 4 of Appendices **30** and **30A** since the purposes of these provisions are already covered under § 4.2.3 of Appendix **30** or § 4.2.2 of Appendix **30A** and under § 4.2.10 of both Appendices.

3.2.3.6.8 § 5.3.1 of Article 5 of Appendices 30 and 30A

The modification of the date of bringing into use which is possible under § 5.3.1 of Article 5 of Appendices **30** and **30A** is limited by a deadline defined by the period of eight years counted from the date of receipt by the Bureau of complete Appendix 4 information plus a possible extension as indicated in Resolution 533 (Rev.WRC-2000). This limitation is not reflected in the RR but in a Rule of Procedure.

In view of the above, it is proposed to revise § 5.3.1 of Article 5 of Appendices **30** and **30A** by adding a footnote after the word "modify" in this provision referring to the regulatory period defined in § 4.1.3 or § 4.2.6 of Article 4 of these Appendices.

3.2.3.6.9 Title and §§ 5.1.3, 5.1.4, 5.1.5 and 5.2.1 f) of Article 5 of Appendix 30A

In revising the Appendix **30A** feeder-link Plans for Regions 1 and 3, WRC-2000 has excluded from the procedure of Article 4 of that Appendix the coordination of the transmitting feeder-link earth stations with respect to receiving earth stations operating in the opposite direction of transmission, as well as with respect to terrestrial stations. This coordination should now be undertaken by the notifying administration directly with the other concerned administrations with respect to terrestrial stations and receiving earth stations operating in the opposite direction of transmission, in accordance with the relevant/corresponding provisions of Article 9 of the RR.

As a consequence, as of 2 June 2000, notification of assignments to transmitting feeder-link earth stations included in the Region 2 feeder-link Plan following successful application of Article 4, or included in the Regions 1 and 3 feeder-link List, shall be effected applying the provisions of Article 11.

With respect to the notification of frequency assignments to transmitting feeder-link earth stations, the application of Article 5 as of 2 June 2000, should be strictly limited to the assignments of the Plans.

In view of the above, administrations may wish to consider the possible revision of the title of Article 5 of Appendix **30A** and its associated footnote.Administrations are also invited to clarify the notification of assignments to transmitting feeder-link earth stations, when agreements have already been obtained through the former Article 4 procedure.

One administration expressed the view that notification of frequency assignments of the Plans to transmitting feeder-link earth stations could be done on a service area basis, and not on a station by station basis. However, careful studies are required for the implementation of this latter approach.

3.2.3.6.10 Orbital positions for Regions 1 and 3 Plan (Section 3.15 of Annex 3 of Appendix 30A)

In revising the Regions 1 and 3 Plans, WRC-2000 used orbital positions shifted by 0.2° from some nominal positions as a means to resolve the interference excess identified during the replanning studies in the feeder-link Plans at both 14 and 17 GHz[2]. This was never understood as corresponding to the Region 2 cluster concept.

Therefore, the use of an orbital position not coincident with that appearing in the Regions 1 and 3 Plan(s) or the List(s) would require, as other major changes of the characteristics, to seek the agreement of the administrations having assignments identified as affected by this change.

In view of the above, it is proposed to consider the deletion of the last indent of § 5.2.1 d) of Article 5 of Appendix **30A**. Administrations are also invited to review Section 3.15 of Annex 3 of Appendix **30A** in order to provide appropriate description of orbital positions in the Regions 1 and 3 feeder-link Plan.

3.2.3.7 Review of the provisions of footnote No. 5.491

As the procedures relating to sharing between the planned broadcasting-satellite service in the 12 GHz band and other services are being reviewed in this agenda item, WRC-03 may want to review the provisions of footnote No. **5.491**, which address the particular situation of the allocation

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[2] For further details, see Section 8.3 of Corrigendum 1 to Document WRC-2000/34.

to the fixed-satellite service (space-to-Earth) in Region 3 in respect of the planned broadcasting-satellite service and terrestrial services. This footnote currently reads as follows:

5.491 *Additional allocation:* in Region 3, the band 12.2-12.5 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a primary basis. The power flux-density limits in Table **21-4** of Article **21** shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz. (WRC-2000)

This footnote therefore entails several regulatory provisions:

a) it allocates, on a primary basis, the band 12.2-12.5 GHz to the fixed-satellite service (space-to-Earth) in Region 3;

b) it refers to the applicable limits in Table **21-4**;

c) it refers to the applicable provisions of Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz, in relation to the broadcasting-satellite service in Region 1.

Provision b) is not necessary, since the limits in Table **21-4** always apply, irrespective of whether or not they are called by a footnote in Article **5**.

Provision c) is no longer necessary, since Article 7 has been modified by WRC-2000 in order to cover this particular provision, and Article 7 therefore applies, whether or not it is called by this footnote.

If WRC-03 decided to suppress the provisions under b) and c) above, provision a), hence the entire footnote, may be reflected in the Table of Article **5** itself, as a primary Table allocation to the fixed-satellite service (space-to-Earth) in Region 3 in the band 12.2-12.5 GHz. In such a case, footnote No. **5.491** may therefore be suppressed, in line with Resolution **26** (Rev. WRC-97).

WRC-03 may consider the following example modifications to the Radio Regulations which intend to implement the conclusions stated above.

SUP

5.491 *Additional allocation:* in Region 3, the band 12.2-12.5 GHz is also allocated to the fixed-satellite service (space-to-Earth) on a primary basis. The power flux-density limits in Table **21-4** of Article **21** shall apply to this frequency band. The introduction of the service in relation to the broadcasting-satellite service in Region 1 shall follow the procedures specified in Article 7 of Appendix **30**, with the applicable frequency band extended to cover 12.2-12.5 GHz. (WRC-2000)

MOD

11.7-14.25 GHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="3">11.7-12.5
FIXED
BROADCASTING
BROADCASTING-SATELLITE
MOBILE except aeronautical mobile

5.487 5.487A 5.492</td><td>11.7-12.1
FIXED 5.486
FIXED-SATELLITE (space-to-Earth) 5.484A
Mobile except aeronautical mobile
5.485 5.488</td><td rowspan="2">11.7-12.2
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE

5.487 5.487A 5.492</td></tr>
<tr><td>12.1-12.2
FIXED-SATELLITE (space-to-Earth) 5.484A
5.485 5.488 5.489</td></tr>
<tr><td>12.2-12.7
FIXED
MOBILE except aeronautical mobile
BROADCASTING
BROADCASTING-SATELLITE

5.487A 5.488 5.490 5.492</td><td>12.2-12.5
FIXED
<u>FIXED-SATELLITE (space-to-Earth)</u>
MOBILE except aeronautical mobile
BROADCASTING
5.484A 5.487 ~~5.491~~</td></tr>
<tr><td>12.5-12.75
FIXED-SATELLITE (space-to-Earth) 5.484A (Earth-to-space)

5.494 5.495 5.496</td><td>12.7-12.75
FIXED
FIXED-SATELLITE (Earth-to-space)
MOBILE except aeronautical mobile</td><td>12.5-12.75
FIXED
FIXED-SATELLITE (space-to-Earth) 5.484A
MOBILE except aeronautical mobile
BROADCASTING-SATELLITE 5.493</td></tr>
</table>

TABLE 3.2-7

Sharing criteria in Annexes 1, 3, 4, 6 and 7 to Appendix 30

Criteria in	Protected service(s) and bands (GHz)	Interfering service	Type of limit	Associated procedures	Possible action	CPM text
1	2	3	4	5	6	7
Annex 1 Sec. 1	Assignments in R1 and 3 BSS Plan or List and new or mod assignments in the R1 and 3 BSS List (11.7-12.5 in R1 and 11.7-12.2 in R3)	Proposed new or modified assignments in R1 and 3 BSS List	Hard pfd limit + Coord arc + pfd(θ) + Δ epm↓ (θ=space station separation)	Art 4, § 4.1.1a) or b)	R1: Replace pfd(θ) limit with BSS protection equations of § 3.2.2.3a) R3: **See Note 4**	Sec. 3.2.2.2b)
Annex 1 Sec. 2	Assignments in Region 2 BSS Plan (12.2-12.7)	Proposed new or modified assignments in R2 BSS Plan	Δ oepm	Art 4, § 4.2.3c)	NOC	Sec. 3.2.2.2a)
Annex 1 Sec. 3	Assignments in Region 2 BSS Plan (12.2-12.5)	Proposed new or modified assignments in R1 and 3 List	pfd(θ); (θ=space station separation)	Art 4, § 4.1.1c)	Replace with BSS protection equations of § 3.2.2.3b)	Sec. 3.2.2.3
	BSS Plan in R1 (12.2-12.5) and unplanned BSS in R3 (12.5-12.7)	Proposed new or modified assignments in R2 Plan		Art 4, § 4.2.3a) or b) or f)	R1: Replace with BSS protection equations of § 3.2.2.3b) R3: **See Note 4**	Sec. 3.2.2.3
Annex 1 Sec. 4	Terrestrial services in R1, 2 or 3 (11.7-12.7)	Proposed new or modified assignments in R2 Plan or R1 and 3 List	Δ pfd + pfd(θ); (θ=angle of arrival)	Art 4, § 4.1.1d) Art 4, § 4.2.3d)	NOC	**No study** per Res. 540 *invites* 1
Annex 1 Sec. 6	FSS↓ in R2 (11.7-12.2) and in R3 (12.2-12.5)	Proposed new or modified assignments in R1 and 3 List	Δ pfd + pfd(θ) (θ=space station separation) Note 1	Art 4, § 4.1.1e) or 4.2.3e)	R1: Replace pfd(θ) with FSS protection equations of § 3.2.2.3a) R2 and 3: **See Note 5**	Sec. 3.2.2.3
	FSS↓ in R1 (12.5-12.7) and R3 (12.2-12.7)	Proposed new or modified assignments in R2 Plan		Art 4, § 4.2.3e)		Sec. 3.2.2.3
Annex 1 Sec. 7	FSS↑ in R1 (12.5-12.7)	Proposed modification to R2 Plan	ΔT/T	Art 4, § 4.2.3e)	Change ΔT/T from 4% to 6%	Sec. 3.2.2.3

Annex 3	BSS receiving earth stations in R1 (11.7-12.5), R2 (12.2-12.7), and R3 (11.7-12.2)	Terrestrial stations and FSS↑ earth stations **Note 7**	pfd at edge of BSS service area	Art 6, § 6.2.2	Retain Annex 3 but with new parameters or replace with App. 7 including new BSS parameters	Sec. 3.2.2.4
Annex 4	R1 and 3 BSS Plan	FSS↓ or unplanned BSS in R2 (11.7-12.2 GHz)	pfd(θ) (θ=space station separation)	Art 7, § 7.1 and 7.2	R1: Replace with BSS protection equations of § 3.2.2.3a)	Sec. 3.2.2.3
	R2 BSS Plan	FSS↓ or unplanned BSS in R1 (12.5-12.7 GHz) and R3 (12.2-12.7 GHz)			R2: Replace with BSS protection equations of § 3.2.2.3b) R3: **See Note 4**	Sec. 3.2.2.3
Annex 6 Note 2	BSS	BSS, FSS, FS, BS	C/I	Not explicitly referenced in Articles 4 - 7 of Annex 30	Replace with new Annex 6 using text from § 3.2.2.1 **See Note 3**	Sec. 3.2.2.1
	FSS	BSS, FSS	C/I, N			
	FS	BSS	N			
	BS	BSS	C/I			
Annex 7 § A3)	FSS in R2 (11.7-12.2)	BSS in R1	Orbital position		NOC	**No study See Note 6**

TABLE 3.2-8

Sharing criteria in Annexes 1 and 4 to Appendix 30A

Criteria in	Protected service(s) and bands (GHz)	Interfering service	Type of limit	Associated procedures	Possible action	CPM text
1	**2**	**3**	**4**	**5**	**6**	**7**
Annex 1 Sec. 3	R2 FL Plan (17.3-17.8)	Proposed modification to R2 FL Plan	Δ oepm	Art 4, § 4.2.2c)	NOC	Sec. 3.2.2.5
Annex 1 Sec. 4	R1 and 3 FL Plan or FL List or modifications to FL List	Proposed modification to R1 and 3 FL List	Hard pfd + coord arc + ΔFLepm	Art 4, § 4.1.1a) or § 4.1.1b)	NOC	
Annex 1 Sec. 5	FSS↑ in R1 and 3 (17.3-18.1) or R2 (17.3-17.8)	Proposed modification to R1 snf 3 FL List or R2 FL Plan	ΔT/T (3%) **Note 8**	Art 4, § 4.2.2a) or § 4.2.2b)	Increase ΔT/T to a common value to be determined by further study	Sec. 3.2.2.6
Annex 1 Sec. 6	Unplanned BSS FL in R2 (17.8-18.1)	Proposed modification to R1 and 3 FL List	ΔT/T (3%) **Note 8**	Art 4, § 4.1.1c)		

Annex 4 Sec. 1	R1 and 3 FL Plan (17.3-18.1) or R2 FL Plan (17.3-17.8)	FSS↓ or BSS	ΔT/T (4%) **Note 8**	Art 7, § 7.1	**Note 8**	
Annex 4 Sec. 2	BSS FL in R1 and 3 Plan or List (17.8-18.1)	Unplanned BSS FL in R2	ΔT/T (3%) **Note 8**	Art 7, § 7.1		

Note 1 – Until § 6 of Annex 1 to Appendix **30** is modified by WRC-03, the pfd limits appearing in the Annex to Resolution **540 (WRC-2000)** shall be applied in place of the –138 dB(W/(m^2 · 27 MHz)) and –160 dB(W/(m^2 · 4 kHz)) criteria appearing in the third paragraph of § 6 of Annex 1 to Appendix **30**.

Note 2 – Annex 6 to Appendix **30** in the 2001 Edition of the Radio Regulations provides a table showing the protection requirements that were assumed at WARC-77 as a basis for developing sharing criteria among the indicated combinations of protected and interfering services assuming the use of analog signals (TV/FM, FDM/FM, TV/VSB, 4φ-PSK) appropriate to those services at the time. Annex 6 also suggests the diameter, gain, and efficiency of a reference FSS earth station used at WARC-77 in calculating interference from BSS space stations, and provides data on the BSS use of energy dispersal.

Note 3 – If desired for historical reasons, a note similar to Note 2 above should be added as a footnote to the title of the new Annex 6.

Note 4 – Requires decision on minimum diameter of BSS antenna to be protected in Region 3. If 60 cm, replace pfd(θ) with BSS protection equations of § 3.2.2.3a); if 45 cm, replace pfd(θ) with BSS protection equations of § 3.2.2.3b).

Note 5 – Requires decision on minimum diameter of FSS antenna to be protected in Region 3. If 60 cm, replace pfd(θ) with FSS protection equations of § 3.2.2.3a); if 45 cm, replace pfd(θ) with FSS protection equations of § 3.2.2.3b).

Note 6 – *Invites the ITU-R* 3 of Resolution **540 (WRC-2000)** invited study of the limitations of § A3 of Annex **7** to Appendix 30 in the context of any changes to the sharing criteria studied by the ITU-R. The responsible Working Party and its Special Rapporteur Group received no responses to this invitation, implying that the proposed changes to the sharing criteria did not warrant changing the § A3 limitations.

Note 7 – Both Res. **540** and Res. **735** invite study of the criteria for this sharing case. The latter Resolution emphasizes sharing in the bands consistent with the decisions of WRC-2000 on No. **9.19**.

Note 8 – ΔT/T is calculated in accordance with the method of Appendix 8 except that the maximum power densities per Hertz averaged over the worst 1 MHz are replaced by power densities per Hertz averaged over the total RF bandwidth of the feeder-link carriers. The further study leading to the new value of ΔT/T should include specification of the reference antenna pattern to be used in lieu of that in Annex III to Appendix **8**.

ATTACHMENT 1 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 1 OF APPENDIX 30

MOD

ANNEX 1 (WRC-2000)

Limits for determining whether a service of an administration is affected by a proposed modification to the Region 2 Plan or by a proposed new or modified assignment in the Regions 1 and 3 List or when it is necessary under this Appendix to seek the agreement of any other administration[14]

(See Article 4)

1 Limits for the interference into frequency assignments in conformity with the Regions 1 and 3 Plan or with the Regions 1 and 3 List or into new or modified assignments in the Regions 1 and 3 List

Under assumed free-space propagation conditions, the power flux-density of a proposed new or modified assignment in the List shall not exceed the value of –103.6 dB(W/(m^2 · 27 MHz)).

With respect to § 4.1.1 *a)* or *b)* of Article 4, an administration in Region 1 or 3 ~~shall be~~is considered by the Bureau as being affected if the minimum orbital spacing between the wanted and interfering space stations, under worst-case station-keeping conditions, is less than 9°.

However, an administration ~~shall not be~~is considered as not being affected if either of the following two conditions are met:

a) under assumed free-space propagation conditions, the power flux-density at any test point within the service area associated with any of its frequency assignments in the Plan or in the List or for which the procedure of Article 4 has been initiated, does not exceed the following values:[15]

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

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[14] With respect to this Annex, except for Section 2, the limits relate to the power flux-density which would be obtained assuming free-space propagation conditions.

With respect to Section 2 of this Annex, the limit specified relates to the overall equivalent protection margin calculated in accordance with § 2.2.4 of Annex 5.

[15] For the protection of analogue assignments brought in service before 17 October 1997, the following values shall be used until 1 January 2015:

-147 dB(W/(m^2 · 27 MHz)) for $0° \leq \theta < 0.44°$

$-138 + 25 \log \theta$ dB(W/(m^2 · 27 MHz)) for $0.44° \leq \theta < 9°$.

~~–147 dB(W/(m^2 · 27 MHz)) for 0° ≤ θ < 0.245°~~

~~134.8 + 20 log θ dB(W/(m^2 · 27 MHz)) for 0.245° ≤ θ < 1.7°~~

~~135 + 1.66 θ^2 dB(W/(m^2 · 27 MHz)) for 1.7° ≤ θ < 3.6°~~

~~127.5 + 25 log θ dB(W/(m^2 · 27 MHz)) for 3.6° ≤ θ < 9°~~

~~where θ corresponds to the minimum geocentric angular separation taking into account the pertinent station-keeping accuracy of the interfering broadcasting-satellite service and the interfered-with broadcasting-satellite service space stations;~~

b) the effect of the proposed new or modified assignments in the List is that the equivalent downlink protection margin[16] corresponding to a test point of its assignment in the Regions 1 and 3 Plan or List, or for which the procedure of Article 4 has been initiated, including cumulative effect of any previous modification to the List or any previous agreement, does not fall more than 0.45 dB below 0 dB or, if already negative, more than 0.45 dB below the value resulting from:

– the Regions 1 and 3 Plan and List as established by WRC-2000; *or*

– a proposed new or modified assignment to the List in accordance with this Appendix; *or*

– a new entry in the Regions 1 and 3 List as a result of successful application of Article 4 procedures.

NOTE – In performing the calculation, the effect at the receiver input of all the co-channel and adjacent-channel signals is expressed in terms of one equivalent co-channel interfering signal. This value is usually expressed in decibels.

NOC

2 Limits to the change in the overall equivalent protection margin for frequency assignments in conformity with the Region 2 Plan

MOD

3 Limits to the change in the power flux-density to protect the broadcasting-satellite service in Regions 1 and 2 in the band 12.2-12.5 GHz and in Region 3 in the band 12.5-12.7 GHz

With respect to § 4.1.1 *c)* of Article 4, an administration in Region 2 ~~shall be~~is considered as being affected if the proposed new or modified assignment in the Regions 1 and 3 List would result in exceeding the power flux-densities given below, at any test point in the service area ~~affected~~of its overlapping frequency assignments.

With respect to § 4.2.3 *a)*, 4.2.3 *b)* or 4.2.3 *f)* of Article 4, as appropriate, an administration in Region 1 or 3 ~~shall be~~is considered as being affected if the proposed modification to the Region 2 Plan would result in exceeding the power flux-densities given below, at any test point in the service area ~~affected~~of its overlapping frequency assignments.

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

~~–147 dB(W/(m^2 · 27 MHz)) for 0° ≤ θ < 0.44°~~

~~–138 + 25 log θ dB(W/(m^2 · 27 MHz)) for 0.44° ≤ θ < 19.1°~~

~~–106 dB(W/(m^2 · 27 MHz)) for θ ≥ 19.1°~~

[16] For the definition of the equivalent protection margin, see § 3.4 of Annex 5.

~~where θ is:~~

~~– the difference in degrees between the longitudes of the broadcasting-satellite space station in Region 1 or 3 and the broadcasting-satellite space station affected in Region 2, *or*~~

~~– the difference in degrees between the longitudes of the broadcasting-satellite space station in Region 2 and the broadcasting-satellite space station affected in Region 1 or 3.~~

NOC

4 Limits to the power flux-density to protect the terrestrial services of other administrations[18, 19, 20]

5 (Not used.)

MOD

6 Limits to the change in the power flux-density of assignments in the Regions 1 and 3 Plan <u>or List</u> to protect the fixed-satellite service (space-to-Earth) in the band 11.7-12.2 GHz in Region 2 or in the band 12.2-12.5 GHz in Region 3, and of assignments in the Region 2 Plan to protect the fixed-satellite service (space-to-Earth) in the band 12.5-12.7 GHz in Region 1 and in the band 12.2-12.7 GHz in Region 3

With respect to § 4.1.1 *e)* of Article 4, an administration ~~in Region 2 or Region 3 shall be~~<u>is</u> considered as being affected if the proposed new or modified assignment in the Regions 1 and 3 List would result in an increase in the power flux-density ~~on its territory~~<u>over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 2 or Region 3</u> of 0.25 dB or more above that resulting from the frequency assignments in the Plan or List for Regions 1 and 3 as established by WRC-2000.

With respect to § 4.2.3 *e)*, an administration ~~in Region 1 or 3 shall be~~<u>is</u> considered as being affected if the proposed modification to the Region 2 Plan would result in an increase in the power flux-density ~~on its territory~~ <u>over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 1 or 3</u> of 0.25 dB or more above that resulting from the frequency assignments in the Region 2 Plan at the time of entry into force of the Final Acts of the 1985 Conference.

~~With respect to § 4.1.1 *e)* of Article 4, where a proposed new or modified assignment in the Regions 1 and 3 List gives a power flux-density of less than –138 dB(W/(m^2 · 27 MHz))[21] anywhere in the territory of an administration of Region 2 or Region 3, that administration shall be considered as not being affected. With respect to § 4.2.3 *e)* of Article 4, where a proposed modification to the Region 2 Plan gives a power flux-density of less than –160 dB (W/(m^2 · 4 kHz))[21] anywhere in the territory of an administration of Region 1 or 3, that administration shall be considered as not being affected.~~

<u>With respect to § 4.1.1 *e)* or § 4.2.3 *e)* of Article 4, an administration is considered as not being affected if the proposed new or modified assignment in the Regions 1 and 3 List, or if a proposed</u>

---

18 See § 3.18 of Annex 5.

19 In the band 12.5-12.7 GHz in Region 1, these limits are applicable only to the territory of administrations mentioned in Nos. **5.494** and **5.496**.

20 See Resolution **34**.

~~21 In place of these values, the values given in the Annex to Resolution **540 (WRC-2000)** shall be applied by administrations and the Bureau until this section is revised by a subsequent conference.~~

modification to the Region 2 Plan, gives a power flux-density anywhere over any portion of the service area of its overlapping frequency assignments in the fixed-satellite service in Region 1, 2 or 3 of less than:

For interference caused by Regions 1 and 3 BSS to Region 2 FSS (space-to-Earth in the band 11.7-12.2 GHz):

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

For interference caused by Region 1 BSS to Region 3 FSS (space-to-Earth in the band 12.2-12.5 GHz), or interference caused by Region 2 BSS to Regions 1 and 3 FSS (space-to-Earth in the band 12.5-12.7 GHz in Region 1 and in the band 12.2-12.7 GHz in Region 3):

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

MOD

7 Limits to the change in equivalent noise temperature to protect the fixed-satellite service (Earth-to-space) in Region 1 from modifications to the Region 2 Plan in the band 12.5-12.7 GHz

With respect to § 4.2.3 *e)* of Article 4, an administration of Region 1 ~~shall be~~is considered as being affected if the proposed modification to the Region 2 Plan would result in:

– the value of $\Delta T/T$ resulting from the proposed modification is greater than the value of $\Delta T/T$ resulting from the assignment in the Region 2 Plan as of the date of entry into force of the Final Acts of the 1985 Conference; *and*

– the value of $\Delta T/T$ resulting from the proposed modification exceeds ~~4~~[6%],

using the method of Appendix **8** (Case II).

ATTACHMENT 2 TO SECTION 3.2 OF CHAPTER 3

Example of possible modification of Annex 3 of Appendix 30

MOD

ANNEX 3

Method for determining the limiting interfering power flux-density at the edge of a broadcasting-satellite service area in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) and for calculating the power flux-density produced there by a terrestrial station, or a transmitting earth station in the fixed-satellite service in the band 12.5-12.7 GHz

1 General

1.1 This Annex describes a method of calculating the interference potential from terrestrial transmitters or transmitting earth stations in the fixed-satellite service to broadcasting-satellite receivers.

1.2 The method is in two parts:

a) the calculation of the maximum permissible interfering power flux-density at the edge of the broadcasting-satellite service area concerned;

b) the calculation of the likely power flux-density produced at any point on the edge of the service area by the terrestrial transmitter or the transmitting earth station in the fixed-satellite service of another administration.

1.3 The interference potential of the terrestrial transmitters or the transmitting earth stations in the fixed-satellite service must be considered case by case; the power flux-density produced by each terrestrial transmitter or transmitting earth station is compared to the limiting power flux-density at any point on the edge of the service area of a broadcasting-satellite station of another administration. If, for a given transmitter, the value of the power flux-density produced is lower than the value of the limiting power flux-density at any point on the edge of the service area, the interference caused to the broadcasting-satellite service by this transmitter is considered to be lower than the permissible value and no coordination is required between administrations before the terrestrial ~~service~~station or the transmitting earth station is brought into use. Where this is not the case, coordination and more precise calculations derived from a mutually agreed basis are necessary.

1.4 It is emphasized that, should the calculation described in this Annex indicate that the maximum permissible power flux-density is exceeded, it does not necessarily preclude the introduction of the terrestrial or the fixed-satellite service since the calculations are necessarily based on worst-case assumptions for:

a) the nature of the terrain of the interference path;

b) the off-beam discrimination on the broadcasting-satellite receiving installations;

c) the necessary protection ratios for the broadcasting-satellite service;

d) the type of reception in the broadcasting-satellite service, i.e., assuming individual reception, this being more critical than community reception for the angles of elevation concerned;

e) the value of power flux-density to be protected in the broadcasting-satellite service;

f) the propagation conditions between the ~~terrestrial~~interfering station or earth station and the broadcasting-satellite service area.

2 Limit of power flux-density

2.1 General

The limiting power flux-density not to be exceeded at the edge of the service area in order to protect the broadcasting-satellite service of an administration is given by the formula:

$$F = F_0 - R + D + P \quad (1)$$

where:

F: the maximum permissible interfering power flux-density (dB(W/m^2)) within the necessary bandwidth of the broadcasting-satellite;

F_0: the wanted power flux-density (dB(W/m^2)) at the edge of the service area;

R: the protection ratio (dB) between the wanted and interfering signals;

D: angular discrimination (dB) provided by the radiation pattern of the broadcasting-satellite receiver antenna;

P: polarization discrimination (dB) between the wanted and interfering signals.

2.2 Wanted power flux-density (F_0)

The value of F_0 is equal to:

For the Regions 1 and 3 Plan and List (WRC-2000), and digital assignments in the Region 2 Plan:

a) –108 dB(W/m^2) in 27 MHz for service areas in Regions 1 and 3, and

b) –115 dB(W/m^2) in 24 MHz, as well as in 27 MHz with respect to the cases mentioned in the footnote to Section 3.8 of Annex 5 concerning the necessary bandwidth in Region 2.

For the analogue BSS assignments in the Region 2 Plan:

–107 dB(W/m^2) for 24 MHz, as well as for 27 MHz with respect to the cases mentioned in the footnote to Section 3.8 of Annex 5 ~~for service areas~~concerning the necessary bandwidth in Region 2.

2.3 Protection ratio (R)

2.3.1 For digital BSS assignments, the single entry protection ratio is equal to 30 dB.

2.3.2 For the analogue BSS assignments in the Region 2 Plan and for BSS assignments in Regions 1 and 3 Plan and List which have been notified in conforming with the Plans and List of AP30 and brought into use and for which the date of bringing into use has been confirmed to the Bureau before [9 June 2003], ~~T~~the single entry protection ratio against all types of ~~terrestrial~~ transmissions, with the exception of amplitude-modulation multichannel television systems, is 35 dB for carrier frequency differences between the wanted and interfering signals of up to ±10 MHz, decreasing linearly from 35 dB to 0 dB for carrier frequency differences between 10 MHz and 35 MHz, and is 0 dB for frequency differences in excess of 35 MHz (see Fig. 1). For amplitude-modulation multichannel television systems which produce high peaks of power

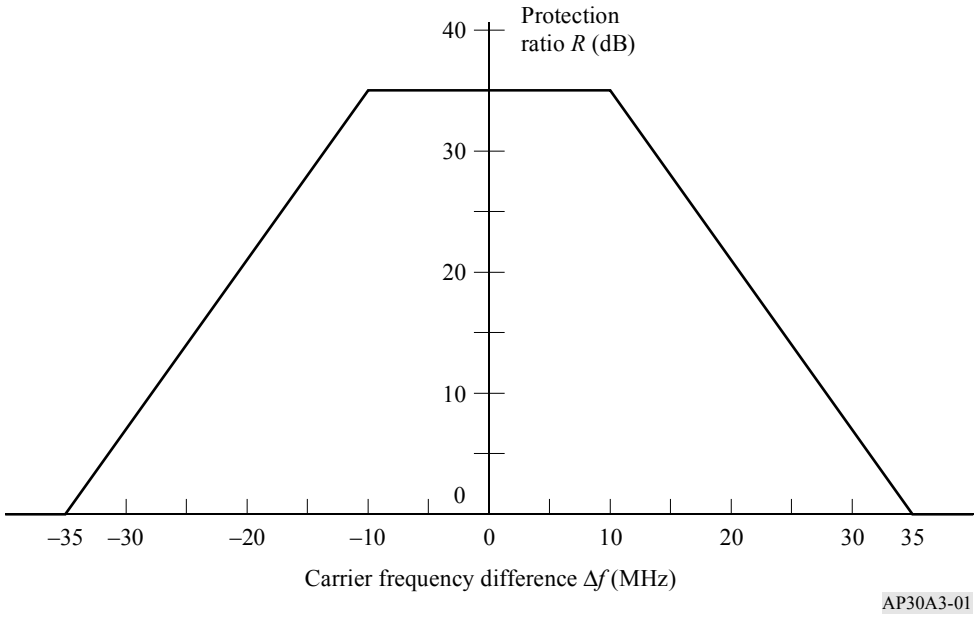
flux-density spread over a wide range of their necessary bandwidth, the protection ratio *R* is 35 dB and is independent of the carrier frequency difference.

2.3.2~~2~~3 The carrier frequency difference should be determined by reference to the frequency assignments in the broadcasting-satellite Plan or, in the case of assignments not contained within a plan, by reference to the characteristics of the proposed or operational system. ~~For amplitude-modulation multichannel television systems which produce high peaks of power flux-density spread over a wide range of their necessary bandwidth, the protection ratio *R* is 35 dB and is independent of the carrier frequency difference.~~

2.3.3~~4~~ A signal from a terrestrial station or a transmitting earth station in the fixed-satellite service should be considered only if its necessary bandwidth overlaps the necessary bandwidth of the broadcasting-satellite assignment.

FIGURE 1

Protection ratio (*R*) (dB) for a broadcasting-satellite signal against a single entry of interference from a terrestrial service (except for AM multichannel TV system)



2.4 Angular discrimination (*D*)

Regions 1 and 3:

2.4.1 The value of *D* to be assumed in equation (1) is derived from the following equations:

$D = 0.0025((d/\lambda)*\varphi)^2$ dB for $0° < \varphi < \varphi_m$

$D = G_{max} - (29 - 25\log(\varphi_r))$ dB for $\varphi_m < \varphi < \varphi_r$

$D = G_{max} - (29 - 25\log(\varphi))$ dB for $\varphi_r < \varphi < 14.45°$

$D = G_{max}$ dB for $14.45° < \varphi$

where:

φ is the angle of elevation for the broadcasting-satellite system

$\varphi_m = (\lambda/d)((G_{max}-G_1)/(0.0025))^{(0.5)}$ deg.

$\varphi_r = 95(\lambda/d)$ deg.

$G_{max} = 35.5$ dB

$G_1 = 29-25\log\varphi_r$ dB

d = 60 cm

λ is the wavelength in centimetres at [12.2] GHz.

~~2.4.1 Where the angle of elevation φ selected for the proposed or operational broadcasting-satellite system for the broadcasting-satellite service area concerned is equal to or greater than 19°, the value of *D* to be assumed in equation (1) is 33 dB. When φ is less than 19°, *D* should be derived from the equation (2) below.~~

Region 2:

2.4.2 For the digital BSS assignments in the Region 2 Plan the value of *D* to be assumed in equation (1) is derived from the following equations:

$D = 0.0025((d/\lambda)*\varphi)^{2}$ dB for $0° < \varphi < \varphi_m$

$D = G_{max}-(29-25\log(\varphi_r))$ dB for $\varphi_m < \varphi < \varphi_r$

$D = G_{max}-(29-25\log(\varphi))$ dB for $\varphi_r < \varphi < 14.45°$

$D = G_{max}$ dB for $14.45° < \varphi$

where:

φ is the angle of elevation for the broadcasting-satellite system

$\varphi_m = (\lambda/d)((G_{max}-G_1)/(0.0025))^{(0.5)}$ deg.

$\varphi_r = 95(\lambda/d)$ deg.

$G_{max} = 33.5$ dB

$G_1 = 29-25\log\varphi_r$ dB

d = 45 cm

λ = wavelength in centimetres at [12.2] GHz.

2.4.3 For the analogue BSS assignments in the Region 2 Plan *D* in dB should be derived from the expression (3) below where φ is the elevation angle for the proposed or operational broadcasting-satellite system for the broadcasting-satellite service area concerned.

NOTE 1 – If more than one value of φ is specified for a particular service area, the appropriate value of φ should be used for each section of the edge of the service area under consideration.

$$\begin{aligned} D &= 0 && \text{dB for } 0° \le \varphi \le 0.43° \\ D &= 4.15\,\varphi^2 && \text{dB for } 0.43° < \varphi \le 1.92° \\ D &= 8.24 + 25\log\varphi && \text{dB for } 1.92° < \varphi \le 25° \end{aligned} \quad (3)$$

$D = 43.2$ dB for $\varphi > 25°$

NOTE 2 – For the graphical determination of *D*, when calculated by equation (3) above, see Fig. 3.

2.5 Polarization discrimination (*P*)

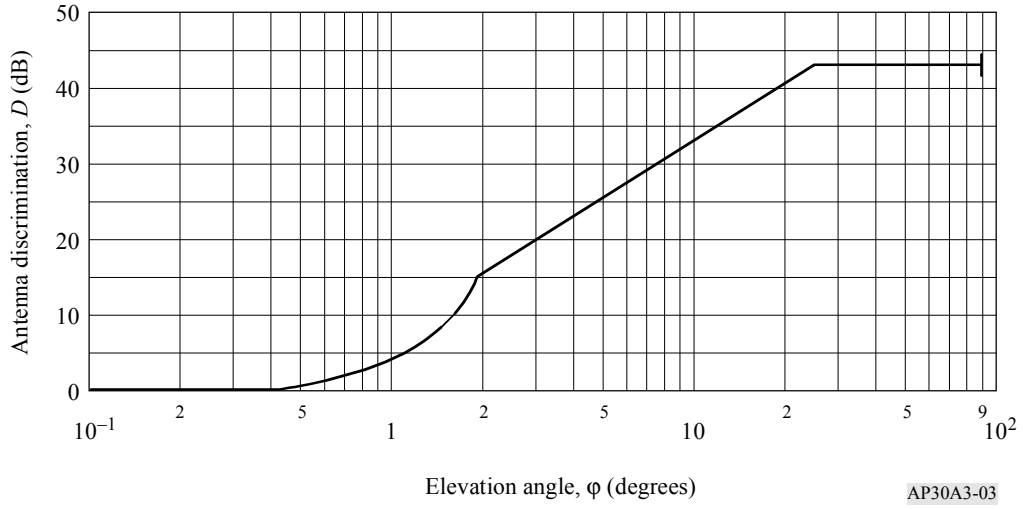
The value of *P* is equal to:

a) 3 dB when the interfering ~~terrestrial~~ service uses linear polarization and the broadcasting-satellite service uses circular polarization or vice versa;

b) 0 dB when the interfering ~~terrestrial~~ service and the broadcasting-satellite service both use circular or both use linear polarization.

FIGURE 3

Discrimination *D* (dB) of broadcasting-satellite receiver antenna as a function of satellite elevation angle



3 Power flux-density produced by a terrestrial station or a transmitting earth station (F_p)

The power flux-density F_p (dB(W/m^2)) produced at any point on the edge of the service area by the terrestrial station or the transmitting earth station is determined from the following formula:

$$F_p = E - A + [43] \quad (4)$$

where:

E: the equivalent isotropically radiated power (dBW) of the terrestrial station or the transmitting earth station in the direction of the point concerned on the edge of the service area;

A: the total path loss (dB) ~~.~~;

Constant of [43] dB: the gain of a 1 m^2 aperture antenna at [12.2] GHz.

3.1 Evaluation of path loss *A* for a terrestrial station or a transmitting earth station at ~~a distance greater than 100 km from~~ the edge of the service area of the broadcasting satellite

~~For path lengths greater than 100 km, *A* is given by:~~

~~*In the case of Regions 1 and 3:*~~

~~$A = 137.6 + 0.2324\, d_t + 0.0814\, d_m$ (5)~~

~~*In the case of Region 2:*~~

~~$A = 141.9 + 0.2867\, d_t + 0.1522\, d_m$ (6)~~

~~where d_t and d_m are the overland and oversea path lengths respectively (km).~~

~~3.2 Evaluation of path loss *A* for a terrestrial station at a distance equal to or less than 100 km from the edge of the service area of the broadcasting satellite~~

~~*In the case of Regions 1 and 3:*~~

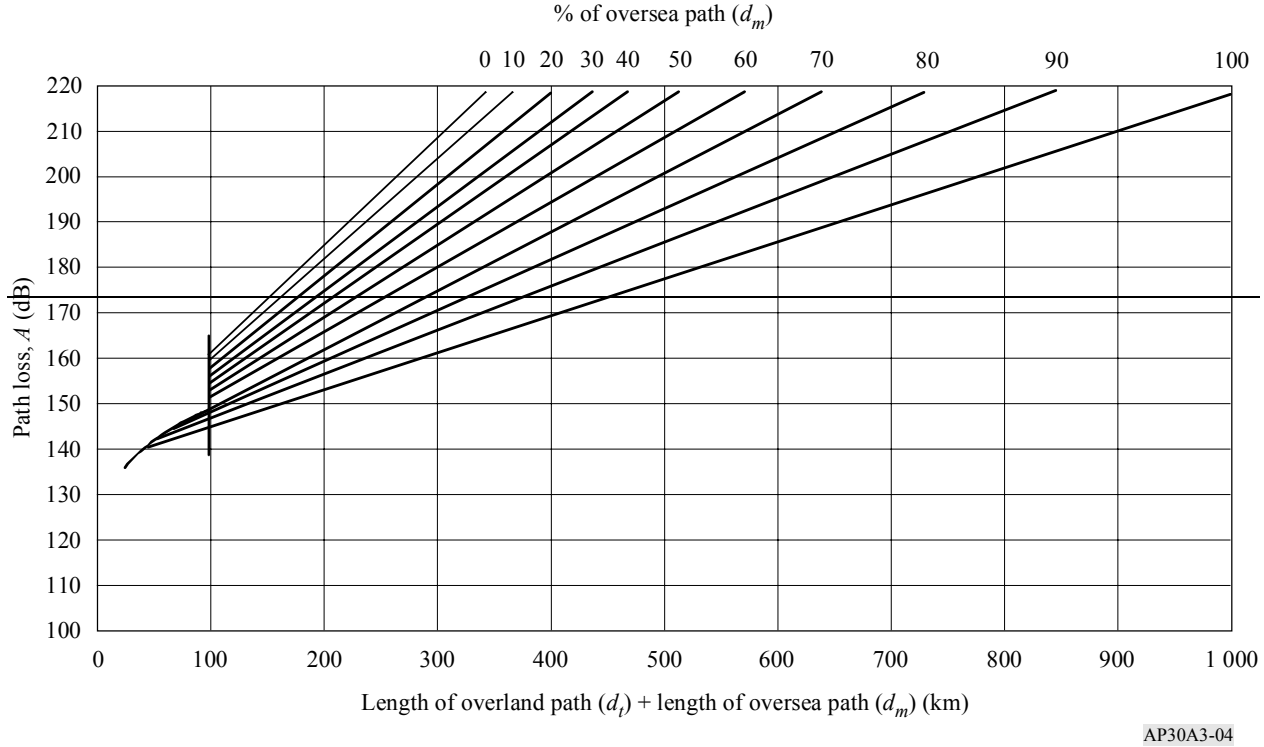
~~For path lengths equal to or less than 100 km, *A* is calculated using equations (5) and (7) and the lower value obtained is substituted in formula (4) to calculate the power flux-density produced at the point concerned on the edge of the service area:~~

~~$A = 109.5 + 20 \log (d_t + d_m)$ (7)~~

~~The variation in *A* for different path lengths and percentage of oversea path is shown in Fig. 4.~~

FIGURE 4

Total path loss *A* (dB) versus total path length ($d_t + d_m$) (km) and percentage of oversea path (Regions 1 and 3)



~~*In the case of Region 2:*~~

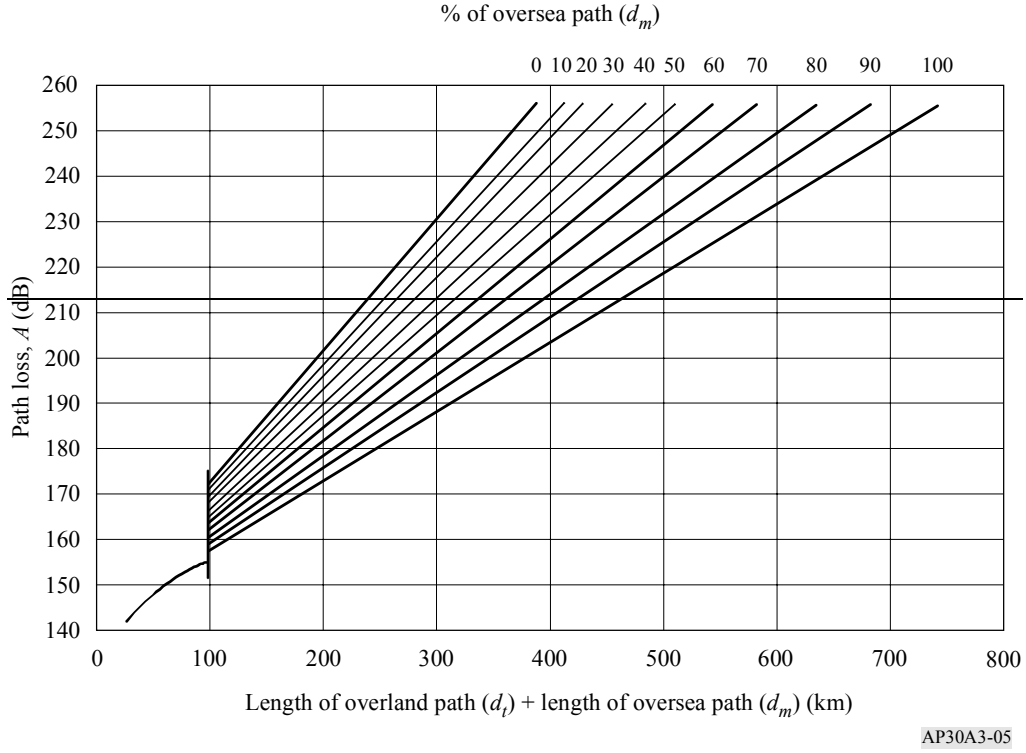
~~For path lengths equal to or less than 100 km, *A* is calculated using equations (6) and (8) and the lower value obtained is substituted in formula (4) to calculate the power flux-density produced at the point concerned on the edge of the service area:~~

~~$A = 114.4 + 20 \log (d_t + d_m) + 0.01 (d_t + d_m)$ (8)~~

~~The variation in *A* for different path lengths and percentage of oversea path is shown in Fig. 5.~~

FIGURE 5

Total path A (dB) versus total path length ($d_t + d_m$) (km) and percentage of oversea path (Region 2)



~~**3.3 Distance beyond which the method need not be applied**~~

~~The method need not be applied and coordination is unnecessary when the distance between the terrestrial station and the service area of the broadcasting satellite is greater than:~~

~~*a)* 400 km in the case of all overland paths; *or*~~

~~*b)* 1 200 km in the case of all oversea or mixed paths.~~

This section provides the propagation model to use for determining the minimum path loss between the interfering terrestrial transmitter or transmit earth station and the edge of the BSS service area. The calculations assume a frequency of [12.2] GHz for the interfering signal. References are made to the appropriate sections of Appendix 7 that describe the model in more detail.

3.1.1 Propagation Mode 1 (Appendix 7: § 4 , § 1 of Annex 1, § 3 of Annex 1)

3.1.1.1 Ducting Model

Distance-independent part of the losses (dB) for ducting

For BSS earth stations, no additional protection can be assumed to be available from the earth station horizon elevation angle, i.e. A_h, the total site shielding attenuation, is 0 dB.

Reduction in attenuation arising from direct coupling into over-sea ducts (dB):

$$A_c = \frac{-6}{(1+ d_c)}$$

where d_c (km) is the distance from a land based earth station to the coast in the direction being considered. d_c is zero in other circumstances.

Distance-independent part of the losses (dB) for ducting:

$$A_1 = 140.35 + A_c$$

Distance-dependent part of the losses (dB) for ducting

Specific attenuation due to gaseous absorption (dB/km):

$$\gamma_g = 7.507 \times 10^{-3} + 1.104 \times 10^{-2}\left(\frac{d_t}{d_i}\right) + 1.551 \times 10^{-2}\left(1 - \frac{d_t}{d_i}\right)$$

where:

d_t (km): aggregate land distance, Zone A1 + Zone A2, along the path

d_i (km): path length considered, it lies within the range between a minimum calculated distance and a maximum calculated distance, which are given in § 4.2 and § 4.3 of Appendix 7.

Values for zone-dependent parameters:

$$\tau = 1 - \exp\left[-\left(4.12 \times 10^{-4}(d_{lm})^{2.41}\right)\right]$$

where:

d_{lm} (km): longest continuous inland distance, Zone A2, along the path considered.

$$\mu_1 = \left[10^{\frac{-d_{tm}}{16-6.6\tau}} + \left[10^{-(0.496+0.354\tau)}\right]^5\right]^{0.2}$$

where:

d_{tm} (km): longest continuous land (i.e. inland + coastal) distance, Zone A1 + Zone A2 along the path considered.

μ_1 limited to $\mu_1 \leq 1$.

$$\sigma = -0.6 - 8.5 \times 10^{-9} d_i^{3.1} \tau$$

σ limited to $\sigma \geq -3.4$.

$$\mu_2 = \left(2.48 \times 10^{-4} d_i^2\right)^{\sigma}$$

μ_2 limited to $\mu_2 \leq 1$.

$$\mu_4 = \begin{cases} 10^{(-0.935+0.0176\zeta_r)\log\mu_1} & for \quad \zeta_r \leq 70^o \\ 10^{0.3\log\mu_1} & for \quad \zeta_r \geq 70^o \end{cases}$$

where ζ_r is given in § 4.1 of Appendix 7.

Path-dependent incidence of ducting, β, and the related parameter, Γ_1:

Time dependency of the path loss:

$$\beta = \beta_e \cdot \mu_1 \cdot \mu_2 \cdot \mu_4$$

where β_e is given in § 4.1 of Appendix 7.

$$\Gamma_1 = \frac{1.076}{(2.0058 - \log\beta)^{1.012}} \exp\left[-\left(9.51 - 4.8\log\beta + 0.198(\log\beta)^2\right) \times 10^{-6} d_i^{1.13}\right]$$

The correction factor, C_{2i} (dB) is given by (see equation 52 in Annex 1 to Appendix 7):

$$C_{2i} = Z(f)(d_i - d_{\min})\tau \qquad dB$$

where Z(f) is given in § 4.4 of Appendix 7. At distances greater than 375 km the value of the correction factor C_{2i} to be applied is the value of C_{2i} at the 375 km distance.

Distance-dependent part of the losses (dB) for ducting:

$$L_5(p) = 0.138 d_i - 4.625 \times 10^{-3} d_t + (1.2 + 3.7 \times 10^{-3} d_i)\log\left(\frac{p}{\beta}\right) + 12\left(\frac{p}{\beta}\right)^{\Gamma_1} + C_{2i}$$

where p is the maximum percentage of time for which the permissible interference power may be exceeded.

Attenuation due to ducting:

$$A_{duct} = A_1 + L_5(p)$$

3.1.1.2 For the tropospheric scatter model

Distance-independent part of the losses (dB) for tropospheric scatter

$$A_2 = 212.98 + 10\varepsilon_h - 0.15 N_o - 10.1\left(-\log\left(\frac{p}{50}\right)\right)^{0.7}$$

where:

ε_h: earth station horizon elevation angle (degrees)

N_o: path centre sea level surface refractivity (§ 4.1 in the main body of Appendix 7)

Distance-dependent part of the losses (dB) for tropospheric scatter

$$L_6(p) = 20\log(d_i) + 5.73 \times 10^{-4}(112 - 15\cos(2\zeta))d_i + 0.0115 d_i + C_{2i}$$

where ζ is the latitude of the earth station's location (degree).

Total attenuation due to tropospheric scatter:

$$A_{trop} = A_2 + L_6(p)$$

Path loss for Mode 1:

$$A_{mode1} = \text{Min}(A_{duct}, A_{trop})$$

ATTACHMENT 3 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 4 OF APPENDIX 30

MOD

ANNEX 4 (WRC-2000)

Need for coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service where this service is not subject to a Plan: in Region 2 (11.7-12.2 GHz) with respect to the ~~Regions 1 and 3~~ Plan~~;~~, the List or proposed new or modified assignments in the List for Regions 1 and 3, in Region 1 (12.5-12.7 GHz) and in Region 3 (12.2-12.7 GHz) with respect to the ~~Region 2~~ Plan or proposed modifications to the Plan for Region 2, in Region 3 (12.2-12.5 GHz) with respect to the Plan, the List or proposed new or modified assignments in the List for Region 1

(See Article 7)

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) of Region 2 is required when, under assumed free-space propagation conditions, the power flux-density ~~on the territory~~over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 1 or Region 3 exceeds the value derived from the expressions given below.

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) of Region 3 is required when, under assumed free-space propagation conditions, the power flux-density over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 1 exceeds the value derived from the expressions given below:

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

With respect to §§ 7.1 and 7.2 of Article 7, coordination of a space station in the fixed-satellite service (space-to-Earth) in Region 1 or 3 or broadcasting-satellite service not subject to a Plan in Region 3 is required when, under assumed free-space propagation conditions, the power flux-density ~~on the territory~~over any portion of the service area of the overlapping frequency assignments in the broadcasting-satellite service of an administration in Region 2 exceeds the value derived from the ~~same~~ expressions given below:

{Editorial note: pfd mask. See Section 3.2.2.3 of the CPM Report}

~~-147 dB(W/(m^2 · 27 MHz)) for $0° \leq \theta < 0.44°$~~

~~$-138 + 25 \log \theta$ dB(W/(m^2 · 27 MHz)) for $0.44° \leq \theta < 19.1°$~~

~~-106 dB(W/(m^2 · 27 MHz)) for $\theta \geq 19.1°$~~

~~where θ is:~~

~~– the difference in degrees between the longitude of the interfering fixed-satellite service space station in Region 2 and the longitude of the affected broadcasting-satellite service space station in Regions 1 and 3, *or*~~

~~– the difference in degrees between the longitude of the interfering fixed-satellite service space station in Region 1 or 3 or the interfering broadcasting-satellite service space station in Region 3 and the longitude of the affected broadcasting-satellite service space station in Region 2.~~

ATTACHMENT 4 TO SECTION 3.2 OF CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEX 6 OF APPENDIX 30

ANNEX 6[39]

Criteria for sharing between services

ADD

Part A Assumptions used in deriving sharing criteria adopted by the WARC–77

NOC

Sections 1 to 3 of Annex 6

ADD

Part B Assumptions used in deriving sharing criteria adopted by WRC-03

The establishment of new sharing criteria between the fixed-satellite service and the broadcasting-satellite service has been based on the following assumptions.

1 Reference antenna patterns

1.1 For earth station antennas in the fixed-satellite service or in the broadcasting-satellite service with diameters between 45 cm and 240 cm, the gain of the side lobes is given by [Recommendation ITU-R BO.1213].

1.2 For earth station antennas in the fixed-satellite service with diameters greater than 240 cm, the gain of the side lobes is given by Recommendation ITU-R S.580-5, with 29-25log θ side-lobe envelope, complemented in the main lobe by Annex 3 to Appendix 8, which is equivalent to Section 3 of Annex 3 to Appendix 7 (WRC-2000).

2 Antenna sizes and total noise temperatures

The range of antenna sizes and total noise temperatures considered for the protection of the fixed-satellite service and the broadcasting-satellite service are given in the following table:

---

[39] Sections 1 and 2 of Part A of this Annex are applicable when the services of Regions 1 or 3 are involved. Section 3 of Part A is applicable to all Regions.

Receive earth station antenna diameter (m)	0.45*	0.60	0.80	1.20	2.4	5.0	8.0	11.0
Receive earth station noise temperature (K)	110	110	125	150	150	200	250	250
Total link noise temperature (K)	174	174	198	238	238	317	396	396

* ***The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases.***

The total link noise temperature was calculated from the receive earth station noise temperature (which includes the antenna temperature, the receive amplifier temperature and the noise increase resulting from feeder losses), and adding 2 dB for all other sources of noise (uplink noise, GSO interference, cross polarization isolation and frequency reuse interference).

3 Protection criteria

Pfd masks developed in Sections 1, 3 and 6 of Annex 1 and in Annex 4 to Appendix 30 to protect the fixed-satellite service and the broadcasting-satellite service have been determined by specifying to 6% the allowable relative noise increase ($\Delta T/T$) into the range of earth station antennas given in the above table.

The allowable interfering pfd was calculated by the following expression:

$$PFD_{all}(\theta) = 10Log(\Delta T/T) + 10Log(kT\, b_{rf}) + G_m - G_a(\varphi)$$

where:

$PFD_{all}(\theta)$ = allowable level of interfering pfd for an orbital separation of θ degrees

$\Delta T/T$ = allowable relative increase in receiver link noise = 6%

k = Boltzmann's constant (1.38×10^{-23} Watt·sec/K)

T = Total link noise temperature (K; see Table in section 2 above)

b_{rf} = Reference bandwidth (27 MHz in Regions 1 and 3; 24 MHz in Region 2)

G_m = Gain of a 1 m^2 effective aperture (dBi/m^2)

$G_a(\varphi)$ = Receive antenna gain for topocentric angle of φ (dBi)

φ = Topocentric angle between interfering and wanted satellites (see Annex 1 of Appendix 8 of the Radio Regulations) (deg)

It was assumed that $\varphi = 1.1\ \theta$

4 Power flux-density to protect FSS and BSS with specific antenna diameters

The table below contains required power flux-density levels for the protection of FSS and BSS with the characteristics in Section 2 above using the criteria specified in Section 3 above.

Required power flux-density (pfd) in dB (W/m^2/27 MHz) corresponding to different antenna diameters								
Orbital separation between wanted and interfering space stations	**45 cm***	**60 cm**	**80 cm**	**120 cm**	**240 cm**	**500 cm**	**800 cm**	**1 100 cm**
0°	–134.2	–136.7	–138.7	–142.2	–147.4	–152.5	–155.6	–158.2
θ>0	For any value of the orbital separation θ between the wanted and interfering space stations, the applicable pfd should be relaxed from the value corresponding to 0° orbital separation by adding the off-axis antenna discrimination, as calculated under the assumptions in Section 1 above.							

* ***The inclusion of the 45 cm diameter in the range of antennas to be protected has not been agreed in all cases.***

ATTACHMENT 5 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ANNEXES 1 AND 4 OF APPENDIX 30A

ANNEX 1

Limits for determining whether a service of an administration is considered to be affected by a proposed modification to the Region 2 feeder-link Plan or by a proposed new or modified assignment in the Regions 1 and 3 feeder-link Lists or when it is necessary under this Appendix to seek the agreement of any other administration (WRC-2000)

1 (SUP - WRC-2000)

2 (SUP - WRC-2000)

NOC

3 Limits to the change in the overall equivalent protection margin with respect to frequency assignments in conformity with the Region 2 feeder-link Plan[18] (WRC-2000)

[18] With respect to § 3 the limit specified relates to the overall equivalent protection margin calculated in accordance with § 1.12 of Annex 3.

MOD

4 Limits to the interference into frequency assignments in conformity with the Regions 1 and 3 feeder-link Plan or with the Regions 1 and 3 feeder-link Lists or proposed new or modified assignments in the Regions 1 and 3 feeder-link Lists (WRC-2000)

MOD

5 Limits applicable to protect a frequency assignment in the bands 17.3-18.1 GHz (Regions 1 and 3) and 17.3-17.8 GHz (Region 2) to a receiving space station in the fixed-satellite service (Earth-to-space)

An administration in Region 1 or 3 ~~shall be~~is considered affected by a proposed modification in Region 2, with respect to § 4.2.2 *a)* or § 4.2.2 *b)* of Article 4, or an administration in Region 2 shall ~~be~~is considered affected by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List~~s~~, with respect to § 4.1.1 *c)* of Article 4, when the power flux-density arriving at the receiving space station of a broadcasting-satellite feeder-link would cause an increase in the noise temperature of the feeder-link space station which exceeds the threshold value of $\Delta T/T$ corresponding to [~~3%~~][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the ~~total Rf~~necessary bandwidth of the feeder-link carriers ~~(24 MHz for Region 2 and 27 MHz for Regions 1 and 3)~~. (WRC-2000)

Interim systems of Region 2 in accordance with Resolution **42 (Rev.Orb-88)** shall not be taken into consideration when applying this provision to proposed ~~modifications to the~~new or modified assignments in the Regions 1 and 3 feeder-link ~~Plan~~List. However, this provision shall be applied to Region 2 interim systems with respect to ~~the~~ Regions 1 and 3 ~~feeder-link Plan~~administrations in accordance with § 5.2 *b)* of Resolution **42**. (WRC-2000)

MOD

6 Limits applicable to protect a frequency assignment in the band 17.8-18.1 GHz (Region 2) to a receiving feeder-link space station in the fixed-satellite service (Earth-to-space) (WRC-2000)

With respect to § 4.1.1 *d)* of Article 4, ~~A~~an administration in Region 2 ~~shall be~~is considered affected by a proposed new or modified assignment in the Regions 1 and 3 feeder-link List~~s~~ when the power flux-density arriving at the Region 2 receiving space station of a broadcasting-satellite feeder-link would cause an increase in the noise temperature of the receiving feeder-link space station which exceeds the threshold value of $\Delta T/T$ corresponding to [~~3%~~][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the ~~total RF~~necessary bandwidth of the feeder-link carriers. (WRC-2000)

ANNEX 4 (WRC-2000)

Criteria for sharing between services

MOD

1 Threshold values for determining when coordination is required between transmitting space stations in the fixed-satellite service or the broadcasting-satellite service and a receiving space station in the feeder-link Plans or List, or a proposed new or modified receiving space station in the List in the frequency bands 17.3-18.1 GHz (Regions 1 and 3) and in the feeder-link Plan or a proposed modification to the Plan in the frequency band 17.3-17.8 GHz (Region 2)

With respect to § 7.1, Article 7, coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service with a receiving space station in a broadcasting-satellite service feeder link in the Regions 1 and 3 feeder-link Plan or List, or a proposed new or modified receiving space station in the List, or in the Region 2 feeder-link Plan or proposed modification to the Plan is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T_S / T_S$ corresponding to [~~4%~~][x%]. $\Delta T_S / T_S$ is calculated in accordance with Case II of the method given in Appendix **8**.

MOD

2 Threshold values for determining when coordination is required between transmitting feeder-link earth stations in the fixed-satellite service in Region 2 and a receiving space station in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List in the frequency band 17.8-18.1 GHz

With respect to § 7.1, Article 7, coordination of a transmitting feeder-link earth station in the fixed-satellite service with a receiving space station in a broadcasting-satellite feeder link in the Regions 1 and 3 feeder-link Plan or List or a proposed new or modified receiving space station in the List is required when the power flux-density arriving at the receiving space station of a broadcasting-satellite service feeder link of another administration would cause an increase in the noise temperature of the feeder-link space station which exceeds a threshold value of $\Delta T/T$ corresponding to [~~3%~~][x%], where $\Delta T/T$ is calculated in accordance with the method given in Appendix **8**, except that the maximum power densities per hertz averaged over the worst 1 MHz are replaced by power densities per hertz averaged over the ~~total Rf~~necessary bandwidth of the feeder-link carriers.

ATTACHMENT 6 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ARTICLES 1, 2, 4, 7, 9 AND ANNEXES 5 AND 7 OF APPENDIX 30

APPENDIX 30* (WRC-2000)

Provisions for all services and associated Plans and List for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2) (WRC-2000)

(See Article **9**)

TABLE OF CONTENTS

MOD

Page

ANNEXES

Annex 4 Need for coordination of a transmitting space station in the fixed-satellite service or in the broadcasting-satellite service where this service is not subject to a Plan: in Region 2 (11.7-12.2 GHz) with respect to the Regions 1 and 3 Plan, the List or proposed new or modified assignments in the List for Regions 1 and 3; in Region 1 (12.5-12.7 GHz) and in Region 3 (12.2-12.7 GHz) with respect to the ~~Region 2~~ Plan or proposed modifications to the Plan for Region 2; in Region 3 (12.2-12.5 GHz) with respect to the Plan, the List or proposed new or modified assignments in the List for Region 1 93

* The expression "frequency assignment to a space station", wherever it appears in this Appendix, shall be understood to refer to a frequency assignment associated with a given orbital position. See also Annex 7 for the orbital limitations. (WRC-2000)

ARTICLE 1 (WRC-2000)

General definitions

1.8 *Regions 1 and 3 List of additional uses (hereafter called in short the "List"):* The List of assignments for additional uses in Regions 1 and 3 as established by WRC-2000 (see Resolution 542 (WRC-2000)), as updated following the successful application of the procedure of § 4.1 of Article 4.

1.9 *Frequency assignment in conformity with the List:* Any frequency assignment which appears in the List as updated following successful application of § 4.1 of Article 4.

ARTICLE 2

Frequency bands

2.1 The provisions of this Appendix apply to the broadcasting-satellite service in the frequency bands between 11.7 GHz and 12.2 GHz in Region 3, between 11.7 GHz and 12.5 GHz in Region 1 and between 12.2 GHz and 12.7 GHz in Region 2 and to the other services to which these bands are allocated in Regions 1, 2 and 3, insofar as their relationship to the broadcasting-satellite service in these bands is concerned.

2.2 The use of the guardbands of the Plans in this Appendix, as defined in § 3.9 of Annex 5, to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service shall be coordinated with the BSS assignments subject to ~~these Plans~~this Appendix using the provisions of Article 7. Coordination among assignments intended to provide these functions and services not subject to a Plan shall be effected using the provisions of No. **9.7** and the associated provisions of Articles **9** and **11**. Coordination of modifications to the Region 2 Plan or assignments to be included in the Regions 1 and 3 List with assignments intended to provide these functions shall be effected using § 4.1.1 *e)*, 4.2.3 *e)* or 4.2.3 *f)* as appropriate, of Article 4. (WRC-2000)

ARTICLE 4 (WRC-2000)

Procedures for modifications to the Region 2 Plan or for additional uses in Regions 1 and 3[2]

4.1 Provisions applicable to Regions 1 and 3

4.1.26 ~~This~~The procedure of this Article may be applied by the administration of a new ITU Member State in order to include new assignments in the List. Upon completion of the procedure, the next World Radiocommunication Conference may be requested to consider, among the assignments included in the List after the successful completion of this procedure, the inclusion in the Plan of up to 10 channels (for Region 1) and up to 12 channels (for Region 3), over the national territory of the new Member State.

---

[2] The provisions of Resolution **49 (Rev.WRC-2000)** apply.

4.2 Provisions applicable to Region 2

4.2.6 An administration intending to make a modification to the Region 2 Plan shall send to the Bureau, not earlier than eight years but preferably not later than two years before the date on which the assignment is to be brought into use, the relevant information listed in Appendix **4**. Modifications to that Plan involving additions under § 4.2.1 *b)* shall lapse if the assignment is not brought into use by that date[7bis].

ARTICLE 7 (WRC-2000)

Coordination, notification and recording in the Master International Frequency Register of frequency assignments to stations in the fixed-satellite service (space-to-Earth) in the bands 11.7-12.2 GHz (in Region 2), 12.2-12.7 GHz (in Region 3) and 12.5-12.7 GHz (in Region 1), and to stations in the broadcasting-satellite service in the band 12.5-12.7 GHz (in Region 3) when frequency assignments to broadcasting-satellite stations in the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3 are involved[11]

7.1 The provisions of No. **9.7**[12] and the associated provisions under Articles **9** and **11** are applicable in respect of frequency assignments to broadcasting-satellite stations in the bands 11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3:

a) to transmitting space stations in the fixed-satellite service in the bands 11.7-12.2 GHz (in Region 2), 12.2-12.7 GHz (in Region 3) and 12.5-12.7 GHz (in Region 1); and

b) to transmitting space stations in the broadcasting-satellite service in the band 12.5-12.7 GHz (in Region 3).

7.2 In applying the procedures referred to in § 7.1, the provisions of Appendix **5** are replaced by the following:

7.2.1 The frequency assignments to be taken into account are:

a) the assignments in conformity with the appropriate Regional Plan in Appendix **30**;

b) the assignments included in the Regions 1 and 3 List;

c) the assignments for which the procedure of Article 4 has been initiated, as from the date of receipt of the complete Appendix **4** information under § 4.1.3 or 4.2.6.

7.2.2 The criteria to be applied are those given in Annex 4.

[7bis] The provisions of Resolution **533 (Rev.WRC-2000)** apply.

[11] These provisions do not replace the procedures prescribed in Articles **9** and **11** when stations other than those in the ~~planned~~ broadcasting-satellite service subject to this Appendix are involved.

[12] The provisions of Resolution **33 (Rev.WRC-97)** are applicable to space stations in the broadcasting-satellite service for which the advance publication information or the request for coordination has been received by the Bureau prior to 1 January 1999.

ARTICLE 9

Power flux-density limits between 12.2 GHz and 12.7 GHz to protect terrestrial services in Regions 1 and 3 from interference from Region 2 broadcasting-satellite space stations

9.1 The power flux-density at the Earth's surface in Regions 1 and 3, produced by emissions from a space station in the broadcasting-satellite service in Region 2 for all conditions and for all methods of modulation shall not exceed the values given in Section ~~5~~4 of Annex 1 on the territory of any country unless the administration of that country so agrees.

ANNEX 5

Technical data used in establishing the provisions and associated Plans and the Regions 1 and 3 List, which should be used for their application[22] (WRC-2000)

3.4 Protection ratio between television signals

For developing the original 1977 broadcasting-satellite service Plan for Regions 1 and 3, the following protection ratios were used[27, 28]:

– 31 dB for co-channel signals;

– 15 dB for adjacent channel signals.

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[22] In revising this Annex at WRC-97 and at WRC-2000, no changes have been made to the technical data applicable to the Region 2 Plan. However, for all three Regions, it should be noted that some of the parameters of networks proposed as modifications to the Region 2 Plan and the Regions 1 and 3 List may differ from the technical data presented herein. (WRC-2000)

[27] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

[28] The equivalent protection margin M is given in dB by the formula:

$$M = -10 \log (10^{-M_1/10} + 10^{-M_2/10} + 10^{-M_3/10})$$

where M_1 is the value (dB) of the protection margin for the same channel. This is defined in the following expression where the powers are evaluated at the receiver input:

$$\frac{\text{wanted power}}{\text{sum of the co-channel interfering powers}} \text{ (dB)} - \text{co-channel protection ratio (dB)}$$

M_2 and M_3 are the values (dB) of the upper and lower adjacent-channel protection margins respectively.

The definition of the adjacent-channel protection margin is similar to that for the co-channel case except that the adjacent-channel protection ratio and the sum of the interfering powers due to emissions in the adjacent channel are considered.

For revising this Plan at WRC-97, the following aggregate downlink protection ratios were specified in Recommendation ITU-R BO.1297 for the purpose of calculating downlink equivalent protection margins[28], [29, 30]:

– 24 dB for co-channel signals;

– 16 dB for adjacent channel signals.

In revising the Regions 1 and 3 Plan at WRC-97, the following aggregate overall protection ratio values were used [~~(as specified in Recommendation **521 (WRC-95)**)~~] for calculating the overall co-channel and adjacent-channel protection margins as defined in §§ 1.8 and 1.9:

– 23 dB for co-channel signals;

– 15 dB for adjacent channel signals.

[~~Recommendation **521 (WRC-95)**~~]It was also specified that for the revision of the Regions 1 and 3 Plan, no overall co-channel single entry *C*/*I* should be lower than 28 dB.

However, for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997, the overall equivalent protection margins were calculated using a co-channel overall protection ratio of 30 dB and lower and upper overall adjacent channel protection ratios of 14 dB[31].

WRC-2000 adopted, for the protection of digital assignments from digital emissions, the following protection ratio values to be applied for calculation of downlink equivalent protection margins of the WRC-2000 Regions 1 and 3 Plan:

– 21 dB for co-channel signals;

– 16 dB for adjacent channel signals.

During planning at WRC-2000, these values were used for all assignments of the Regions 1 and 3 Plan and List except those for which WRC-2000 adopted different values used in the planning process[32].

Revision of the Regions 1 and 3 Plan at WRC-97 and planning at WRC-2000 were generally based on a set of reference parameters such as the average e.i.r.p., the reference earth station receiving antenna, all test points placed within the –3 dB contour, a bandwidth of 27 MHz and the predetermined value of *C*/*N*. The Regions 1 and 3 Plan as established by WRC-2000 is generally based on the use of digital modulation.

Protection masks and associated calculation methods for interference into broadcast satellite systems involving digital emissions are given in Recommendation ITU-R BO.1293-1. (WRC-2000)

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[29] These protection ratio values were used for the assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau between 27 October 1997 and 12 May 2000. (WRC-2000)

[30] These protection ratio values were used for protection of digital and analogue assignments from analogue emissions. (WRC-2000)

[31] The overall protection margin calculation method used is based on the first formula in § 1.12 of Annex 3 to Appendix **30A**.

[32] For analogue assignments, the protection ratios adopted by WRC-97 were used (24 dB co-channel and 16 dB adjacent channel). (WRC-2000)

In Region 2, the following protection ratios have been adopted for the purpose of calculating the overall equivalent protection margin[33]:

– 28 dB for co-channel signals;

– 13.6 dB for adjacent-channel signals;

– –9.9 dB for second adjacent-channel signals.

In Region 2, as a guide for planning, the reduction in the overall *C/I* ratio due to co-channel interference in the feeder link is taken as equivalent to a degradation in the down-link co-channel *C/I* ratio of approximately 0.5 dB not exceeded for 99% of the worst month, but the feeder-link and downlink Plans are evaluated on the basis of the overall equivalent protection margin, which includes the combined downlink and feeder-link contributions.

In Region 2, an overall equivalent protection margin of 0 dB, or greater, indicates that the individual protection ratios have been met for the co-channel, the adjacent channels and the second adjacent channels.

3.9 Guardbands

3.9.1 A guardband is defined as the portion of the frequency spectrum between the edge of the allocated band and the edge of the necessary bandwidth of the emission in the nearest channel.

3.9.2 For the planning of the broadcasting-satellite service, the guardbands chosen at the 1977 Conference to protect the services in adjacent frequency bands are shown in the Table below.

Regions	Guardband at the lower edge of the band (MHz)	Guardband at the upper edge of the band (MHz)
1	14	11
2	12	12
3	14	11

For Regions 1 and 3 at WARC-77, the guardbands were derived on the assumption of analogue emissions and a maximum beam centre e.i.r.p. of 67 dBW (value relating to individual reception), and a filter roll-off of 2 dB/MHz. If smaller e.i.r.p. values are assumed, the guardbands can be reduced in width by 0.5 MHz for each decibel decrease in e.i.r.p. The degree of possible reduction also depends on improvements in technology and on the type of modulation. (WRC-2000)

3.9.3 (SUP - WRC-97)

3.9.4 The guardbands at both the lower and upper edges may be used ~~for transmissions in the space operation service~~to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service.

[33] The definitions in §§ 1.7, 1.8, 1.9, 1.10 and 1.11 of the Annex apply to these calculations.

ANNEX 7 (WRC-2000)

Orbital position limitations

A In applying the procedure of Article 4 for proposed modifications to the ~~appropriate Regional~~Region 2 Plan or for proposed new or modified assignments in the Regions 1 and 3 List, administrations should observe the following criteria:

1) No broadcasting satellite serving an area in Region 1 and using a frequency in the band 11.7-12.2 GHz shall occupy a nominal orbital position further west than 37.2° W or further east than 146° E.

2) No broadcasting satellite serving an area in Region 2 that involves an orbital position different from that contained in the Region 2 Plan shall occupy a nominal orbital position:

a) further east than 54° W in the band 12.5-12.7 GHz; *or*

b) further east than 44° W in the band 12.2-12.5 GHz; *or*

c) further west than 175.2° W in the band 12.2-12.7 GHz.

However, modifications necessary to resolve possible incompatibilities during the incorporation of the Regions 1 and 3 feeder-link Plan into the Radio Regulations shall be permitted.

3) The purpose of the following orbital position and e.i.r.p. limitations is to preserve access to the geostationary-satellite orbit by the Region 2 fixed-satellite service in the band 11.7-12.2 GHz. Within the orbital arc of the geostationary-satellite orbit between 37.2° W and 10° E, the orbital position associated with any proposed new or modified assignment in the Regions 1 and 3 ~~Plan or the~~ List of additional uses shall lie within one of the portions of the orbital arc listed in Table 1. The e.i.r.p. of such assignments shall not exceed 56 dBW, except at the positions listed in Table 2.

TABLE 1

Allowable portions of the orbital arc between 37.2° W and 10° E for new or modified assignments in the Regions 1 and 3 Plan and List

Orbital position	37.2° W to 36° W	33.5° W to 32.5° W	30° W to 29° W	26° W to 24° W	20° W to 18° W	14° W to 12° W	8° W to 6° W	4° W[1]	2° W to 0°	4° E to 6° E	9° E[1]

[1] ~~Modifications to~~Proposed new or modified assignments in the List which involve this orbital position shall not exceed the pfd limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.

TABLE 2

Nominal positions in the orbital arc between 37.2° W and 10° E at which the e.i.r.p. may exceed the limit of 56 dBW

Orbital position	37° W ±0.2°	33.5° W	30° W	25° W ±0.2°	19° W ±0.2°	13° W ±0.2°	7° W ±0.2°	4° W[1]	1° W ±0.2°	5° E ±0.2°	9° E[1]
[1] ~~Modifications~~Proposed new or modified assignments in ~~to~~ the List which involve this orbital position shall not exceed the pfd limit –138 dB(W/(m^2 · 27 MHz)) at any point in Region 2.											

B The Region 2 Plan is based on the grouping of the space stations in nominal orbital positions of ±0.2º from the centre of the cluster of satellites. Administrations may locate those satellites within a cluster at any orbital position within that cluster, provided they obtain the agreement of administrations having assignments to space stations in the same cluster. (See § 4.13.1 of Annex 3 to Appendix **30A**.)

ATTACHMENT 7 TO SECTION 3.2 CHAPTER 3

DRAFT EXAMPLE OF POSSIBLE MODIFICATION OF ARTICLES 1, 2, 4, 7 AND ANNEX 3 OF APPENDIX 30A

APPENDIX 30A (WRC-2000)

Provisions and associated Plans and Lists[1] for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz[2] and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2 (WRC-2000)

TABLE OF CONTENTS

ARTICLE 1 (WRC-2000)

General definitions

1.10 *Regions 1 and 3 feeder-link Lists of additional uses (hereafter called in short the "feeder-link Lists")*: The lists of assignments for additional uses in Regions 1 and 3 as established by WRC-2000 (see Resolution 542 (WRC-2000)), as updated following the successful application of the procedure of § 4.1 of Article 4.

1.11 *Frequency assignment in conformity with the List:* Any frequency assignment which appears in the List as updated following successful application of § 4.1 of Article 4.

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[1] *Note by the Secretariat:* The Regions 1 and 3 feeder-link Lists of additional uses are annexed to the Master International Frequency Register (see Resolution **542 (WRC-2000)**). (WRC-2000)

[2] This use of the band 14.5-14.8 GHz is reserved for countries outside Europe.

ARTICLE 2

Frequency bands

2.1 The provisions of this Appendix apply to the feeder-links in the fixed-satellite service (Earth-to-space) in the frequency bands 14.5-14.8 GHz and 17.3-18.1 GHz for the broadcasting-satellite service in Regions 1 and 3, and 17.3-17.8 GHz for the broadcasting-satellite service in Region 2 and to other services to which these bands are allocated in Regions 1, 2 and 3 so far as their relationship to the fixed-satellite service (Earth-to-space) in these bands is concerned.

2.2 The use of the guardbands of the Plans in this Appendix, as defined in § 3.1 and 4.1 of Annex 3, to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks broadcasting-satellite service, shall be coordinated with the BSS feeder-link assignments subject to ~~these Plans~~this Appendix using the provisions of Article 7. Coordination among assignments intended to provide these functions and services not subject to a Plan shall be effected using the provisions of No. **9.7** and the associated provisions of Articles **9** and **11**. Coordination of modifications to the Region 2 feeder-link Plan or assignments to be included in the Regions 1 and 3 feeder-link Lists, with assignments intended to provide these functions shall be effected using § 4.1.1 *d)* of Article 4. (WRC-2000)

ARTICLE 4 (WRC-2000)

Procedures for modifications to the Region 2 feeder-link Plan or for additional uses in Regions 1 and 3

4.1 Provisions applicable to Regions 1 and 3

4.1.26 ~~This~~The procedure of this Article may be applied by the administration of a new ITU Member State in order to include new assignments in the feeder-link Lists. Upon completion of the procedure, the next world radiocommunication conference may be requested to consider, among the assignments included in the feeder-link Lists after the successful completion of this procedure, the inclusion in the Regions 1 and 3 feeder-link Plan of up to 10 channels (for Region 1) and up to 12 channels (for Region 3), over the national territory of the new Member State.

4.2 Provisions applicable to Region 2

4.2.6 An administration intending to make a modification to the Region 2 feeder-link Plan shall send to the Bureau, not earlier than eight years but preferably not later than two years before the date on which the assignment is to be brought into use, the relevant information listed in Appendix **4**. Modifications to that Plan involving additions under § 4.2.1 *b)* shall lapse if the assignment is not brought into use by that date[9*bis*].

9*bis* The provisions of Resolution **533 (Rev.WRC-2000)** apply.

ARTICLE 7 (WRC-2000)

Coordination, notification and recording in the Master International Frequency Register of frequency assignments to stations in the fixed-satellite service (space-to-Earth) in Regions 1, 2 and 3 in the band 17.7-18.1 GHz, to stations in the fixed-satellite service (Earth-to-space) in Region 2 in the band 17.8-18.1 GHz and to stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz when frequency assignments to feeder links for broadcasting-satellite stations in the 17.3-18.1 GHz band in Regions 1 and 3 or in the band 17.3-17.8 GHz in Region 2 are involved

Section I – Coordination of transmitting space or earth stations in the fixed-satellite service or transmitting space stations in the broadcasting-satellite service with assignments to broadcasting-satellite service feeder links

7.1 The provisions of No. **9.7**[14] and the associated provisions under Articles **9** and **11** are applicable to transmitting space stations in the fixed-satellite service in the band 17.7-18.1 GHz, to transmitting earth stations in the fixed-satellite service in Region 2 in the band 17.8-18.1 GHz and to transmitting space stations in the broadcasting-satellite service in Region 2 in the band 17.3-17.8 GHz.

7.2 In applying the procedures referred to in § 7.1, the provisions of Appendix **5** are replaced by the following:

7.2.1 The frequency assignments to be taken into account are:

a) the assignments in conformity with the appropriate Regional feeder-link Plan in Appendix **30A**;

b) the assignments included in the Regions 1 and 3 feeder-link Lists;

c) the assignments for which the procedure of Article 4 has been initiated as from the date of receipt of the complete Appendix **4** information under § 4.1.3 or 4.2.6.

7.2.2 The criteria to be applied are those given in Annex 4.

[14] The provisions of Resolution **33 (Rev.WRC-97)** are applicable to space stations in the broadcasting-satellite service for which the advance publication information or the request for coordination has been received by the Bureau prior to 1 January 1999.

ANNEX 3

Technical data used in establishing the provisions and associated Plans and Regions 1 and 3 feeder-link Lists, which should be used for their application[21] (WRC-2000)

3 Basic technical characteristics for Regions 1 and 3

3.1 Translation frequency and guardbands

a) 17 GHz feeder-links

The feeder-link Plan generally uses a frequency translation of 5.6 GHz between the 17 GHz feeder-link channels and the 12 GHz downlink channels. Other values of the translation frequency may be used, provided that the corresponding channels have been assigned to the space station of the administration concerned.

With the value of frequency translation between the feeder-link frequency band (17.3-18.1 GHz in Regions 1 and 3) and the downlink frequency band (11.7-12.5 GHz in Region 1 and 11.7-12.2 GHz in Region 3), the guardbands specified in § 3.9 of Annex 5 to Appendix **30** for the downlink Plan result in corresponding guardband bandwidths of 11 MHz at the upper and 14 MHz at the lower feeder-link band edges. These feeder-link guardbands may be used ~~for transmissions in the space operation service~~to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service.

3.8 System noise temperature

The satellite system noise temperature values generally used in the Plan at the 1988 Conference (WARC Orb-88) are 1 800 K for 17 GHz and 1 500 K for 14 GHz[32]. For revising the Regions 1 and 3 Plan at WRC-97 these values are 900 K for 17 GHz and 750 K for 14 GHz. A value of 600 K is used for the 17 GHz band in the revision of the Regions 1 and 3 Plan at WRC-2000.

4 Basic technical characteristics for Region 2

4.1 Translation frequency and guardbands

The feeder-link Plan is based on the use of a single frequency translation of 5.1 GHz between the 17 GHz feeder-link channels and the 12 GHz downlink channels. Other values of the translation frequency may be used, provided that the corresponding channels have been assigned to the space station of the administration concerned.

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21 In revising this Annex at WRC-97 and at WRC-2000, no changes were made to the technical data applicable to the Region 2 feeder-link Plan. However, for all three Regions it should be noted that some of the parameters of networks proposed as modifications to the Region 2 feeder-link Plan and the Regions 1 and 3 feeder-link Lists may differ from the technical data presented herein. (WRC-2000)

32 These system temperature values are still used for assignments notified, which are in conformity with this Appendix, brought into use, and for which the date of bringing into use has been confirmed to the Bureau before 27 October 1997.

With a single value frequency translation between the feeder-link frequency band (17.3-17.8 GHz) and the downlink frequency band (12.2-12.7 GHz), the guard bands present in the downlink Plan result in corresponding bandwidths of 12 MHz at the upper and lower feeder-link band edges. These feeder-link guard bands may be used to provide space operations functions in accordance with No. **1.23** in support of the operation of geostationary-satellite networks in the broadcasting-satellite service~~for transmissions in the space operation service~~.

4.6 Receiving antenna

4.6.1 Cross-section of receiving antenna beam

Planning has been based on beams of elliptical or circular cross-section. When the assignments are implemented, or when the Plan is modified, administrations may use non-elliptical or shaped beams.

If the cross-section of the receiving antenna beam is elliptical, the effective beamwidth φ_0 is a function of the angle of rotation q between the plane containing the satellite and the major axis of the beam cross-section and the plane in which the beamwidth is required.

The relationship between the maximum gain of an antenna and the half-power beamwidth can be derived from the expression:

$$G_m = 27\,843/ab$$

or

$$G_m \text{ (dB)} = 44.44 - 10 \log a - 10 \log b$$

where:

a and b are the angles (degrees) subtended at the satellite by the major and minor axes of the elliptical cross-section of the beam.

An antenna efficiency of 55% is assumed.

4.6.2 Minimum beamwidth

A minimum value of 0.6° for the half-power beamwidth of the receiving antenna has been agreed on for planning.

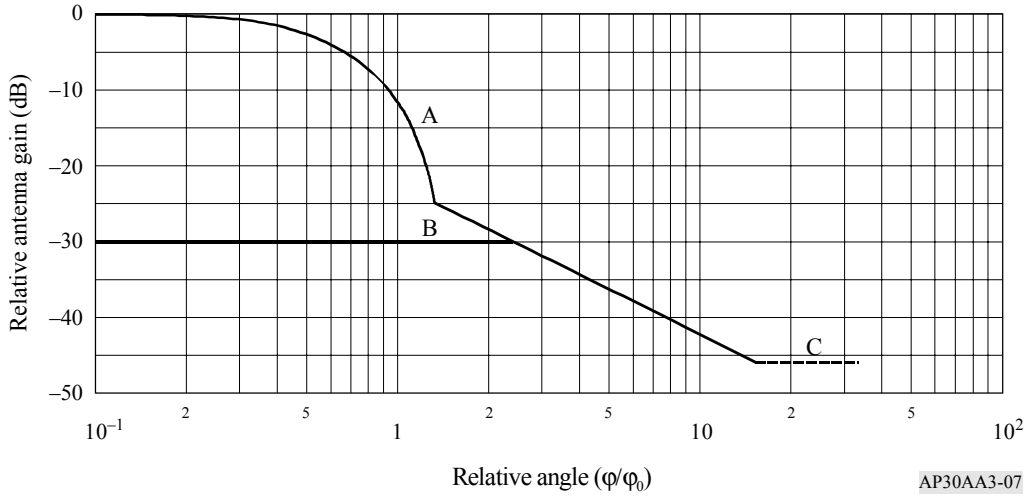
4.6.3 Reference patterns

The reference patterns for the co-polar and cross-polar components of the satellite receiving antenna used in preparing the Plan are given in Fig. 7.

Where it was necessary to reduce interference, the pattern shown in Fig. 8 was used; this use will be indicated in the Plan by an appropriate symbol. This pattern is derived from an antenna producing an elliptical beam with fast roll-off in the main lobe. Three curves for different values of φ_0 are shown as examples.

FIGURE 7

Reference patterns for co-polar and cross-polar components for satellite receiving antenna in Region 2



Curve A: co-polar component (dB relative to main beam gain)

$-12\ (\varphi/\varphi_0)^2$ for $0 \le (\varphi/\varphi_0) \le 1.45$

$-(22 + 20 \log (\varphi/\varphi_0))$ for $(\varphi/\varphi_0) > 1.45$

after intersection with Curve C, as Curve C.

Curve B: cross-polar component (dB relative to main beam gain)

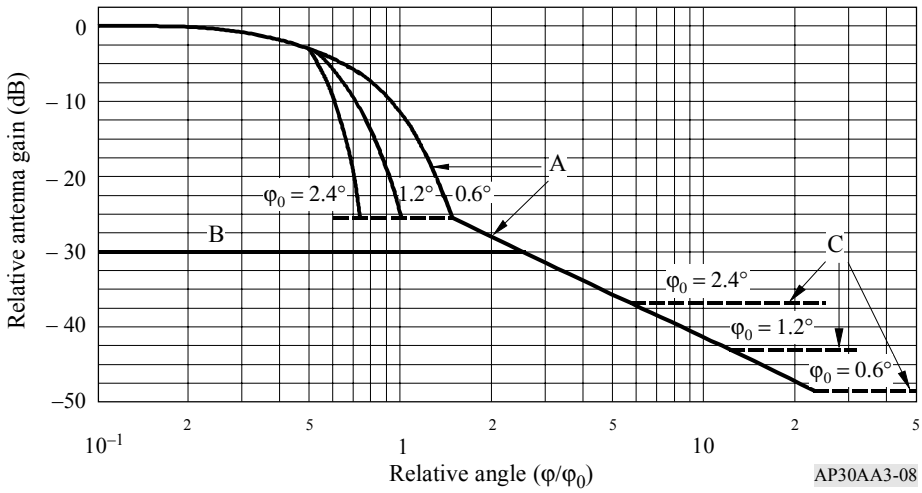
-30 for $0 \le (\varphi/\varphi_0) \le 2.51$

after intersection with Curve A, as Curve A.

Curve C: minus the on-axis gain (Curve C in this Figure illustrates the particular case of an antenna with an on-axis gain of 46 dBi)

FIGURE 8

Reference patterns for co-polar and cross-polar components for satellite receiving antennas with fast roll-off in the main beam for Region 2



Curve A: co-polar component (dB relative to main beam gain)

$-12\ (\varphi/\varphi_0)^2$ for $0 \le \varphi/\varphi_0 \le 0.5$

$-33.33\ \varphi_0^{\,2}\ (\varphi/\varphi_0 - x)^2$ for $0.5 < \varphi/\varphi_0 \le \dfrac{0.87}{\varphi_0} + ~~x~~\ \underline{36}$

-25.23 for $\dfrac{0.87}{\varphi_0} < \varphi/\varphi_0 \le 1.~~413~~\underline{45}$

$-(22 + 20 \log (\varphi/\varphi_0))$ for $\varphi/\varphi_0 > 1.~~413~~\underline{45}$

after intersection with Curve C, as Curve C.

Curve B: cross-polar component (dB relative to main beam gain)

-30 for $0 \le \varphi/\varphi_0 < 2.51$

after intersection with Curve A, as Curve A.

Curve C: minus the on-axis gain (Curves A and C represent examples for three antennas having different values of φ_0 as labelled in Fig. 8. The on-axis gains of these antennas are 37, 43 and 49 dBi, respectively).

where:

φ: off-axis angle (degrees)

φ_0: dimension of the minimum ellipse fitted around the feeder-link service area in the direction of interest (degrees)

$$x = 0.5 \left(1 - \frac{0.6}{\varphi_0}\right)$$

~~#########~~

3.3 Agenda item 1.29

"to consider the results of studies related to Resolutions **136 (WRC-2000)** and **78 (WRC-2000)** dealing with sharing between non-GSO and GSO systems"

3.3.1 Resolution 136 (WRC-2000)

"Frequency sharing in the range 37.5-50.2 GHz between GSO FSS networks and non-GSO FSS systems"

3.3.1.1 Summary of technical studies, including a list of relevant ITU-R Recommendations

Both GSO FSS and non-GSO FSS systems are planned for operation within the 37.5-42.5 GHz and 47.2-50.2 GHz bands. FSS systems based on the use of new technologies associated with both GSO and non-GSO orbits are capable of providing the most isolated regions of the world with high capacity and low-cost means of communications. Although plans are to operate FSS in 3 GHz of uplink spectrum (at 47.2-50.2 GHz) and 5 GHz of downlink spectrum (37.5-42.5 GHz), most proposed FSS systems are planned to use approximately 2 GHz of spectrum in each direction for user links. Due to constraints imposed by the need to protect the fixed and other services, and resulting pfd limits, the bands 37.5-40 GHz and 42-42.5 GHz are expected to be available to the FSS (GSO and non-GSO alike) only for use by gateway/hub applications with a limited number of coordinated earth stations using large antennas. In addition, because propagation impairments are severe in the 40/50 GHz bands, most FSS systems operating in these bands are not planned to use dual polarizations.

Frequency sharing between GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz frequency range is currently regulated under No. **22.2**, which provides that "non-geostationary-satellite systems shall not cause unacceptable interference to geostationary-satellite systems in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations". Because there has been little or no deployment of satellite systems to date in the band 37.5-50.2 GHz, WRC-2000 concluded in Resolution **136 (WRC-2000)** that both GSO FSS and non-GSO FSS operators should be expected to exhibit flexibility in achieving the appropriate balance in the sharing environment, and urged administrations, in the application of Article **22** to their GSO and non-GSO FSS systems in this range prior to WRC-03, to seek balanced sharing arrangements. Resolution **136** invited the ITU-R to undertake the appropriate technical, operational, and regulatory studies on sharing arrangements that achieve an appropriate balance between GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz frequency range.

To date the ITU-R studies done specifically for the 40/50 GHz bands have been fairly limited in extent. However, in recent years a very substantial amount of work has been carried out on non-GSO/GSO sharing in bands below 30 GHz, and much of this applies at 40/50 GHz. The principal differences for the higher frequencies are the use of narrower spot-beams in greater numbers on each satellite, and the trend towards higher bit-rates, which leads to emissions and transponders of increased bandwidth. Also the increased propagation loss during bad weather leads to higher system margins and/or greater reliance on fade counter-measures such as adaptive coding.

Relevant Recommendations ITU-R: S.1323, S.1325, S.1328, S.1529, S.1557.

Information on the characteristics of both GSO and non-GSO FSS systems planned to operate in the 40/50 GHz bands can be found in the latest version of Recommendation ITU-R S.1328.

On a related matter, Recommendation ITU-R S.1557 sets forth the system parameters of GSO FSS networks and non-GSO FSS systems operating in the 50/40 GHz bands, and contains operational requirements for both types of systems.

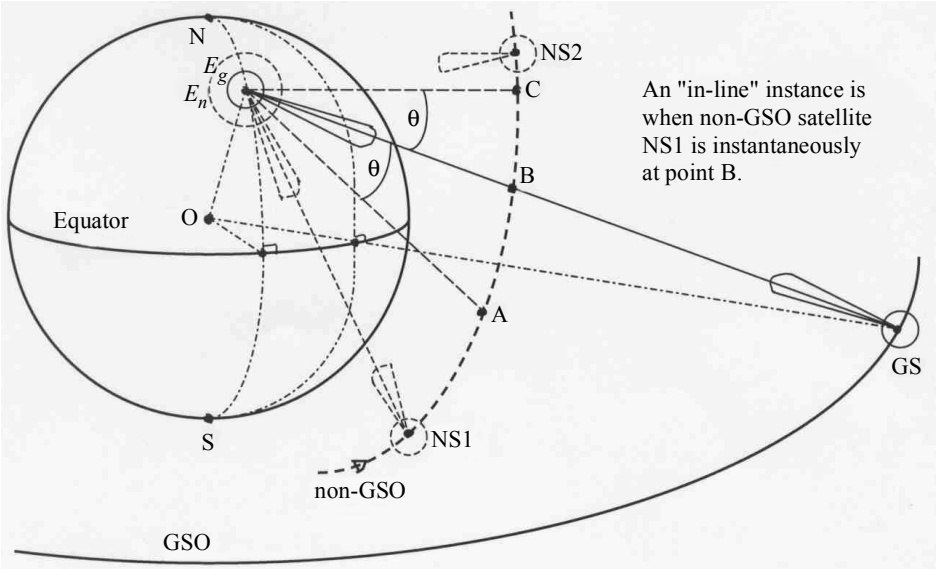
Given the system characteristics, long and short-term criteria for acceptable interference may be calculated using Recommendation ITU-R S.1323, taking into account the increased rain fade environment in the 40/50 GHz bands.

To determine whether given criteria for the interference between a GSO and a non-GSO system would be met, proprietary software packages are available which may be used based on Recommendation ITU-R S.1325 or on Recommendation ITU-R S.1529.

If no techniques are employed to avoid direct coupling between the main beams of satellites in a non-GSO system and the main beams of earth stations in a GSO system, and vice versa, during the short periods when "in-line" transitions occur, the interference in both directions, which is likely to be modest for the majority of the time, will rise sharply by many dB for short periods aggregating to small percentages of time (see Figure 3.3-1). Several possible techniques to mitigate this short-term interference have been investigated, as summarized below.

FIGURE 3.3-1

"In-line" transition



NOTE – (main beam)/(near sidelobe) ratio is of the order of 30 dB for earth stations and 20 dB for satellites.

Several studies involving sharing between GSO FSS networks and non-GSO FSS systems in the frequency range 37.5-50.2 GHz have been conducted within the ITU-R. However the levels of acceptable interference for GSO FSS networks and non-GSO systems were not fully assessed. Moreover the mitigation techniques cannot be easily translated into regulatory provisions. Such provisions would require development of a set of epfd masks to protect GSO FSS networks and of off-axis e.i.r.p. density masks to protect non-GSO FSS systems.

3.3.1.2 Analysis of the results of studies

The ITU-R did not consider whether new regulatory regimes would provide a more appropriate balance between GSO FSS networks and non-GSO FSS systems than the current regime under No. **22.2**. Nevertheless the studies, which conclude that both GSO networks and non-GSO FSS systems can co-exist in this band if certain technical standards are observed, confirm that the establishment of a first-come/first-served regulatory regime in the 37.5-50.2 GHz band (i.e. the removal of No. **22.2** and application of No. **9.11A** without appropriate technical standards) would

create an imbalance between GSO FSS networks and non-GSO FSS systems in this frequency range. In addition, because the studies conducted show that co-frequency sharing between GSO FSS networks and non-GSO FSS systems is feasible, imposition of band segmentation or some other form of mandatory frequency separation would also create an imbalance between GSO FSS networks and non-GSO FSS systems. In the last regard, it is noteworthy that if highly-elliptical orbit non-GSO FSS systems are introduced into the 40/50 GHz bands, GSO/non-GSO sharing on a co-frequency basis would be greatly enhanced, as highly-elliptical orbit non-GSO systems typically operate at separation angles from the GSO of the order of 40 degrees or more.

In most cases sharing between a GSO FSS network and a non-GSO FSS system of the LEO or MEO type will be feasible only if mitigation techniques to avoid main beam-to-main beam coupling of "in-line" interference are applied. Such techniques include:

3.3.1.2.1 Mitigation techniques

a) Satellite diversity or arc avoidance

An example of one form of satellite diversity is illustrated in Figure 3.3-1. When non-GSO satellite NS1, which is shown currently serving earth station En (and other earth stations within the same "cell"), reaches point A - i.e. a topocentric angle θ degrees from "in-line" transition point B - earth station En diverts its transmission and reception temporarily to satellite NS2, and NS1 temporarily switches off its transmit and receive beams which would otherwise interfere with and receive interference from the main beams of earth station E_g operating to GSO satellite GS. When satellite NS1 has moved to point C, which is θ degrees beyond point B, the operation of earth station E_n reverts to satellite EN1.

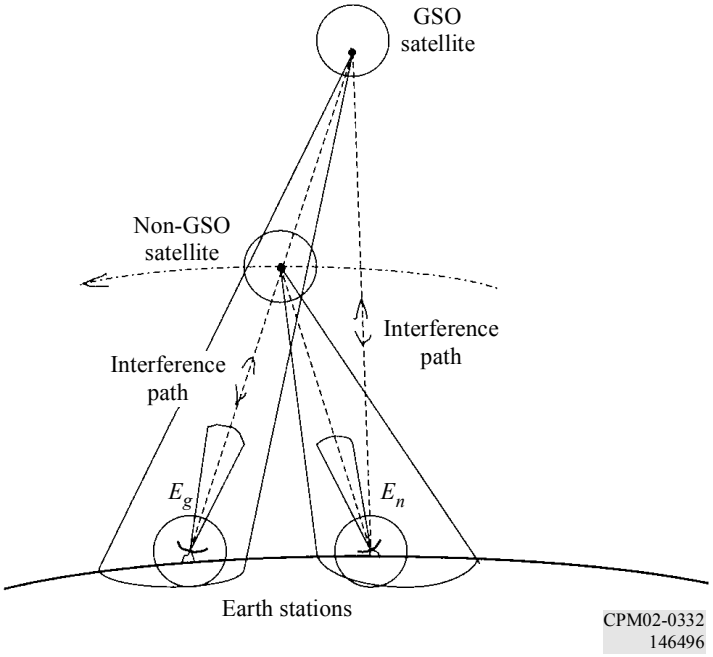
Satellite diversity or arc avoidance is the most effective of the mitigation techniques, but it requires either an increase in the number of satellites or transponders per satellite, or the reservation of some existing space-sector capacity, to accommodate the temporarily diverted traffic. Since it is not practicable to apply it to GSO systems, the burden falls on the non-GSO systems.

b) Geographical isolation between earth stations

Figure 3.3-2 shows a non-GSO satellite at an instant when it is crossing the line between a GSO satellite and one of its earth stations E_g. This is an instant of maximum interference to and from E_g because there is no transmit or receive discrimination from its antenna pattern. However, there is both transmit and receive discrimination from the antenna of the non-GSO satellite, and this mitigates the maximum levels of short-term interference in both directions.

FIGURE 3.3-2

Geographical isolation

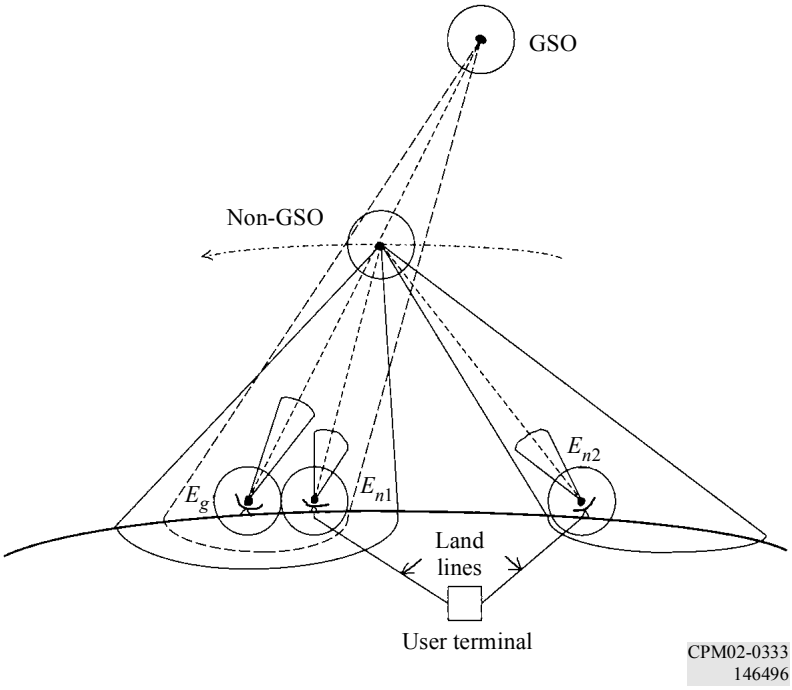


c) Site diversity

Site diversity is illustrated in Figure 3.3-3.

FIGURE 3.3-3

Site diversity



When a non-GSO satellite nears an "in-line" transition its links serving the relevant earth stations (e.g. En1) are temporarily switched to alternative earth stations (e.g. En2), via a co-frequency satellite beam illuminating a geographically separate "cell" and alternative land lines to the user terminals. Alternatively the site diversity could be implemented in the GSO network.

d) Adaptive coding

In the frequency bands concerned it is likely that some systems will employ measures to counter the significant additional propagation loss, which occurs during bad weather. For example, in a TDM or TDMA transmission it is possible to leave part of each time frame normally unallocated to traffic bursts, and to allocate this time to individual up and downlinks when they are experiencing heavy rainfall (heavy rain cells are normally relatively small in diameter). By adapting the error-correction coding in these instances maximum use of the additional time to maintain the required BER is made.

In addition to countering rain fades, it is conceptually possible to design such an adaptive coding technique so that it also counters the effect of short-term interference peaks. Since for much of the time there is no heavy rain anywhere within the coverage of a given GSO satellite beam, most non-GSO/GSO "in-line" transitions within that beam occur when the adaptive-coding is not being used to counter fades, and in principle it may therefore be used to mitigate "in-line" interference.

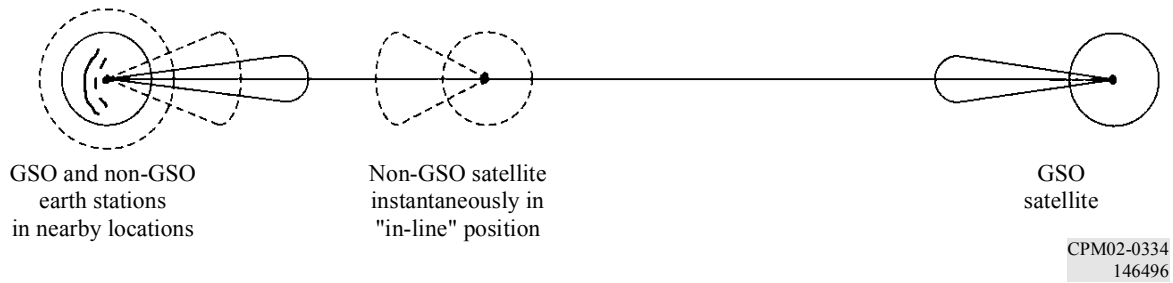
e) Link balancing

From Figure 3.3-4 it can be seen that, at an "in-line" instant, downlink interference will occur from a transmit main beam of the non-GSO satellite to the receive main beam of the GSO earth station, and also from a transmit main beam of the GSO satellite to the receive main beam of the non-GSO earth station. Similarly there will be main beam-to-main beam up-link interference from non-GSO link to GSO link and vice versa.

In general the two systems will not be designed with identical link margins, and on the downlink for example it is likely that the C/I at the instant depicted will be lower for one of the two earth stations than for the other. In principle it may be possible in many cases to ameliorate the worst interference effects by an increase in the e.i.r.p. of the more vulnerable of the two downlinks and a reduction in the e.i.r.p. of the other downlink. Such link balancing may also be applied on the up-paths.

FIGURE 3.3-4

Link balancing



f) Use of orthogonal polarizations

Under a set of conditions on antenna performance both for earth stations and for space stations, the frequency sharing between GSO FSS networks and non-GSO FSS systems would be feasible if the systems operated on opposite polarizations.

3.3.1.2.2 Sharing between GSO networks and non-GSO systems in the range 37.5-50.2 GHz

No operational studies were conducted since the actual operational parameters of both non-GSO and GSO systems that are planned to operate in the range 37.5-50.2 GHz are still unclear.

3.3.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method

Modification of Resolution 136 to call for further studies

It is considered premature to conclude on the advantages and disadvantages of each technique described in section 3.3.1.2.1 until further studies have been accomplished. Such studies should focus on the scope of application of one or more of the interference mitigation techniques described in section 3.3.1.2.1 above or other suitable techniques. It is thus proposed to call for additional studies on this topic.

3.3.1.4 Regulatory and procedural considerations

It is considered that no modification is needed in Article **22** at this time. Implementation of the method given in section 3.3.1.3 above would involve the modification of Resolution **136 (WRC-2000)** to reflect a new date for completion of studies and action by a future conference.

An example of modified Resolution **136 (WRC-2000)** is given below.

MOD

EXAMPLE OF PROPOSED REVISION OF RESOLUTION 136 (~~WRC-2000~~MOD WRC-03)

Frequency sharing in the range 37.5-50.2 GHz between geostationary fixed-satellite service networks and non-geostationary fixed-satellite service systems

The World Radiocommunication Conference **(**~~Istanbul, 2000~~~~Caracas2000~~Geneva, 2003**)**

considering

a) that ~~this Conference has~~WRC-2000 made provisions for the operation of geostationary fixed-satellite service (GSO FSS) networks and non-GSO FSS systems in the 10-30 GHz frequency range;

b) that there is an emerging interest in operating GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz range;

c) that there is a need to provide for the orderly development and implementation of new satellite technologies in the 37.5-50.2 GHz frequency range;

d) that systems based on the use of new technologies associated with both GSO FSS networks and non-GSO FSS systems are capable of providing the most isolated regions of the world with high-capacity and low-cost means of communication;

e) that there should be equitable access to the radio frequency spectrum and orbital resources in a mutually acceptable manner that allows for new entrants in the provision of services;

f) that the Radio Regulations should be sufficiently flexible to accommodate the introduction and implementation of innovative technologies as they evolve;

g) that ~~the CPM Report to WRC-2000 stated that~~ in the bands 37.5-50.2 GHz, where there has been little or no deployment of satellite systems to date, both GSO FSS and non-GSO FSS operators should be expected to exhibit flexibility in achieving the appropriate balance in the sharing environment~~,~~;

h) that this Conference, having considered the outcome of ITU-R studies on this subject, has decided that further studies are needed before the conditions for non-GSO FSS systems to share these bands with GSO FSS systems can reliably be determined,

resolves to urge administrations

to seek balanced sharing arrangements between GSO FSS networks and non-GSO FSS systems in the application of Article 22 to such systems in the 37.5-50.2 GHz frequency range, ~~in the application of Article 22 to their GSO FSS networks and non-GSO FSS systems in the 37.5-50.2 GHz frequency range~~ prior to ~~WRC-03~~ the review by a future competent Conference of the results of the studies called for by this Resolution ~~to seek balanced sharing arrangements between these systems~~,

invites ITU-R

1 to undertake, as a matter of urgency, ~~the appropriate~~ further technical, operational and regulatory studies on sharing arrangements which achieve an appropriate balance between GSO FSS networks and non-GSO FSS systems in the frequency range 37.5-50.2 GHz. Such further studies should include, but not necessarily be limited to:

a) Techniques which individually or in combination avoid, or otherwise adequately mitigate interference resulting from coupling of main beams in both directions between non-GSO FSS and GSO FSS systems at "in-line" instants. The studies should be based on the key parameters of systems firmly planned to operate in the bands concerned, and should be pursued sufficiently far to establish appropriate long-term and short-term interference criteria and to compute the time statistics of interference from non-GSO systems to GSO networks, and from GSO networks to non-GSO systems, to determine whether those criteria would be met. The computations and comparisons should be made firstly assuming no mitigation, and subsequently with each of the various mitigation techniques or combinations of mitigation techniques envisaged. The mitigation techniques thus investigated should include:

- Satellite diversity or arc avoidance.
- Geographical isolation between earth stations.
- Site diversity.
- Adaptive coding.
- Link balancing.
- Opposite polarizations for GSO and non-GSO systems.
- Other appropriate techniques, if any.

b) The development of technical, operational and regulatory guidance which would enable WRC-07 to decide whether or not to include, in the Radio Regulations, epfd limits on non-GSO FSS systems for the protection of GSO FSS networks, and off-axis e.i.r.p. density limits on earth stations in GSO FSS networks for the protection of non-GSO FSS systems, in the frequency range 37.5-50.2 GHz. Such guidance should include quantitative values for suitable $epfd_{\downarrow}$, $epfd_{\uparrow}$ and off-axis e.i.r.p. density limits;

2 to report the results of these studies to ~~WRC-03~~ a future competent Conference.

~~##########~~

3.3.2 Resolution 78 (WRC-2000)

"Development of procedures in case the operational or additional operational limits in Article 22 are exceeded"

3.3.2.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The situation described in Resolution **78 (WRC-2000)** is unique in the Radio Regulations. The operational and additional operational epfd↓ limits were created and included in Section II of Article **22**, and left to administrations to enforce on an operational basis. The limits were requirements for non-GSO FSS systems to be accommodated in certain frequency bands. The need for procedures to facilitate the process of compliance is a very important part of the package of measures developed for this accommodation.

ITU-R has developed a set of Recommendations on identifying and quantifying (by measurement or by simulation) the interference levels generated by a non-GSO FSS system in the parts of the band 10.7-20.2 GHz covered by Resolution **78**, to aid administrations in determining whether a non-GSO FSS system is in compliance with the operational or additional operational epfd↓ limits contained in Section II of Article **22.**

Relevant Recommendations ITU-R: S.1527, S.1554, S.1558, and S.1592.

3.3.2.2 Analysis of the results of studies

No. **22.5I** clearly stipulates that if a non-GSO FSS system subject to the operational or additional operational epfd↓ limits contained in Section II of Article **22** at an operational receiving earth station within a GSO network operating in accordance with the Radio Regulations, exceeds these limits then it is a violation of No. **22.2** except as otherwise agreed between concerned administrations. In other words, exceeding the limits by such a non-GSO FSS system is, by itself, an infringement of the RR.

The RR contain provisions that can be applied when non-GSO systems exceed the operational or additional operational epfd↓ limits contained in No. **22.5I** (including the provisions of Section V) (Report of infringements) or VI (Procedure in case of harmful interference), as appropriate, of Article **15**).

The procedures are intended only to help a victim GSO network determine the source of interference in an environment where multiple non-GSO FSS systems are operating and to facilitate expeditious remedy of exceedances of the limits in No. **22.5I**.

ITU-R studied the options for regulatory procedures that would assist administrations that experience exceedances of the limits in No. **22.5I** at their operational GSO earth stations in determining the source of the interference and rapidly bringing the interference levels produced by such a system back into compliance with the regulations. ITU-R also considered the issue of where in the regulatory framework such a set of procedures, if deemed necessary by WRC-03, could be placed. The options considered were inclusion of the procedures facilitating compliance with the limits as an Annex to an ITU-R Recommendation to which the RR may or may not refer to (without incorporating it by reference), inclusion of the procedures facilitating compliance with the limits as an Annex to a Resolution that would be referenced exclusively in the text of the RR (No. **22.5I**) that they are to help enforce, and inclusion of the procedures in a new section of Article **15**.

3.3.2.3 Methods to satisfy this agenda item and their advantages and disadvantages

Method A1

Method A1 is to apply the existing provisions in RR Article **15** (including the provisions of Sections V - Reports of Infringements and VI - Procedure in a case of harmful interference) to the resolution of interference, including cases where non-GSO systems exceed the operational or additional operational epfd↓ limits contained in No. **22.5I**. An ITU-R Recommendation containing a set of procedures in an Annex to the Recommendation could provide more structure for this particular case. ITU-R Recommendations referred to in § 3.3.2.1 and concerning methodologies to be used to address operational and additional operational epfd↓ compliance also provide useful guidance to administrations and/or their GSO system operators. These methodologies should be referenced to in ITU-R Recommendation containing a set of procedure; however, there is no need to incorporate any of these Recommendations by reference in the Radio Regulations.

No change to the Radio Regulations, including Article **15** or Article **22**, would be required to implement Method A1.

Advantages:

- The provisions in Article **15** have been used successfully to resolve interference problems between all services in a variety of sharing situations. It is reasonable to expect that Article **15** could be applied successfully by administrations that experience exceedances of the limits in No. **22.5I** at their operational GSO earth stations. Lack of specific time-frames or means to identify the interference source in the Article **15** procedures has not been a barrier between cooperating administrations to resolving infringements or cases of harmful interference.
- Using the existing procedures in Sections V and VI of Article **15** could avoid an unintended imbalance of status of services and systems within the Radio Regulations.
- It avoids placing additional burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational epfd↓ limits.
- GSO earth station operators would, as contemplated by WRC-2000, have access to specific procedures that would assist them in identifying and expeditiously remedying infringement of the limits in No. **22.5I** of the Radio Regulations.
- ITU-R Recommendations are intended to give guidance and to recommend one or more procedures for a specific application, which are considered to be sufficient to serve as a basis for international cooperation.
- All the necessary material (technical and additional procedural) for remedying an infringement of No. **22.51** is referred to in a single ITU-R Recommendation.

Disadvantages:

- ITU-R Recommendations do not contain mandatory procedures (i.e. time-frames and required actions by BR) of the type that would facilitate compliance with No. **22.5I**. These types of instructions to BR are typically given in regulatory determinations made by a WRC.
- In the event that mandatory procedures are desired, reliance on Article **15**, which provides no specific time-frames, may not be sufficient to expeditiously remedy infringement of No. **22.5I**.

Method A2

This method is similar to the one proposed in Method A1, except for the following:

the ITU-R Recommendation containing a set of procedures in an Annex to the Recommendation should be referred to in No **22.5I**, but not incorporated by reference.

Advantages:

The same as for Method A1, plus

- It provides a unique entry point referred to in the appropriate place in No. **22.5I** to find all the necessary elements developed by ITU-R and that may be useful to administrations to handle such a case of interference.

Disadvantage:

The same as for Method A1.

Method B1

Method B1 is to make no change to the procedures in Sections V and VI of Article **15**. Instead, add a reference in No. **22.5I** to a new WRC resolution that contains the procedures to be used by affected GSO and non-GSO networks and systems to determine which non-GSO FSS system is responsible for exceedances and to facilitate the expeditious return to the levels required in No. **22.5I**. The procedures themselves have been developed within ITU-R, and provide administrations operating non-GSO FSS systems with an incentive to cooperate to expeditiously resolve exceedances of the operational and/or additional operational epfd$\downarrow$ limits.

Advantages:

- GSO earth station operators would, as contemplated by WRC-2000, have access to measures in a WRC-03 Resolution that would assist them in identifying and expeditiously remedying exceedances of the limits in No. **22.5I**.
- The procedures are limited specifically to the unique situation in No. **22.5I** where the level of unacceptable interference is pre-determined in the Radio Regulations, and thus are suitable only for use in conjunction with that regulation.
- Limiting the use of the procedures to the specific case in No. **22.5I** could avoid an unintended imbalance of status of services and systems within the Radio Regulations.

Disadvantages:

- Places potential burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational epfd$\downarrow$ limits. However, if it were required to act under the procedures, the BR role would be largely limited to administrative, non-discretionary functions, which would be unnecessary if administrations cooperate to resolve the interference.
- The relationship and precedence between these procedures and those of Article **15** is unclear.
- Not using the existing procedures in Sections V and VI of Article **15** could cause an unintended imbalance of status of services and systems within the Radio Regulations.
- There is no reference to the material developed by ITU-R that may be used to quantify and identify the source(s) of an infringement of No. **22.5I**.

Method C

The procedures currently contained in Sections V and VI of Article **15**, suitably modified to address only the precise situation described in No. **22.5I**, is one method to satisfy this agenda item. (No identification has yet been made of what type of modifications of Article **15** could be considered.)

Advantage:

GSO earth station operators would have access to specific regulations that would assist them in identifying and expeditiously remedying infringement of the limits in No. **22.5I**.

Disadvantages:

- The need for procedures identified in Resolution **78** is a very narrow one that applies to a single specific case where unacceptable interference has been quantified in the Radio Regulations. Inclusion of such procedures in an article of general applicability such as Article 15 may create confusion and lead to unintended consequences.
- Modifying Article **15** for this particular case could lead to further revisions of Article **15** to address a variety of interference situations in specific terms.
- Places additional burden on BR for a case where administrations, rather than BR, are responsible for determining compliance with the operational or additional operational epfd↓ limits.

Method B2

This method is similar to that proposed above in Method A2 but with the ITU-R Recommendation to be incorporated by reference in the Radio Regulations. The only change would be the addition of a footnote to **22.5I**.

3.3.2.4 Regulatory and procedural considerations

Care should be taken to ensure that the solution to the issue raised in Resolution **78 (WRC-2000)** is no broader than absolutely necessary to address the specific and unique situation found in Section II of Article **22** generally, and in No. **22.5I** and its associated tables in particular. The provisions of Article **15** address cases of general applicability, and any modification thereto would have to take this into account. To date, no study has been done with regard to applying the procedures developed pursuant to Resolution **78** to any case other than exceedances of the operational and additional operational epfd↓ limits by non-GSO FSS systems subject to those limits.

As the objectives of having a set of procedures for this specific case are to help a victim GSO network determine the source of non-GSO FSS interference in an environment where multiple non-GSO FSS systems are operating and to facilitate the expeditious return to the required power levels, it is important that the time requirements in the procedures be as short as feasible. The time periods should strike the best balance possible between the need by affected GSO networks for expeditious remedial action and the provision of sufficient time for administrations and BR to effectively accomplish their required tasks.

Examples of the regulatory provisions that could implement the proposed Methods A1, A2 and B are given below.

Method A1

No change to the Radio Regulations, including Article **15** or Article **22**, would be required to implement Method A1, noting that a suitable ITU-R Recommendation is being developed, making reference to existing ITU-R Recommendations on the identification and measurement of

interference exceeding the *operational* limits, and on the computation of interference statistics for comparison with the *additional operational* limits, and setting out detailed procedures.

Method A2

The only change to the Radio Regulations will be the addition of a footnote to No. **22.5I.**

The following is an example of such a footnote to No. **22.5I.**

ADD

22.5I.1 In addition to the procedures contained in the Radio Regulations (including the provisions of Sections V and VI of Article **15**), administrations may also use Recommendation ITU-R S.[XXX] as a guide to resolving such an infringement of No. **22.2**.

*****

Method B1

The following is an example of some of the regulatory provisions that would allow Method B1 under Section 3.3.2.3 above to be implemented:

1) Modification of No. **22.5I** to include reference to a new WRC-03 resolution containing the procedures for resolving cases of exceedances of the operational and additional operational limits:

MOD

22.5I 6) … The provisions of Resolution **XXX (WRC-03)** shall apply in the event of non-compliance with the single-entry operational and additional operational limits in Section II of Article **22** by a non-geostationary-satellite system in the fixed-satellite service that is subject to the limits in Nos. **22.5C, 22.5D** and **22.5F**.

Method B2

The only change would be the addition of a footnote to No. **22.5I** similar to that proposed above in Method A2 but with the ITU-R Recommendation to be incorporated by reference in the Radio Regulations. The following is an example of such a footnote.

ADD

22.5I.1 In addition to the procedures contained in the Radio Regulations (including the provisions of Sections V and VI of Article **15**), the specific procedures in Recommendation ITU-R [XXX] shall apply.

*****

2) Addition of a new Resolution **[OPLIM]** that includes the procedures in an its Annex.

Example Resolution **[OPLIM]** on Method B is given below.

RESOLUTION [OPLIM] (WRC-03)

Procedures in case the operational or additional operational limits in Article 22 are exceeded

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that WRC-2000 adopted in Article **22** single-entry operational limits (see Tables **22-4A** through **22-4C)** and single-entry additional operational epfd↓ limits (see Table **22-4A**1) applicable to non-geostationary (non-GSO) fixed-satellite service (FSS) systems (space-to-Earth) in certain parts of the frequency range 10.7-20.2 GHz to protect geostationary systems operating in the same frequency bands;

b) that, taking into account Nos. **22.5H** and **22.5I**, wherever the limits referred to in *considering a)* are exceeded by a non-GSO FSS system to which the limits apply, this constitutes an infringement of No. **22.2**, except where otherwise agreed between concerned administrations;

c) that WRC-2000 identified the need for specific procedures that correct in the most expeditious manner any cases where the limits in *considering a)* are exceeded;

d) that ITU-R has developed Recommendations ITU-R S.1527 and ITU-R S.1558 to assist administrations in identifying the source of interference in excess of the operational epfd limits and measuring levels of epfd↓ levels to verify compliance with the operational limits, respectively;

e) that no procedures currently exist in the Radio Regulations to expeditiously address the unique regulatory situation of No. **22.5I**,

resolves

that the procedures contained in the Annex be applied in the event of non-compliance with the single-entry operational and additional operational limits in Section II of Article **22** by a non-geostationary-satellite system in the fixed-satellite service that is subject to the limits in Nos. **22.5C**, **22.5D** and **22.5F**.

ANNEX

Procedures to be applied in the event of non-compliance with single-entry operational and additional operational limits in Section II of Article 22

1 It is essential that Member States exercise the utmost goodwill and mutual assistance in the application of these procedures for the expeditious elimination of equivalent power flux-density (epfd↓) interference from non-geostationary-satellite systems in the fixed-satellite service at levels above the operational epfd↓ limits given in Tables **22-4A, 22-4B** and **22-4C** and/or the additional operational epfd↓ limits given in Table **22-4A1** ("excess epfd↓ interference").

2 In securing the expeditious elimination of excess epfd↓ interference, due consideration should be given to all factors involved, including the relevant technical and operational factors.

3 Administrations should cooperate in the detection and elimination of excess epfd↓ interference.

4 Where practicable, and subject to agreement between the administrations concerned, the case of excess epfd↓ interference may be dealt with directly between their operating organizations.

5 When a case of excess epfd↓ interference to a frequency assignment in a geostationary-satellite network is detected at an operating earth station associated with the geostationary-satellite network and such excess epfd↓ interference cannot be accepted by the affected administration, the affected administration should first attempt to identify the source of the

excess epfd↓ interference. For purposes of these procedures, the term "affected administration" shall mean the administration on whose territory the receiving earth station associated with the geostationary-satellite network is located or its designee.

6 If an affected administration referred to in § 5 has difficulty in determining the source or characteristics of the excess epfd↓ interference:

a) It may send a request for cooperation to any administration which has submitted to the Bureau complete advance publication, coordination, or notification information, as appropriate, for non-GSO FSS systems with overlapping frequency assignments that have been brought into use in the frequency bands subject to the limits referred to in § 1, providing all relevant details in a Report of non-compliance with single-entry operational and additional operational equivalent power flux-density (epfd↓) limits in Section II of Article 22 utilizing the form provided in the Appendix to these procedures. A copy of any such request, including the Report of non-compliance with single-entry operational and additional operational equivalent power flux-density (epfd↓) limits in Section II of Article 22, should be sent to Bureau.

a*bis*) It may request the assistance of the Bureau to identify the administrations referred to in § 6 a). Upon receipt of such a request of assistance, the Bureau should promptly communicate to the requesting administration the list of administrations which have submitted to the Bureau complete advance publication, coordination or notification information, as appropriate, for a non-geostationary satellite system in the fixed-satellite service in the frequency bands referred to in § 1 with overlapping frequency assignments that have been brought into use. Upon receipt from the Bureau of the list of administrations, the affected administration should then apply § 6 a).

b) Upon receipt of such a request for cooperation under § 6 a), each administration should, as soon as possible but within 30 days, acknowledge receipt and send to the requesting administration(s), with a copy to the Bureau, information that may be used to identify the source of the excess epfd↓ interference and/or to eliminate one or more non-GSO FSS systems referred to in § 6 a) as the source of the excess epfd↓ interference.

c) If an administration fails to respond within 30 days of receipt to a request for cooperation under § 6 a), an affected administration may request the assistance of the Bureau, in which case Bureau should forthwith request the non-responding administration, to provide the information referred to in § 6 b) within 30 days of an affected administration's request for the assistance of the Bureau.

d) If an administration fails to respond to the Bureau within the time period established in § 6 c) above, the Bureau should:

- If the procedure of Article **11** has not been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, publish a remark in the IFIC within one month to the effect that the responsible administration did not respond to a request for cooperation regarding an unresolved complaint of excess epfd↓ interference; or
- if the procedure of Article **11** has been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, enter a remark in the Remarks column of the Master Register against the relevant frequency assignments of the non-GSO FSS system in question to the effect that the responsible administration did not respond to a request for cooperation regarding an unresolved complaint of excess epfd↓ interference.

7 Upon receipt of the information identified in § 6 a), the Bureau should promptly communicate to all administrations contacted under § 6 a) the identity of any non-geostationary fixed-satellite service systems that, on the basis of determining compliance with the epfd↓ validation limits in Tables **22-1A** through **22-1D**, the Bureau has concluded to have a maximum epfd↓ lower than the limits referred to in § 1, for all pointing directions towards the geostationary-satellite orbit and therefore would not be responsible for causing epfd↓ interference in excess of the limits referred to in § 1.

8 Once the source(s) of the excess epfd↓ interference have been identified, an affected administration may send a letter, by fax or other mutually agreed electronic means, to the administration(s) concerned and request immediate corrective action. It should give all useful information, including a Report of Non-Compliance with Single-Entry Operational and Additional Operational Equivalent Power Flux-Density (epfd↓) Limits in Section II of Article **22**, to enable the responding administration(s) to take such steps as may be necessary to reduce the interference to the epfd↓ levels required in Table **22-4A, 22-4A1, 22-4B** or **22-4C,** as appropriate, or to higher levels as may otherwise be or have been agreed between concerned administrations pursuant to No. **22.5I**. A copy of any such request for immediate corrective action, including the Report of Excess epfd↓ Interference, should be sent to Bureau.

9 Upon receipt of such a request for immediate corrective action under § 8, an administration should acknowledge receipt to the requesting administration within 30 days, with a copy to the Bureau. Such acknowledgement would not constitute acceptance of responsibility.

10 Within 30 days after receipt of a request for immediate corrective action pursuant to § 8 above, the administration receiving the request should either:

a) Provide the requesting administration and the Bureau with information indicating that no non-geostationary fixed-satellite service system for which it is responsible could have caused the excess epfd↓ interference experienced by the receiving earth station associated with the geostationary-satellite network; or

b) acknowledge responsibility for causing the excess epfd↓ interference and immediately reduce emissions of the interfering system into the affected receiving earth station associated with the geostationary-satellite network to the epfd↓ levels specified in Table **22-4A, 22-4A1, 22-4B** or **22-4C,** as appropriate, or to the epfd↓ levels otherwise agreed between concerned administrations pursuant to No. **22.5I**, whichever is higher. Full particulars of the action taken by the administration responsible for causing the excess epfd↓ interference should be provided to the requesting administration.

In either case, the Bureau should be informed of the action taken.

11 If an administration fails to act in accordance with § 10 above, an affected administration may request the assistance of the Bureau, in which case the Bureau should forthwith request the non-responding administration to act in accordance with § 10 within 30 days of the affected administration's request for the assistance of the Bureau.

12 If the administration fails to respond to the Bureau within the time period established in § 11 above, the Bureau should:

– if the procedure of Article **11** has not been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, publish a remark in the IFIC within one month to the effect that the responsible administration did not respond to a request for immediate corrective action regarding an unresolved complaint of excess epfd↓ interference; or

– if the procedure of Article **11** has been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, enter a remark in the Remarks column of the Master Register against the relevant frequency assignments of the non-GSO FSS system in question to the effect that the responsible administration did not respond to a request for immediate corrective action regarding an unresolved complaint of excess epfd↓ interference.

13 If an administration acknowledges responsibility for causing the excess epfd↓ interference pursuant to § 10 b) above, but fails to reduce immediately emissions of the interfering system as required:

a) It should have an additional 10 days to take the necessary action to correct the excess epfd↓ interference situation pursuant to No. **15.21** of the Radio Regulations.

b) If, after the 10-day period, the administration responsible for the interference has still not reduced emissions of the interfering system as required, the Bureau should:

– if the procedure of Article **11** has not been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, publish a remark in the IFIC within one month to the effect that the responsible administration is in contravention of its obligations under No. **22.2** and No. **22.5I**; or

– if the procedure of Article **11** has been completed for the frequency assignments of the non-geostationary-satellite system in the fixed-satellite service in question, enter a remark in the Remarks column of the Master Register against the relevant frequency assignments of the non-GSO FSS system in question to the effect that the use of the affected frequency assignments by the interfering system is in contravention of its obligations under No. **22.2** and No. **22.5I** of the Radio Regulations. Notice of the entry of the remark should be included in the IFIC.

14 The Bureau shall retain any entry in the Remarks column of the Master Register made pursuant to § 6 d), § 12 or § 13 b) above, which shall remain in place until such time as the non-responding administration responds and/or corrects the excess epfd↓ interference, as appropriate.

APPENDIX TO ANNEX

Report of non-compliance with single-entry operational and additional operational equivalent power flux-density (epfd↓) limits in Section II of Article 22

Part 1: Particulars concerning the non-geostationary-satellite system exceeding the operational epfd↓ limits:

1) Name of non-geostationary-satellite system, if known, or other mean of identification:

2) Frequency measured:

a) Date:

b) Time (UTC):

3) Class of emission:

4) Bandwidth (indicate whether measured or estimated):

5) Measured epfd↓:

a) Date:
b) Time (UTC):
c) Duration (seconds)
d) Repeatability (Yes/no)
If yes, associated period (seconds)

6) Applicable epfd↓ limit in Article **22** Tables **22-4A** through **22-4C**:
7) Observed polarization:
8) Class of station and nature of service, if known:

Part II: Particulars furnished by the administration responsible for the operating geostationary fixed-satellite service earth station receiving epfd↓ levels exceeding the operational limits in Tables 22-4A through 22-4C:

1) Name of earth station:
2) Antenna diameter of the receiving earth station:
3) Name of the transmitting GSO space station interfered with, if known or other means of identification:
4) Longitude of the associated geostationary-satellite network:
5) Orbital inclination of the associated geostationary-satellite network:
6) Latitude, Longitude, Elevation and Azimuth of the earth station at which the epfd↓ levels exceeded the operational limits in Tables **22-4A** through **22-4C**:
7) Nature of interference:
8) Characteristics of the wanted emission at the receiving station
a) Class of emission
b) Bandwidth (indicate whether measured or estimated, or indicate the necessary bandwidth notified to the Radiocommunication Bureau)
c) Frequency measured
Date:
Time (UTC):
d) Field strength or power flux-density
Date:
Time (UTC):
9) Polarization of the receiving antenna or observed polarization:
10) Action requested:

##########

3.4 Agenda item 1.30

"to consider possible changes to the procedures for the advance publication, coordination and notification of satellite networks in response to Resolution **86** (Minneapolis, 1998)"

In response to Resolution 86 (Minneapolis, 1998) ITU-R studies have progressed in four areas:

1) improvement and reformatting of Appendix 4;

2) automation of the regulatory examination for checking compliance with the RR Table of Frequency Allocations and the footnotes thereto;

3) FSS earth stations deployed in large numbers;

4) BSS frequency bands not subject to Appendix 30.

3.4.1 Modification of Appendix 4

3.4.1.1 Summary of technical and operational studies

The ITU-R has examined the structure and content of the Appendix 4 data and the format used by Member States to supply this data to the Bureau as well as the format used by the Bureau to publish this data.

3.4.1.2 Analysis of the results of studies

The results of these studies can be divided into three categories.

a) Limiting the volume of data provided under section C.8 of Appendix 4

The volume of data supplied by Member States may be reduced by limiting the data supplied under section C8a and C8c of Appendix 4 to the carriers with the maximum potential for causing interference and having the maximum sensitivity to interference, see Annex 1 to section 3.4.1. This proposal is already permitted under the current Radio Regulations but Member States are not necessarily aware that this option for supplying data is available. However, noting the Rule of Procedure on No. **9.35** agreed by the RRB at its 25th meeting, care needs to be exercised in the use of this option as the impact on the filing from an unfavourable finding, during the technical/regulatory examination, due to excess power/pfd may be more significant from the perspective of the network as the unfavourable finding would then apply to all carriers using that emission.

During the studies a number of other requests for changes to the Appendix **4** data were identified but it has been recognised that these can be resolved by extending the number of queries available in the Bureau's Space-Query software and a correspondence group will progress the work.

b) Removal of duplicated data requirements and inconsistencies from Appendix 4

The structure and contents of App. **4** requirements for space services have been examined to remove duplication and inconsistencies particularly in relation to the data presented in Annex 2B to App. **4**. The proposal is based on individually identifying each data item and Recommendation ITU-R SM.1413. Annex 2 to section 3.4.1 presents a suggested structure for Annex 2B to App. **4**.

The revised structure of App. **4** would enable duplicated data elements to be identified and removed e.g. the maximum isotropic gain for a satellite antenna is listed 6 times in App. **4** (items B3a1, B3b1, B3b2, B3g1, B3g5 and B4a). Identifying each data element simplifies the validation of data by Member States and the Bureau and the removal of the need for additional footnotes to clarify requirements would make maintenance easier. The proposal would make it possible to combine Annexes 2A and 2B into this one suggested structure.

The table notes in Annex 2 to section 3.4.1 are provided for the purpose of explaining of the changes to the data requirements and are not expected to be retained in the final version of App. **4**.

The proposed corrections of inconsistencies to the data in App. **4** are based on:

- Recommendation ITU-R SM.1413 - provides the separation of the App. **4** data into their individual elements and identifies a number of inconsistencies in the presentation of the data;

- Rules of Procedure on App. **4** - identifying inconsistencies in the identification of data elements with respect to various forms of notice and service;
- Radiocommunication Bureau Circular Letters CR/158 and CR/158c1 - identifying inconsistencies in the identification of data elements relating to the Plan bands.

In the course of studies the following issues have been identified with regard to the data contained in App. **4** and while there appear to be no technical limitations in developing a solution there may be other factors:

- the visibility arc (App. **4** data item A4A3) is not used by the Bureau and is no longer used by administrations, on that basis it could be deleted as could App. **4** data item A4A5 (the reason the visibility arc is less than the service arc);
- there is some duplication in the data requirements for the orbital parameters of non-GSO satellite systems affecting satellite systems subject to coordination as well as satellite systems not subject to coordination, Annex 3.4.1-3 contains a possible solution.

Administrations and the Special Committee may wish to consider whether there any other factors that would require this data to be retained in its present form and if there is a requirement for corresponding text in § 3.4.1.4.

c) Rationalization of presentation format for supply and publication of data

This proposal considers rationalization of the format used by Member States to supply the Appendix 4 data to the Bureau and the format used by the Bureau to publish this data. The following report is provided to the CPM for information only.

The suggested rationalization would reformat the data into a simpler structure than that now utilized by the Radiocommunication Bureau's data entry software and a simpler structure than that now published in the space Special Sections of the International Frequency Information Circular. This study is not yet completed and can be considered an effort for the longer term that would not provide an immediate impact on reducing the backlog in satellite filings if implemented. A conclusion has not been reached as to whether changes to the Regulations would be necessary to implement such an approach.

3.4.1.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

Limiting the volume of data provided under section C.8 of Appendix **4**.

While it is understood that limiting the volume of data to be provided under section C.8 of Appendix **4** is permitted under the existing Radio Regulations, it may be appropriate to include a footnote to clarify that this option is available to Member States in the submission of satellite network filing data. Appendix **4** could be modified with text contained in Annex 1 to section 3.4.1 so that Member States can optionally decide if they want to provide a reduced set of data.

Advantage:

Clarifies the requirements of the existing Radio Regulations for Member States to have the flexibility to provide a reduced data set if they so wish, thus potentially speeding up their provision and handling of data.

Disadvantage:

The impact, on the network concerned, of an unfavourable finding during technical/regulatory examination arising from excess power/pfd may be more significant.

Method B

Removal of duplicated data requirements and inconsistencies from Appendix **4**.

To replace the text of Appendix 4 based on the text contained in Annex 3.4.1-3. The table notes in this Annex are provided for the purpose of explanation of the changes to the data requirements and are not expected to be retained in the final version of Appendix **4**.

Advantage:

To have complete and consistent Appendix **4** data available.

Disadvantage:

None.

Method C

Implementing both Method A and Method B.

Method A and Method B may be combined and used to replace the text of Appendix **4**.

Advantage:

As noted above.

Disadvantage:

As noted above.

Disadvantages of retaining the existing text of the Radio Regulations

Member States may not be aware of their rights to have flexibility in reducing the volume of data to be submitted. In addition known problems with the existing text will not be resolved.

Method D

Implement Method C and limit the information required under Section D of Annex 2A of Appendix 4.

The information currently required under Section D only affects the calculation of $\Delta T/T$ when there is an overlap in frequency on both the uplink and the downlink of the network effecting coordination. For networks having an overlap in either the uplink or the downlink, the calculation of $\Delta T/T$ ($\Delta T_s/T_s$ or $\Delta T_e/T_e$) is done independently on the uplink and the downlink and the data in Section D is not used in this case. Supplying overall link characteristics should not be mandatory for all FSS or BSS satellite networks in all frequency bands with the exception of a space radiocommunication service, in a frequency band and in a Region where the service is subject to a Plan. If Section D is revised to be non-mandatory for these cases, it will reduce the burden of filing and make processing of filings more efficient by BR. There are provisions to file such information when it is required.

Modify Section D of Annex 2A of Appendix 4 as follows:

D Overall link characteristics

"To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite.

In the case of fixed-satellite service networks or broadcasting-satellite networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§ 1), 2) and 3) of the

frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau."

Consequential to the above revision, changes must also be made to the relevant sections of Table 5-1 of Appendix 5. The changes to Appendix 4 and Appendix 5 are shown in Annex 3.4.1-1 attached.

Concomitantly, there should be a provision included in Article 59 for this revision of Appendix 4 and Appendix 5 to provisionally enter into force as of 5 July 2003.

Advantages

Removes the mandatory requirement for the provision of information that does little to aid BR in identifying networks that may be affected as a result of the eventual bringing into use of the network that is effecting the coordination of the satellite network. Elimination of the mandatory requirement to provide overall link characteristics can significantly reduce the amount of data required when submitting Ap4 satellite network characteristics. In addition, elimination of this requirement can reduce the workload of BR and hopefully help in the effort to reduce the satellite backlog.

Disadvantages

The administration that is effecting the coordination carries a risk that the increase in the equivalent satellite link noise temperature may be greater than ΔT_e when there is a frequency overlap with potentially interfering networks on the uplink and the product of γ and ΔT_s is significant relative to ΔT_e. Also, not knowing the strapping of the network that is effecting coordination, BR and other potentially affected administrations can only calculate the effect of the interference to other networks independently on the uplinks and downlinks of those networks. The calculation of $\Delta T/T$ would have to be done on the uplink and the downlink independently just as in the case of a network with onboard processing, independently of whether or not the interfered-with network uses simple frequency changing transponders or onboard processing.

3.4.1.4 Regulatory and procedural considerations

Limiting the volume of data provided under sections C.8 and D of Appendix 4

The text contained in Annex 3.4.1-2 to section 3.4.1 could be used as the basis for updating section C.8 and the text contained in § 3.4.1.3 could be used as the basis for updating section D of Appendix **4**.

Removal of duplicated data requirements and inconsistencies from Appendix 4

The text contained in Annex 3.4.1-3 to section 3.4.1 could be used as the basis for updating Appendix **4**.

MOD

ANNEX 3.4.1-1

TABLE 5-1 (WRC-2000)

Technical conditions for coordination
(see Article **9**)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.7** GSO/GSO	A station in a satellite network using the geostationary-satellite orbit (GSO), in any space radiocommunication service, in a frequency band and in a Region where this service is not subject to a Plan, in respect of any other satellite network using that orbit, in any space radiocommunication service in a frequency band and in a Region where this service is not subject to a Plan, with the exception of the coordination between earth stations operating in the opposite direction of transmission	1) 3 400-4 200 MHz 5 725-5 850 MHz (Region 1) and 5 850-6 725 MHz 2) 10.95-11.2 GHz 11.45-11.7 GHz 11.7-12.2 GHz (Region 2) 12.2-12.5 GHz (Region 3) 12.5-12.75 GHz (Regions 1 and 3) 12.7-12.75 GHz (Region 2) and 13.75-14.5 GHz	i) Bandwidth overlap, and ii) any network in the fixed-satellite service (FSS) with a space station within an orbital arc of ± 10° of the nominal orbital position of a proposed network in the FSS i) Bandwidth overlap, and ii) any network in the FSS, or BSS, not subject to a plan with a space station within an orbital arc of ± 9° of the nominal orbital position of a proposed network in the FSS or BSS		With respect to the FSS or BSS in the bands in 1), 2) and 3), an administration may request, pursuant to No. **9.41**, to be included in requests for coordination, indicating the networks for which the value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** exceeds 6%. When the Bureau, on request by an affected administration, studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used. With respect to the FSS or BSS in the bands in 1), 2) and 3), an administration may request, pursuant to No. **9.41**, that an administration be excluded from requests for coordination, giving as reason

TABLE 5-1 (*continued*)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.7** GSO/GSO (*cont.*)		3) <u>All bands above 17.3 GHz</u> ~~17.7-20.2 GHz, and 27.5-30 GHz~~	i) Bandwidth overlap, and ii) any network in the FSS<u>, or BSS, not subject to a plan</u> with a space station within an orbital arc of ± 8° of the nominal orbital position of a proposed network in the FSS <u>or BSS</u>	Appendix **8**	that the network of this administration will not be affected because value of $\Delta T/T$ calculated by the method in § 2.2.1.2 and 3.2 of Appendix **8** do not exceed 6%. When the Bureau, at the request of an administration, studies this information pursuant to No. **9.42**, the calculation method given in § 2.2.1.2 and 3.2 of Appendix **8** shall be used
		4) All frequency bands, other than those in § 1), 2) and 3), allocated to a space service, and the bands in § 1), 2) and 3) where the radio service of the proposed network or affected networks is other than the FSS, or in the case of coordination of space stations operating in the opposite direction of transmission	Value of $\Delta T/T$ exceeds 6%		

Annex 3.4.1-2

Example limiting the volume of data provided under Section C.8 of Appendix 4

Items in Appendix	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9	Notification or coordination of a geostationary-satellite network (including Appendix 30B)	Notification or coordination of a non-geostationary-satellite network	Notification or coordination of an earth station	Notice for space stations in the broadcasting-satellite service under Appendix 30	Notice for feeder-link stations under Appendix 30A	Notice for stations in the fixed-satellite service under Appendix 30B	Items in Appendix	Radio astronomy
C.8.a			X[1, 7,AA]	X[7,AA]	X[7,AA]	C[8,AA]				C.8.a	
C.8.b			X[1, 7]	X[7]	X[7]	X[11]				C.8.b	
C.8.c			O	X[6,AA]	X[6,AA]	X[6, 11,AA]				C.8.c	
C.8.d				X[2]	X[2]					C.8.d	
C.8.e			O	X[6]	X[6]	X[6, 11]				C.8.e	
C.8.f			X[3]							C.8.f	
C.8.g				C[4]	C[4]	C[4, 5]				C.8.g	
C.8.h							X			C.8.h	
C.8.i								X		C.8.i	
C.8.j									X	C.8.j	

New footnote AA: Member States may optionally supply, for each class of emission, only the powers related to the carriers that have the greatest sensitivity to interference and the greatest potential for causing interference.

Annex 3.4.1-3

Removal of duplicated data requirements and inconsistencies from Appendix 4

In the following table two columns have been added: the first entitled "Extra code field" that is used to identify compound data elements, this field is temporary and is not expected to be retained in the final version of Appendix 4; and, the column entitled "Data Description" containing the data descriptions from Annex 2A to Appendix 4.

New data elements are identified by the text "Not in App. 4" in column 1. Existing data elements that have been relocated within the table are identified by an appropriate existing Appendix 4 item code combined with one of the following terms "*bis*", "*ter*", or "*quinter*". Where data items have been relocated or combined, the reference code for the original location or the constituent data items are listed at the new location with each reference enclosed in square brackets. Revision marking is used to show changes to the text and a series of table notes provide the details of changes and the source of more detailed reference material. The existing footnotes to Annex 2B to Appendix 4 are separately listed, for reference, after the table notes.

Example of a rationalized structure for Appendix 4

Characteristics to be submitted for stations in the space and radio astronomy services

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary satellite network ~~(including Appendix 30B)~~ (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendi~~x~~ces 30A and 30B) (76)**	**Notice for ~~space~~ a satellite network~~stations~~ in the broadcasting-satellite service under Appendix 30 * (77)**	**Notice for a satellite network (feeder-link) ~~stations~~ under Appendix 30A * (78)**	**Notice for a satellite network ~~stations~~ in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
A		**GENERAL CHARACTERISTICS TO BE PROVIDED FOR THE SATELLITE NETWORK OR THE EARTH OR RADIO ASTRONOMY STATION**										
A1		**IDENTITY OF THE SATELLITE NETWORK OR THE EARTH OR RADIO ASTRONOMY STATION**										
A1a [A1d]		Identity of a satellite network and in the case of Appendix 30B for a network not derived from the Allotment Plan.	X	X	X	X	X		X	X	X	
~~**A1b**~~		~~Country and ITU number (Regions 1 and 3); country and beam identification (Region 2).~~							~~X~~(50)			
A1c [A1d]		Country and beam identification.							X (51)	X	X	
~~**A1d**~~		~~For a network derived from the Allotment Plan, the country and identification of the allotment.~~									~~X~~	
~~**A1d**~~		~~For a network not derived from the Allotment Plan the identity of the network.~~									~~X~~	
A1e		**Identity of an earth or radio astronomy station:**										
A1e1		the type of earth station (specific or typical)						X				
A1e2	a	the name by which the station is known, required if the name of the locality is not supplied ~~or the name of the locality in which it is situated~~;						~~X~~ +				~~X~~ +
A1e2	b	the name of the locality in which it is situated (i.e. site name), required if the name of the station is not supplied.						~~X~~ + (3)				~~X~~ + (3)
A1e3		**for a specific earth station or radio astronomy station:**										

1		2	3	4	5	6	7	8	9	10	11	12
A1e3 [A1e4_a]	a	the country or geographical area in which the station is located, using the symbols from the Preface to the International Frequency List;						X				X
A1e3 [A1e4_b]	b	the geographical coordinates of each transmitting ~~and~~or receiving antenna site constituting the earth station (longitude and latitude in degrees and minutes). For a specific earth station ~~as well as~~ seconds ~~with~~ (to an accuracy of one-tenth of a minute)~~;~~ are to be provided~~the seconds need only be furnished~~ if the coordination area of the earth station overlaps the territory of another administration~~)~~;						X				X
~~**A1e4**~~		~~**for a radio astronomy station:**~~										
~~**A1e4**~~	~~a~~	~~the country or geographical area in which the station is located, using the symbols from the Preface to the International Frequency List;~~										~~X~~
~~**A1e4**~~	~~b~~	~~the geographical coordinates of the station site (longitude and latitude in degrees and minutes).~~										~~X~~
A1f [A18_4]	1	Country symbol of the notifying administration. ~~In the case of advance information, give the symbol of the administration or the symbols of the administrations in the group submitting the advance information on the satellite network~~.	X	X	X	X	X	X (59)	X	X	X	X
A1f [A18_2]	2	The country symbols of the administrations in the group submitting the ~~advance~~ information on the satellite network.	X	X	X						X	
Not in App. 4		If the notice is submitted on behalf of an intergovernmental satellite organization provide its symbol (4)	X	X	X	X	X		X	X		
A2		**DATE OF BRINGING INTO USE**										
A2a		The date (actual or foreseen, as appropriate) of bringing the frequency assignment (new or modified) into use. The date of bringing into use denotes the date at which the frequency assignment of a geostationary satellite network is brought into regular ~~operation~~[2a] operation* to provide the published radiocommunication service with the technical parameters within the technical characteristics notified to the Bureau. Whenever the assignment is changed in any of its basic characteristics (except in the case of a change in item A.1 a), the date to be given shall be that of the latest change (actual or foreseen, as appropriate). ~~2a~~ * Pending further studies by ITU-R on the applicability of the term "regular operation" to non-geostationary satellite networks, the condition of regular operation shall be limited to geostationary satellite networks.	X	X	X	X	X	X	X	X	X	
A2b		For the case of a space station onboard a geostationary satellite, the period of validity of the frequency assignments (see Res. 4 (Rev.Orb-88)).	X			X						

1		2	3	4	5	6	7	8	9	10	11	12
A2c		The date (actual or foreseen, as appropriate) on which reception of the frequency band begins or on which any of the basic characteristics are modified.										X
A3		**OPERATING ADMINISTRATION OR AGENCY**										
A3	a	Symbols for the operating administration or agency ~~and for the address of the administration to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the network or station (see Article **15**)~~. if it is in operational control of the space station or earth station; required in the case of Appendix 30B for notification under Article 8 only.			X	X	X	X	X	X	**X** (5)	X
A3	b	Symbols for the address of the administration to which communication should be sent on urgent matters regarding interference, quality of emissions and questions referring to the technical operation of the space network or earth station (see Article **15**); required in the case of Appendix 30B, for notification under Article 8 only.	X (6)	X (6)	X	X	X	X	X	X	**X** (5)	X
A4		**ORBITAL INFORMATION**										
A4a		**For the case of a space station onboard a geostationary satellite:**										
A4a1		the nominal geographical longitude on the geostationary-satellite orbit;	X			X			X	X	X	
A4a2	a	the planned longitudinal tolerance easterly limit ~~and inclination excursion~~.				X			X	X	X (7)	
A4a2	b	the planned longitudinal tolerance westerly limit.				X			X	X	X (7)	
A4a2	c	the planned inclination excursion.				X			O (8)~~X~~	O (8)~~X~~	X (7)	
A4a		**In the case where a geostationary space station is intended to communicate with an earth station:**										
A4a3	a	the arc of visibility easterly limit (the arc of the geostationary-satellite orbit over which the space station is visible at a minimum angle of elevation of 10° at the Earth's surface from its associated earth stations or service areas);				X						
A4a3	b	the arc of visibility westerly limit (the arc of the geostationary-satellite orbit over which the space station is visible at a minimum angle of elevation of 10° at the Earth's surface from its associated earth stations or service areas);				X						
A4a4	a	the service arc easterly limit (the arc of the geostationary-satellite orbit within which the space station could provide the required service to its associated earth stations or service areas); required in the case of Appendix 30B, for satellite networks not derived from the Allotment Plan.				X					+ (9)	

1		2	3	4	5	6	7	8	9	10	11	12
A4a4	b	the service arc westerly limit (the arc of the geostationary-satellite orbit within which the space station could provide the required service to its associated earth stations or service areas); required in the case of Appendix 30B, for satellite networks not derived from the Allotment Plan.				X					+ (9)	
A4a5		in the event that the service arc is less than the arc of visibility, the reasons therefore.				X						
A4b		**For the case of space station(s) onboard non-geostationary satellite(s):**										
A4b1		the angle of inclination of the orbit;		X	X		X (10)					
A4b2		the period;		X	X		X (11)					
A4b3	a	the altitude in kilometres of the apogee ~~and perigee~~ of the space station(s);		X	X		X (11)					
A4b3	b	the altitude in kilometres of the perigee of the space station(s);		X	X		X (11)					
A4b4		the number of satellites used.		X	X		X					
Not in App. 4		Reference body code (12)		X	X		X					
A4b5		**In addition, if the stations operate in a frequency band subject to the provisions of No. 9.11A: ~~new~~ data elements required to characterize properly the orbital statistics of non-GSO satellite systems:**										
A4b5 N_p	a	number of orbital planes;		X (14)	X (14)		X (15)					
A4b5 N_s	b	number of satellites in each orbital plane;					X					
A4b5 Ω_j	c	right ascension of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ($0° \le \Omega_j < 360°$);					X					
A4b5 i_j	d	inclination angle for the j-th orbital plane with respect to the reference plane, which is taken to be the Earth's equatorial plane ($0° \le i_j < 180°$);					X					
A4b5 ω_i	e	initial phase angle of the i-th satellite in its orbital plane at reference time t = 0, measured from the point of the ascending node ($0° \le \omega_i < 360°$);					X					
A4b5 α	f	semi-major axis;					X					
A4b5 e	g	eccentricity ($0 \le e < 1$);					X					
A4b5 ω_p	h	argument of perigee, measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ($0° \le \omega_p < 360°$).					X					

1		2	3	4	5	6	7	8	9	10	11	12
A4b6		**In addition, if the stations operate in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, data elements required to characterize properly the orbital operation of non-geostationary satellite systems:**										
~~**A4b6**~~		~~**new data elements required to characterize properly the orbital operation of the non-geostationary satellite systems:**~~										
A4b6a		**for each range of latitudes provide:**										
A4b6a	1	the maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location; ~~and the associated latitude range~~					X (72)					
A4b6a	2	the associated start of the latitude range;					X (72)					
A4b6a	3	the associated end of the latitude range;					X (72)					
A4b6b		the minimum altitude of the space station above the surface of the Earth at which any satellite transmits;					X (72)					
A4b6c		an indicator identifying if the space station uses station-keeping to maintain a repeating ground track;					X (72)					
A4b6d		where the space station uses station-keeping to maintain a repeating ground track, the time in seconds that it takes for the constellation to return to its starting position, i.e. such that all satellites are in the same location with respect to the Earth and each other;					X (72)					
A4b6e		an indicator identifying if the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term;					X (72)					
A4b6f		for a space station that is to be modelled with a specific precession rate of the ascending node of the orbit instead of the J_2 term, the precession rate in degrees/day, measured counter-clockwise in the equatorial plane;					X (72)					
A4b6g		the longitude of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the Greenwich meridian to the point where the satellite orbit makes its south-to-north crossing of the equatorial plane ($0° \le \Omega_j < 360°$) ~~(see Note)~~; NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					
A4b6h	1	the time (date) at which the satellite is at the location defined by Ω_j ~~(see Note)~~; NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					

1		2	3	4	5	6	7	8	9	10	11	12
A4b6h	2	the time at which the satellite is at the location defined by Ω_{i_2}; NOTE – For the evaluation of epfd a reference to a point on the Earth is used and hence the "longitude of the ascending node" is required. All satellites in the constellation should use the same reference time.					X (72)					
A4b6i		the longitudinal tolerance of the longitude of the ascending node					X (72)					
A4b7		**In addition, if the stations operate in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F ~~new~~ data elements required to characterize properly the performance of ~~the~~ non-geostationary satellite systems:**										
A4b7a		the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell;					X (72)					
A4b7b		the average number of associated earth stations with overlapping frequencies per square kilometre within a cell;					X (72)					
A4b7c		the average distance between co-frequency cells;					X (72)					
A4b7d		**for the exclusion zone about the geostationary-satellite orbit provide:**										
A4b7d		the type of zone;					X (72)					
A4b7d	1	in the case of an exclusion zone based on topocentric angle the width of the zone in degrees.					X (72)					
A4b7d	2	in the case of an exclusion zone determined using a satellite based angle the width of the zone in degrees.					X (72)					
A4c	1	For the case of an earth station, the identity of the associated space station(s) with which communication is to be established ~~as well as, in the case of a geostationary space station, its orbital position~~.						X				
A4c	2	For the case of an earth station, if communication is to be established with an associated geostationary space station its orbital position.						X				
A5		**COORDINATION**										
A5		The country symbol of any administration with which coordination has been successfully effected as well as the country symbol of any administration with which coordination has been sought but not completed. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
Not in Ap 4		If coordination has been sought or completed provide the related provision code. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
A6		**AGREEMENTS**										

1		2	3	4	5	6	7	8	9	10	11	12
A6		If appropriate, the country symbol of any administration or administration representing a group of administrations with which agreement has been reached, including where the agreement is to exceed the limits prescribed in these Regulations. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
Not in Ap 4		If agreement has been reached provide the related provision code. For the case of an FSS earth station, not required for coordination under No. 9.7A.				X	X	X (23)	X	X	X	
A7		**EARTH OR RADIO ASTRONOMY STATION SITE CHARACTERISTICS**										
A7		**For a specific earth station:**										
A7a1		The horizon elevation angle in degrees for each azimuth around the earth station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		X (17)		
A7a2		the distance in kilometres from the earth station to the horizon for each azimuth around the earth station.						O				
A7b [B6]		that is operating to an associated GSO space station, the planned minimum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane. For an earth station the minimum elevation angle should, having due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		X (17)		X
A7b-bis [B6]		The planned maximum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane.										X
A7c [B6]	1	That is operating to an associated GSO space station, The start azimuth for the planned range of operating azimuthal angles for the direction of maximum radiation in degrees, clockwise from True North., For an earth station the start azimuth should having due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				X
A7c [B6]	2	The end azimuth for the planned range of operating azimuthal angles for the direction of maximum radiation in degrees, clockwise from True North. For an earth station the start azimuth should have due regard to possible inclined-orbit operation of the associated geostationary space station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				X
A7d		The altitude (metres) of the antenna above mean sea level. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)		X (17)		

1		2	3	4	5	6	7	8	9	10	11	12
A7e		~~that is operating to associated non-GSO space stations, t~~The minimum angle of elevation of the antenna in the direction of maximum radiation in degrees from the horizontal plane for each azimuth around the earth station that is operating to associated non-geostationary space stations. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
~~A8~~		~~The rain climatic zone(s)~~ (20)										
A10		**EARTH STATION COORDINATION AREA DIAGRAMS**										
A10		The diagrams shall be drawn to an appropriate scale, indicating, for both transmission and reception, the location of the earth station and its associated coordination areas, or the coordination area related to the service area in which it is intended to operate the mobile earth station. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
A11	a	Regular hours of operation start time UTC (30)							X	X		
A11	b	Regular hours of operation stop time UTC (30)							X	X		
A12		**RANGE OF AUTOMATIC GAIN CONTROL**										
A12		Range of automatic gain control, expressed in dB.								X		
A13		**AS APPROPRIATE, REFERENCE TO THE SPECIAL SECTION OF THE BUREAU'S INTERNATIONAL FREQUENCY INFORMATION CIRCULAR (BR IFIC).**										
A13a		providing the advance publication special section reference information required in accordance with No. 9.1;				X	X	X				
A13b		providing the coordination special section reference information required in accordance with No. 9.7;				X	(22)	+ (38)				
A13c		providing the special section reference information required in accordance with No. 9.21;				X	X	X				
A13d		providing the coordination special section reference information required in accordance with ~~No. S9.8~~ Art. 7 of Ap. 30;				X	(22)	(24)				
A13e		providing the coordination special section reference information required in accordance with ~~No. S9.9~~ Art. 7 of Ap. 30A;				X	(22)	+ (73)				
A13f		providing the coordination special section reference information required in accordance with No. 9.11;				+ (43)	+ (43)	(24)				
A13g		providing the coordination special section reference information required in accordance with No. 9.11A;				X	X	X				
A13h		providing the special section reference information required in accordance with Article 6 of Appendix 30B.				~~+ (36)~~	(22)	+ (36)			+ (80)	
Not in Ap 4		providing the special section reference information required in accordance with Article 4 of Appendix 30. (84)							X			

1		2	3	4	5	6	7	8	9	10	11	12
Not in Ap 4		providing the special section reference information required in accordance with Article 4 of Appendix 30A (84)								X		
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.7A (84)						X				
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.7B. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.12. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.12A. (84)					X					
Not in Ap 4		providing the coordination special section reference information required in accordance with No. 9.13. (84)				X						
A14		**SPECTRUM MASKS**										
A14		**For stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F**										
A14a		**for each e.i.r.p. mask used by the non-geostationary space station provide**:										
A14a		~~the type of mask;~~					~~X~~ (65)					
A14a	1	the mask identification code;					X					
A14a	2	the mask pattern defined in terms of the power in the reference bandwidth for a series of off-axis angles with respect to a specified reference point;					X					
A14a	3	the lowest frequency for which the mask is valid;					X					
A14a	4	the highest frequency for which the mask is valid;					X					
A14b		**for each associated earth station e.i.r.p. mask provide**:										
A14b		~~the type of mask;~~					~~X~~ (65)					
A14b	1	the mask identification code;					X					
A14b	2	the mask pattern defined in terms of the power in the reference bandwidth for a series of off-axis angles with respect to a specified reference point;					X					
A14b	3	the lowest frequency for which the mask is valid;					X					
A14b	4	the highest frequency for which the mask is valid;					X					
A14b	5	the minimum elevation angle at which any associated earth station can transmit to a non-geostationary satellite;					X					
A14b	6	the minimum separation angle between the geostationary-satellite orbit arc and the associated earth station main beam-axis at which the associated earth station can transmit towards a non-geostationary satellite;					X					
A14c		**for each pfd mask used by the non-geostationary space station provide:**										
A14c	1	the type of mask;					X					

1		2	3	4	5	6	7	8	9	10	11	12
A14c	2	the mask identification code;					X					
A14c	3	the mask pattern of the power flux-density defined in three dimensions;					X					
A14c	4	the lowest frequency for which the mask is valid;					X					
A14c	5	the highest frequency for which the mask is valid.					X					
A15		**COMMITMENT REGARDING COMPLIANCE WITH ADDITIONAL OPERATIONAL EPFD↓ LIMITS**										
A15		For non-geostationary-satellite systems operating in the fixed-satellite service in the bands 10.7-11.7 GHz (in all Regions), 11.7-12.2 GHz (Region 2), 12.2-12.5 GHz (Region 3), and 12.5-12.75 GHz (Regions 1 and 3), a commitment that the filed for system will meet the additional operational epfd↓ limits that are specified in Table **22-4A1** under No. **22.5I**.					X					
A16		**COMMITMENT REGARDING COMPLIANCE WITH OFF-AXIS POWER LIMITATIONS**										
A16		A commitment that the associated earth stations operating with a geostationary-satellite network in the fixed-satellite service meet the off-axis power limitations given in Nos. **22.26** to **22.28** or **22.32** (as appropriate) under the conditions specified in Nos. **22.30**, **22.31** and **22.34** to **22.39**, where the earth stations are subject to those power limitations.				X						
A17		**COMPLIANCE WITH AGGREGATE POWER FLUX-DENSITY LIMITS**										
A17a	1	For ~~non-geostationary-~~satellite systems operating in the radionavigation-satellite service in the band 5 010-5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz in a 150 kHz bandwidth as defined in No. **5.4443~~C~~B** (60)**.**				X (61)	X					
A17a	2	For satellite systems operating in the radionavigation-satellite service in the band 5 010-5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 4 990-5 000 MHz in a 10 MHz bandwidth, as defined in No. **5.443B** (60)**.**				X (61)	X					
A17b		For ~~non-geostationary-~~satellite systems operating in the fixed-satellite service and broadcasting-satellite service in the band 41.5-42.5 GHz the calculated aggregate power flux-density in any 1 MHz bandwidth produced at the site of a radio astronomy station for more than 2% of the time in the band 42.5-43.5 GHz, as defined in No. **5.551G**.				X (62)	X					
A17c		For satellite systems operating in the radionavigation-satellite service in the band 1 164-1 215 MHz, the calculated aggregate power flux-density produced at the Earth's surface by all the space stations within all radionavigation-satellite systems, as defined in No. **5.328A**.				X (63)	X					

1		2	3	4	5	6	7	8	9	10	11	12
A17d		For non-geostationary-satellite systems operating in the fixed-satellite service (feeder links) in the band 15.43-15.63 GHz (space-to-Earth), the aggregate power flux-density produced at the Earth's surface in the band 15.35-15.4 GHz, as defined in No. **5.511A**.					X					
A18	1	**SUB-REGIONAL SYSTEMS**: for the case of a space network submitted in accordance with Appendix **30B**, indicate the type of system (i.e. if the network is part of a sub-regional system) (26).									X	
~~**A18**~~	~~2~~	~~**SUB-REGIONAL SYSTEMS** In the case of a space network submitted in accordance with Appendix **30B, I**ndicate the participating administrations (see A1.f). (26)~~									~~X~~	
A18	3	**SUB-REGIONAL SYSTEMS**: for the case of a space network submitted in accordance with Appendix **30B,** ~~If applicable,~~ indicate for each participating administration, if applicable, the part of the national allotment proposed to be used to form the subregional system.(26)									X	
~~**A18**~~	~~4~~	~~**SUB-REGIONAL SYSTEMS** In the case of a space network submitted in accordance with Appendix **30B,** If applicable, indicate the notifying administration.(26)~~									~~X~~	
X - Mandatory; + Mandatory under specified conditions; O - Optional; C- Mandatory if used as a basis to effect coordination with another administration.												

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
B		**CHARACTERISTICS TO BE PROVIDED FOR EACH SATELLITE ANTENNA BEAM OR EACH EARTH OR RADIO ASTRONOMY STATION ANTENNA**										
B1		The designation of the satellite antenna beam ~~and, if appropriate, an indication as to whether it is a steerable or reconfigurable antenna beam~~. The designation shall be a character code, and the last character shall be an "R" for steerable or reconfigurable beams.			X	X	X	X	X	X	X	
B2		Transmission/Reception indicator. For the case of an FSS earth station, not required for coordination under No. 9.7A.			X	X	X	X (23)			X	
B3		~~**GEOSTATIONARY**~~ **SPACE STATION ANTENNA CHARACTERISTICS**										
~~**B3a**~~		~~**Where it is intended to communicate with an earth station via an antenna pointing in a fixed direction:**~~										
B3a1 [B3b1] [B3b2_a] [B3g1_a] [B3g5] [B4a_1]		the maximum co-polar isotropic gain (dBi)~~.~~; Where a steerable beam (see No. 1.191) is used, if the effective boresight area (see No. 1.175) is identical with the global or nearly global service area, the maximum antenna gain (dBi) is applicable to all points on the Earth's visible surface;			X	X	X		X	X	X	
B3a1- bis [B3g1_b]		maximum cross-polar isotropic antenna gain (dBi) in the case of beams that are not elliptical.							X	X	(21)	

1		2	3	4	5	6	7	8	9	10	11	12
B3a2 [B3b2_b] [B3g5_a]		the antenna gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite onto a plane perpendicular to the axis from the centre of the Earth to the satellite. For the case of a steerable beam (see No. 1.191), if the effective boresight area (see No. 1.175) is less than the global or nearly global service area, the contours are the result of moving the boresight of the steerable beam around the limit defined by the effective boresight area. The space station antenna gain contours shall be drawn as isolines of the isotropic gain, at least for –2, –4, –6, –10 and –20 dB and at 10 dB intervals thereafter, as necessary, relative to the maximum antenna gain, when any of these contours is located either totally or partially anywhere within the limit of visibility of the Earth from the given geostationary satellite. Whenever possible, the gain contours of the space station antenna should also be provided in a numerical format (e.g. equation or table). Required for the case of Aps. 30, 30A and 30B, non-elliptical beams only.				X			±	±	±	
B3a2-bis [B3g5_b]		cross-polar gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite on to a plane perpendicular to the line from the centre of the Earth to the satellite. The isotropic or absolute gain shall be indicated at each contour which corresponds to a decrease in gain of 2, 4, 6, 10 or 20 dB and thereafter at 10 dB intervals down to a value of 0 dB relative to an isotropic radiator. Whenever practicable, a numerical equation or table providing the necessary information to allow the gain contours to be plotted should be provided. Required for the case of Aps. 30, and 30A non-elliptical beams only.;							±	±	(69)	
B3a2-ter [B3e] [B3g4_a] [B4a_2] [B4b_2]		the co-polar antenna radiation pattern; for non-geostationary space stations, space stations where the antenna radiation beam is directed towards another satellite and required for the case of Appendices 30, 30A and 30B elliptical beams.			X	X	X		X	X	X	
B3a2-quinter [B3g4_g]		the cross-polar antenna radiation pattern; required for the case of elliptical beams.							X	X	(69)	
~~**B3b**~~		~~**Where a steerable beam (see No. 1.191) is used:**~~										
~~**B3b1**~~		~~the maximum isotropic antenna gain (dBi), if the effective boresight area (see No. 1.175) is identical with the global or nearly global service area. The maximum antenna gain is applicable to all points on the Earth's visible surface;~~				~~X~~						
~~**B3b2**~~	~~a~~	~~the maximum antenna gain~~				~~X~~						
~~**B3b2**~~	~~b~~	~~the effective antenna gain contours (see No. 1.176), if the effective boresight area (see No. 1.175) is less than the global or nearly global service area. These contours shall be provided as defined in B.3 a) 2 above.~~				~~X~~						

1		2	3	4	5	6	7	8	9	10	11	12
B3c	a	The antenna gain contours of B.3 a) 2 ~~and B.3 b) 2~~ above shall include the effect of the planned, inclination excursion.				X (27)						
B3c	b	The antenna gain contours of B.3 a) 2 ~~and B.3 b) 2~~ above shall include the effect of the planned longitudinal tolerance.				X (27)						
B3c	c	The antenna gain contours of B.3 a) 2 ~~and B.3 b) 2~~ above shall include the effect of the planned pointing accuracy of the antenna.				X (27)						
B3d		The pointing accuracy of the antenna.				X			X	X	X	
~~**B3e**~~		~~The antenna radiation pattern, where the antenna radiation beam is directed towards another satellite.~~				~~X~~						
B3f [B3g5_g]		The gain of the antenna in the direction of those parts of the geostationary-satellite orbit which are not obstructed by the Earth, in the case of operation in a band allocated in the Earth-to-space direction and in the space-to-Earth direction.				X				X		
B3g		**For the case of a space station submitted in accordance with Appendix 30, Appendix 30A or Appendix 30B:**										
B3g-bis [B3g4_f] [B3g5_c]		nominal intersection of the antenna beam axis with the Earth (boresight longitude and latitude); required for the case of non-steerable beams.							X	X	X	
~~**B3g1**~~	~~a~~	~~maximum isotropic co-polar antenna gain (dBi);~~							~~X~~	~~X~~	~~X~~	
~~**B3g1**~~	~~b~~	~~maximum cross-polar isotropic antenna gain (dBi) in the case of a beam of other than elliptical shape~~							~~X~~	~~X~~	~~(21)~~	
~~**B3g2**~~		~~shape of the beam (elliptical, circular, or other);~~ (52)									~~X~~	
~~**B3g3**~~		~~**for circular beams:**~~ (52)										
~~**B3g3**~~	~~a~~	~~half-power beamwidth in degrees;~~ (52)									~~X~~	
~~**B3g3**~~	~~b~~	~~co-polar radiation patterns;~~ (52)									~~X~~	
~~**B3g3**~~	~~c~~	~~cross-polar radiation patterns;~~ (52)										
~~**B3g3**~~	~~d~~	~~nominal intersection of the antenna beam axis with the Earth (boresight longitude and latitude);~~ (52)									~~X~~	
B3g4		**for elliptical beams:**										
~~**B3g4**~~	~~a~~	~~co-polar radiation patterns;~~							~~X~~	~~X~~	~~X~~	
~~**B3g4**~~	~~g~~	~~cross-polar radiation patterns;~~							~~X~~	~~X~~	~~(69)~~	
B3g4	b	rotational accuracy in degrees;							X	X	X	
B3g4	c	major axis orientation in degrees anticlockwise from the Equator;							X	X	X	
B3g4	d	major axis (degrees) at the half-power beamwidth;							X	X	X	
B3g4	e	minor axis (degrees) at the half-power beamwidth;							X	X	X	
~~**B3g4**~~	~~f~~	~~nominal intersection of the antenna beam axis with the Earth (boresight longitude and latitude);~~							~~X~~	~~X~~	~~X~~	
~~**B3g5**~~		~~**for beams of other than circular or elliptical shape:**~~ (52)										

1		2	3	4	5	6	7	8	9	10	11	12
~~**B3g5**~~	~~a~~	~~co-polar gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite on to a plane perpendicular to the line from the centre of the Earth to the satellite. The isotropic or absolute gain shall be indicated at each contour which corresponds to a decrease in gain of 2, 4, 6, 10 or 20 dB and thereafter at 10 dB intervals down to a value of 0 dB relative to an isotropic radiator. Whenever practicable, a numerical equation or table providing the necessary information to allow the gain contours to be plotted should be provided;~~							~~X~~	~~X~~	~~X~~	
~~**B3g5**~~	~~b~~	~~cross-polar gain contours plotted on a map of the Earth's surface, preferably in a radial projection from the satellite on to a plane perpendicular to the line from the centre of the Earth to the satellite. The isotropic or absolute gain shall be indicated at each contour which corresponds to a decrease in gain of 2, 4, 6, 10 or 20 dB and thereafter at 10 dB intervals down to a value of 0 dB relative to an isotropic radiator. Whenever practicable, a numerical equation or table providing the necessary information to allow the gain contours to be plotted should be provided;~~							~~X~~	~~X~~	~~(69)~~	
~~**B3g5**~~	~~c~~	~~beam aim point longitude and latitude;~~							~~X~~	~~X~~	~~X~~	
~~**B3g5**~~	~~d~~	~~where a steerable beam (see No. 1.191) is used, the maximum co-polar antenna gain~~							~~X~~	~~X~~	~~X~~	
~~**B3g5**~~	~~e~~	~~where a steerable beam (see No. 1.191) is used, the effective antenna co-polar gain contours (see No. 1.176); these contours shall be provided as defined above;~~							~~X~~	~~X~~	~~X~~	
~~**B3g5**~~	~~f~~	~~where a steerable beam (see No. 1.191) is used, the effective antenna cross-polar gain contours (see No. 1.176); these contours shall be provided as defined above;~~							~~X~~	~~X~~	~~(69)~~	
~~**B3g5**~~	~~g~~	~~for an assignment in the bands 14.5 – 14.8 GHz or 17.7 – 18.1 GHz, the isotropic gain in the direction of those parts of the geostationary satellite orbit which are not obstructed by the Earth. Use a diagram to show estimated isotropic gain relative to orbit longitude;~~							(70)	~~X~~		
B4		**NON-GEOSTATIONARY SPACE STATION ANTENNA CHARACTERISTICS**										
~~**B4a**~~	~~1~~	~~The isotropic gain of the antenna in the direction of maximum radiation (dBi).~~			~~X~~		~~X~~					
~~**B4a**~~	~~2~~	~~The antenna radiation pattern.~~			~~X~~		~~X~~					
B4b		**In the case of a space station submitted in accordance with No. 9.11A:**										
B4b	1a	orientation angle alpha of the satellite transmitting and receiving antenna beams ~~and their radiation pattern~~;			(32)		X					
B4b	1b	orientation angle beta of the satellite transmitting and receiving antenna beams;			(32)		X					

1		2	3	4	5	6	7	8	9	10	11	12
~~**B4b**~~	~~2~~	~~satellite transmitting and receiving antenna beams radiation pattern;~~			~~(32)~~		~~X~~					
B4b	3	the satellite antenna gain G(θ) as a function of elevation angle at a fixed point on the Earth;			(32)		X					
B4b	4	the spreading loss (for a non-GSO satellite) as a function of elevation angle (to be determined by equations or provided in graphical format);			(32)		X					
B4b	5a	maximum beam peak e.i.r.p./4 kHz for each beam			(32)		X					
B4b	5c	maximum beam peak e.i.r.p./1 MHz for each beam			(32)		X					
B4b	5b	average beam peak e.i.r.p./4 kHz for each beam			(32)		X					
B4b	5d	average beam peak e.i.r.p./1 MHz for each beam			(32)		X					
B4b	6	for the fixed-satellite service (space-to-Earth) in the band 6 700-7 075 MHz, calculated peak value of power flux-density produced within ±5 degrees inclination of the geostationary-satellite orbit.			(32)		X					
B5		**EARTH STATION ANTENNA CHARACTERISTICS**										
B5a		The isotropic gain (dBi) of the antenna in the direction of maximum radiation (see No. 1.160).						X				
B5b		Half-power beamwidth in degrees. For the case of an FSS earth station, not required for coordination under No. 9.7A.						X (23)				
B5c		Either the measured radiation pattern of the antenna or the reference radiation pattern to be used for coordination. For coordination under No. 9.7A, the reference radiation pattern is to be provided						X (53)				
B6		**RADIO ASTRONOMY STATION ANTENNA CHARACTERISTICS**										
B6	a	The antenna type and dimensions, effective area ~~and angular coverage (in azimuth and elevation)~~										X
~~**B6**~~	~~b~~	~~Operational sector's start azimuth.~~										~~X~~
~~**B6**~~	~~c~~	~~Operational sector's end azimuth.~~										~~X~~
~~**B6**~~	~~d~~	~~Planned minimum elevation angle.~~										~~X~~
~~**B6**~~	~~e~~	~~Planned maximum elevation angle.~~										~~X~~

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the FSS under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
C		**CHARACTERISTICS TO BE PROVIDED FOR EACH GROUP OF FREQUENCY ASSIGNMENTS FOR A SATELLITE ANTENNA BEAM OR AN EARTH OR RADIO ASTRONOMY STATION ANTENNA**										
C1		**FREQUENCY RANGE**										
C1	a	The frequency range lower limit within which the carriers and the bandwidth of the emission will be located for each Earth-to-space or space-to-Earth service area, or for each space-to-space relay.	X	X	X						X	
C1	b	The frequency range upper limit within which the carriers and the bandwidth of the emission will be located for each Earth-to-space or space-to-Earth service area, or for each space-to-space relay.	X	X	X						X	
C2		**ASSIGNED FREQUENCY (FREQUENCIES)**										
C2a	1	The assigned frequency (frequencies), as defined in No. 1.148, in kHz up to 28 000 kHz inclusive, in MHz above 28 000 kHz to 10 500 MHz inclusive and in GHz above 10 500 MHz. Required for the case of Appendix 30B for notification under Article 8 only. ~~Alternatively, in the case of a space station submitted in accordance with Appendix **30**, the channel number.~~ If the basic characteristics are identical, with the exception of the assigned frequency, a list of frequency assignments may be provided.				X	X	X	X	X	X (5)	
C2a	2	Channel number							O (19)~~X~~			
C2b		The centre of the frequency band observed, in kHz up to 28 000 kHz inclusive, in MHz above 28 000 kHz to 10 500 MHz inclusive and in GHz above 10 500 MHz.										X
C3		**ASSIGNED FREQUENCY BAND**										

1		2	3	4	5	6	7	8	9	10	11	12
C3a		The bandwidth of the assigned frequency band in kHz (see No. 1.147). Required for the case of Appendix 30B for notification under Article 8 only.				X	X	X	X (28)	X	X (5)	
C3b		The bandwidth of the frequency band in kHz observed by the station.										X
C4		**CLASS OF STATION(S) AND NATURE OF SERVICE**										
C4	a	The class of station using the symbols shown in the Preface to the International Frequency List.	X	X	X	X	X	X	X	X		X
C4	b	The nature of service performed, using the symbols shown in the Preface to the International Frequency List.	X	X	X	X	X	X	X	X		X
C5		**RECEIVING SYSTEM NOISE TEMPERATURE**										
C5a		In the case of a space station, the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the space station.			X	X	X			X	X	
C5b		In the case of an earth station, the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the earth station under clear-sky conditions. This value shall be indicated for the nominal value of the angle of elevation when the associated transmitting station is onboard a geostationary satellite and, in other cases, for the minimum value of the angle of elevation.						X				
C5c		In the case of a radio astronomy station, the overall receiving system noise temperature in kelvins, referred to the output of the receiving antenna.										X
C6		**POLARIZATION**										
C6	a	The type of polarization and, if appropriate, sense of polarization of the antenna. In the case of circular polarization, indicate the direction of polarization (see Nos. 1.154 and 1.155). ~~In the case of linear polarization, indicate the angle (in degrees) measured counter-clockwise in a plane normal to the beam axis from the equatorial plane to the electric vector of the waves as seen from the satellite.~~ In the case of a space station submitted in accordance with Appendix **30** or **30A**, this indication is to be in the direction of the boresight or the aim point or as defined in ~~B.3 *g) 3),*~~ B.3 *g)* 4) and B.3 *g)* 5), respectively. For the case of an FSS earth station, not required for coordination under No. 9.7A. (34) (52)			X	X	X	X (23)	X	X		

1		2	3	4	5	6	7	8	9	10	11	12
C6	b	In the case of linear polarization, indicate the angle (in degrees) measured counter-clockwise in a plane normal to the beam axis from the equatorial plane to the electric vector of the waves as seen from the satellite. In the case of a space station submitted in accordance with Appendix **30** or **30A**, this indication is to be in the direction of the boresight or the aim point or as defined in ~~B.3 *g)* 3)~~, B.3 *g)* 4) and B.3 *g)* 5), respectively. For the case of an FSS earth station, not required for coordination under No. 9.7A. (34) (52)			X	X	X	X (23)	X	X		
C7		**CLASS OF EMISSION, NECESSARY BANDWIDTH AND DESCRIPTION OF THE TRANSMISSION**										
C7		**In accordance with Article 2 and Appendix 1:**										
C7a [C7c_1] [C7c_3] [C7d_1] [C7d_3]	1	the class of emission; and, if required for coordination only, for each carrier. Required for the case of Appendix 30B for notification under Article 8 only.			O	X	X	X	X	X	X (5)	
C7a [C7c_2] [C7d_2]	2	the necessary bandwidth; and, if required for coordination only, for each carrier. Required for the case of Appendix 30B for notification under Article 8 only.			O	X	X	X	X	X	X (5)	
C7b	1	the carrier frequency of the emission(s);			O	C	C	C				
C7b	2	the frequencies of the emission(s);			O	C	C	C				
~~**C7c**~~	~~1~~	~~for each carrier the class of emission,;~~			~~O~~	~~C~~	~~C~~	~~C~~				
~~**C7c**~~	~~2~~	~~for each carrier the necessary bandwidth;~~			~~O~~	~~C~~	~~C~~	~~C~~				
~~**C7c**~~	~~3~~	~~for each carrier the description of transmission;~~			~~O~~	~~C~~	~~C~~	~~C~~				
~~**C7d**~~	~~1~~	~~for the carrier having the smallest bandwidth of the assignments in the system, the class of emission.~~			~~O~~	~~C~~	~~C~~	~~C~~				
~~**C7d**~~	~~2~~	~~for the carrier having the smallest bandwidth of the assignments in the system, the necessary bandwidth.~~			~~O~~	~~C~~	~~C~~	~~C~~				
~~**C7d**~~	~~3~~	~~for the carrier having the smallest bandwidth of the assignments in the system, the description of the transmission.~~			~~O~~	~~C~~	~~C~~	~~C~~				
C8		**POWER CHARACTERISTICS OF THE TRANSMISSION**										

1		2	3	4	5	6	7	8	9	10	11	12
C8a	1	The maximum value of the peak envelope power (dBW) ~~and the maximum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz, or averaged over the worst 1 MHz band for carriers above 15 GHz,~~ supplied to the input of the antenna for each carrier type.			O (31) (46)	~~X~~ + (46)	~~X~~ + (46)	C (37)				
C8a	2	The maximum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz, supplied to the input of the antenna for each carrier type.			~~X~~ + (31) (46)	~~X~~ + (46)	~~X~~ + (46)	O				
C8a	3	The maximum power density (dB(W/Hz))[3] averaged over the worst 1 MHz band for carriers above 15 GHz, supplied to the input of the antenna for each carrier type.			~~X~~ + (31) (46)	~~X~~ + (46)	~~X~~ + (46)	O				
C8b [C8h 1] [C8i 1]	1	The total peak envelope power (dBW) supplied to the input of the antenna ~~and the maximum power density (dB(W/Hz))[3] supplied to the input of the an~~tenna, averaged over the worst ~~4 kHz band for carriers below 15 GHz, or averaged over the worst 1 MHz band for carriers above 15 GHz.~~ . For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O (31) (46)	~~X~~ + (46)	~~X~~ + (46)	X (23) (81)	X	X		
C8b [C8h 3] [C8i 3] [C8j 3]	2	The maximum power density (dB(W/Hz))[3] supplied to the input of the antenna, averaged over the worst 4 kHz band for carriers below 15 GHz. For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			~~X~~ + (31) (46)	~~X~~ + (46)	~~X~~ + (46)	X (23) (81)	X (54)	+	X	
C8b [C8i 2]	3	The maximum power density (dB(W/Hz))[3] supplied to the input of the antenna averaged over the worst 1 MHz band for carriers above 15 GHz. For coordination/notification of an Appendix 30A earth station the values shall include the maximum range of power control. For the case of an FSS earth station, not required for coordination under No. 9.7A.			~~X~~ + (31) (46)	~~X~~ + (46)	~~X~~ + (46)	X (23) (81)		+		
C8c	1	The minimum value of the peak envelope power (dBW) ~~and the minimum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz, or averaged over the worst 1 MHz band for carriers above 15 GHz,~~ supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				

[3] The most recent version of Recommendation ITU-R SF.675 should be used to the extent applicable in calculating the maximum power density per Hz.

1		2	3	4	5	6	7	8	9	10	11	12
C8c	2	The minimum power density (dB(W/Hz))[3], averaged over the worst 4 kHz band for carriers below 15 GHz supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8c	3	The minimum power density (dB(W/Hz))[3] averaged over the worst 1 MHz band for carriers above 15 GHz, supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8c	4	Reason for absence of the minimum value of the peak envelope power (dBW) supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8c	5	Reason for absence of the minimum power density supplied to the input of the antenna for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8d	1	For a space to earth or space to space link the maximum total peak envelope power (dBW) supplied to the input of the antenna for each contiguous satellite bandwidth ~~and this bandwidth~~. For a satellite transponder, this corresponds to the maximum saturated peak envelope power. (64)				X	X					
C8d	2	For a space to earth or space to space link each contiguous satellite bandwidth. For the maximum saturated peak envelope power of the satellite transponder, this corresponds to the bandwidth of each transponder. (64)				X	X					
C8e	1	The required carrier-to-noise ratio (dB), considering clear-sky operation, for each carrier type. For the case of an FSS earth station, not required for coordination under No. 9.7A.			O	+ (40)	+ (40)	+ (40) (23)				
C8e	2	Reason for absence of the carrier-to-noise ratio. For the case of an FSS earth station, not required for coordination under No. 9.7A. (40)				+	+	+ (23)				
C8f	1	For space to space the space station's nominal equivalent isotropically radiated power(s) on the beam axis. (35)			X							
C8f	2	For space to space the associated space station's nominal equivalent isotropically radiated power(s) on the beam axis. (35)			X							
C8g	1	The maximum aggregate power (dBW) of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna ~~and their aggregate bandwidth.If this corresponds to the bandwidth of a transponder, this shall be indicated.~~ Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				

1		2	3	4	5	6	7	8	9	10	11	12
C8g	2	The aggregate bandwidth of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna. Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				
C8g	3	The aggregate bandwidth of all carriers (per transponder, if applicable) supplied to the input of the transmitting associated earth station antenna or the transmitting earth station antenna. If this corresponds to the bandwidth of a transponder, this shall be indicated. Not required for coordination of a specific earth station under No. **9.15**, **9.17** or **9.17A**. (68)				C	C	C (44)				
~~**C8h**~~		~~**In the case of a space station submitted in accordance with Appendix 30:**~~										
C8h	~~1~~	~~the power supplied to the antenna (dBW);~~							~~X~~			
C8h	~~2~~	~~the maximum power density per Hz (dB(W/Hz)), averaged over the worst 5 MHz, supplied to the antenna~~							~~X~~ (82)			
C8h	~~3~~	~~the maximum power density per Hz (dB(W/Hz)), averaged over the worst 4 kHz supplied to the antenna~~							~~X (54)~~			
C8h [C8i_4] [C8j_1]	4	the maximum power density per Hz (dB(W/Hz)), averaged over ~~27 MHz~~the necessary bandwidth. For the case of Appendix 30A in the band 17.3-18.1 GHz only. (71)							X (74)	X	X (55)	
C8h	~~5~~	~~the maximum power density per Hz (dB(W/Hz)), averaged over the worst 40 kHz supplied to the antenna (Region 2).~~							~~X~~ (82)			
C8i		**In the case of an earth station submitted in accordance with Appendix 30A:**										
~~**C8i**~~	~~1~~	~~total transmitting power (dBW) in the assigned frequency band supplied to the input of the antenna;~~								~~X~~		
~~**C8i**~~	~~2~~	~~for the band 17.3-18.1 GHz, the maximum power density per Hz (dB(W/Hz)) supplied to the input of the antenna averaged over the worst 1 MHz band;~~								~~X~~		
~~**C8i**~~	~~3~~	~~for the band 14.5-14.8 GHz, the maximum power density per Hz (dB(W/Hz)) supplied to the input of the antenna averaged over the worst 4 kHz band;~~								~~X~~		
~~**C8i**~~	~~4~~	~~for the band 17.3-17.8 GHz, the maximum power density per Hz (dB(W/Hz)) supplied to the input of the antenna averaged over the total RF bandwidth (24 MHz for Region 2 or 27 MHz for Regions 1 and 3) (71);~~							~~+ (74)~~	~~X~~		
C8i	5	range of power control, expressed in dB, above the transmitting power indicated above (if power control is used).								X		
C8j		**In the case of a space station or an earth station submitted in accordance with Appendix 30B:**										
~~**C8j**~~	~~1~~	~~the maximum value of power density, in dB(W/Hz), averaged over the necessary bandwidth of the modulated carrier, supplied to the input of the antenna;~~									~~X (55)~~	

1		2	3	4	5	6	7	8	9	10	11	12
C8j	2	the frequency below which signals whose peak-to-average ratio is less than 5 dB will be located;									X	
~~**C8j**~~	~~3~~	~~maximum carrier power density, in dB(W/Hz), averaged over the worst 4 kHz band, supplied to the antenna input.~~									~~X~~	
C9		**INFORMATION ON MODULATION CHARACTERISTICS**										
C9a		**For each carrier, according to the nature of the signal modulating the carrier and the type of modulation:**										
C9a1	a	the lowest frequencies of the baseband; in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband~~: the lowest and highest frequencies of the baseband and the r.m.s. frequency deviation of the test tone as a function of baseband frequency~~;			O	C	C					
C9a1	b	the highest frequencies of the baseband; in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband;			O	C	C					
C9a1	c	the r.m.s. frequency deviation of the pre-emphasis characteristic for a test tone as a function of baseband frequency in the case of a carrier frequency modulated by a frequency-division multichannel telephony baseband (FDM/FM) or by a signal that can be represented by a multichannel telephony baseband;			O	C	C					
C9a2 [C9b3]	a	the standard of the television signal; in the case of a carrier frequency modulated by a television signal: ~~the standard of the television signal (~~including, where appropriate, the standard used for colour~~), the frequency deviation for the reference frequency of the pre-emphasis characteristic and the pre-emphasis characteristic itself as well as, where applicable, the characteristics of the multiplexing of the video signal with the sound signal(s) or other signals~~;			O	C	C		X	X		
C9a2 [C9b2 a]	b	the P-P frequency deviation of the pre-emphasis characteristic; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a2 [C9b2 b]	c	the pre-emphasis characteristic itself; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a2 [C9b7]	d	where applicable, the characteristics of the multiplexing of the video signal with the sound signal(s) or other signals; in the case of a carrier frequency modulated by a television signal:			O	C	C		X	X		
C9a3 [C9b9 b]	a	~~the bit rate~~ the bit rate; in the case of a carrier phase-shift modulated by a digital signal~~: the bit rate and the number of phases~~			O	C	C		X	X		

1		2	3	4	5	6	7	8	9	10	11	12
C9a3	b	the number of phases; in the case of a carrier phase-shift modulated by a digital signal:			O	C	C					
C9a4	a	in the case of an amplitude modulated carrier (including single sideband): as precisely as possible, the nature of the modulating signal; ~~the kind of amplitude modulation used~~			O	C	C					
C9a4	b	in the case of an amplitude modulated carrier (including single sideband): as precisely as possible, the kind of amplitude modulation used;			O	C	C					
C9a5		for all other types of modulation: such particulars as may be useful for an interference study.			O	C	C					
C9a6 [C9b8 a]	a	for any type of modulation, as applicable: the characteristics of energy dispersal, such as the peak-to-peak frequency deviation ~~(MHz) and the sweep frequency (kHz) of the energy dispersal waveform~~.			O	C	C		X	X		
C9a6 [C9b8 b]	b	for any type of modulation, as applicable: the characteristics of energy dispersal, such as the sweep frequency (kHz) of the energy dispersal waveform.			O	C	C		X	X		
C9a6 [C9b8 c]	c	for any type of modulation, as applicable: the energy dispersal waveform.			O	C	C		X	X		
C9b		**In the case of a space station submitted in accordance with Appendix 30 or the case of a space station submitted in accordance with Appendix 30A:**										
C9b1		type of modulation;							X	X		
~~**C9b2**~~	~~a~~	~~P-P frequency deviation of the pre-emphasis characteristics;~~							~~X~~	~~X~~		
~~**C9b2**~~	~~b~~	~~Pre-emphasis characteristic;~~							~~X~~	~~X~~		
~~**C9b3**~~		~~TV standard;~~							~~X~~	~~X~~		
C9b4		sound-broadcasting characteristics;							X	X		
C9b5		frequency deviation;							X	X		
C9b6		composition of the baseband;							X	X		
~~**C9b7**~~		~~type of multiplexing of the video and sound signals;~~							~~X~~	~~X~~		
~~**C9b8**~~	~~a~~	~~peak-to-peak frequency deviation of the energy dispersal waveform.~~							~~X~~	~~X~~		
~~**C9b8**~~	~~b~~	~~Sweep frequency of energy dispersal waveform.~~							~~X~~	~~X~~		
~~**C9b8**~~	~~c~~	~~Energy dispersal waveform.~~							~~X~~	~~X~~		
C9b9	a	~~the effective bit rate;~~ the effective bit rate; in the case of a carrier phase-shift modulated by a digital signal: ~~the effective bit rate, the transmitted the bit rate (Mbits/s) and the symbol rate;~~							X	X		
~~**C9b9**~~	~~b~~	~~the transmitted bit rate; in the case of a carrier phase-shift modulated by a digital signal:~~							~~X~~	~~X~~		
C9b9	c	the symbol rate; in the case of a carrier phase-shift modulated by a digital signal:							X	X		

1		2	3	4	5	6	7	8	9	10	11	12
C9b10		roll-off factor of the filter of the receiver.							X	X		
C9c	1	the type of modulation ~~I~~in the case of a non-geostationary space station submitted in accordance with No. 9.11A: ~~the type of modulation and multiple access, and spectrum mask~~			(32)		X					
C9c	2	the type of multiple access. In the case of a non-geostationary space station submitted in accordance with No. 9.11A,			(32)		X					
C9c	3	the spectrum mask. In the case of a non-geostationary space station submitted in accordance with No. 9.11A.			(32)		X					
C9d		**For stations operating in a frequency band subject to Nos. 22.5C, 22.5D or 22.5F, provide:**										
C9d	1	the type of mask;			(58)		X		(56)	(56)		
C9d	2	the pfd mask identification code.			(58)		X		(56)	(56)		
C9d	3	the space station's e.i.r.p. mask identification code.			(58)		X		(56)	(56)		
C9d	4	the associated earth station's e.i.r.p. mask identification code.			(58)		X		(56)	(56)		
C10		**TYPE AND IDENTITY OF THE ASSOCIATED STATION(S)**										
C10		**The associated station may be another space station, a typical earth station of the network or a specific earth station.**										
C10a		For an associated space station, its identity.			X	X	X					
Not in App. 4		If an associated space station is in the geostationary orbit provide its nominal longitude (41)			X	X	X					
Not in App. 4		For an associated earth station, the name by which the station is known.			X	X	X			X		
Not in App. 4		Typical/Specific indicator (42)			X	X	X			X		
C10b	1	For a specific associated earth station, the identity of the earth station (i.e. site name) ~~and the geographical coordinates of the antenna site~~.			X	X	X			X		
C10b	2	For a specific associated earth station, the geographical coordinates of the antenna site.			X	X	X			X		
Not in App. 4		For a specific associated earth station the country or geographical area in which the associated earth station is located, using the symbols from the Preface to the International Frequency List; (83)			X	X	X			X		
C10c		**For an associated earth station (whether specific or typical):**										
C10c1	a	the class of station ~~and the nature of service performed,~~ using the symbols shown in the Preface to the International Frequency List;			X	X	X			~~X~~ (57)	~~X~~ (57)	
C10c1	b	the nature of service performed, using the symbols shown in the Preface to the International Frequency List;			X	X	X			~~X~~ (57)	~~X~~ (57)	
C10c2		the isotropic gain (dBi) of the antenna in the direction of maximum radiation (see No. 1.160);			X	X	X		X (28)	X	X	

1		2	3	4	5	6	7	8	9	10	11	12
C10c3		the beamwidth in degrees between the half power points (describe in detail if not symmetrical);			O	X	X		X(28)	X	X	
C10c4	a	either the measured co-polar radiation pattern of the antenna or the reference radiation pattern;			X	X	X		X (28)	X	X	
C10c4	b	either the measured cross-polar radiation pattern of the antenna or the reference radiation pattern;							X (28)	X		
C10c5		the lowest total receiving system noise temperature, in kelvins, referred to the output of the receiving antenna of the earth station under clear-sky conditions, when the associated station is a receiving earth station;			X	X	X				X	
C10c6		the antenna diameter (metres).								X		
Not in App. 4		Equivalent Antenna Diameter							X (28)			
C11		**SERVICE AREA**										
C11a [C11b] [C11c_2]	1	The service area or areas of the satellite beam on the Earth, when the associated transmitting ~~or receiving~~stations are earth stations. In the case of a space station submitted in accordance with Appendix 30A or 30B, the feeder-link service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or defined by a minimum elevation angle. For advance publication of satellite networks subject to coordination, only the list of country or geographic designators or a narrative description of the service area shall be supplied.	X (49)	X (49)	X	X	X			X	X	
C11a [C11c_1]	2	The service area or areas of the satellite beam on the Earth, when the associated receiving stations are earth stations. In the case of a space station submitted in accordance with Appendix 30 or Appendix 30B, the service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or a service area defined by a minimum elevation angle (Rev.WRC-97). For advance publication of satellite networks subject to coordination, only the list of country or geographic designators or a narrative description of the service area shall be supplied.	X (49)	X (49)	X	X	X		X		X	
~~**C11b**~~		~~The feeder-link service area identified by a set of a maximum of~~ twenty feeder-link test points, ~~and by a service area contour on the surface of the Earth or defined by a minimum elevation angle. (Rev.WRC-97)~~								~~X~~		
~~**C11c**~~	~~1~~	~~In the case of a space station submitted in accordance with Appendix 30 or Appendix 30B, the service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or a service area defined by a minimum elevation angle (Rev.WRC-97).~~							~~X~~		~~X~~	

1		2	3	4	5	6	7	8	9	10	11	12
~~**C11c**~~	~~2~~	~~In the case of a space station submitted in accordance with Appendix 30B, the feeder link service area identified by a set of a maximum of twenty test points and by a service area contour on the surface of the Earth or defined by a minimum elevation angle.~~									~~X~~	
C11d		In the case of a non-geostationary space station submitted in accordance with No. 9.11A, appropriate information required to calculate the affected region due to the MSS space stations (as defined in Recommendation ITU-R M.1187).					X					
C12		**REQUIRED PROTECTION RATIO**										
C12		The minimum acceptable aggregate carrier-to-interference ratio, if less than 26 dB. The carrier-to-interference ratio is to be expressed in terms of the power averaged over the necessary bandwidth of the modulated wanted and interfering signals, assuming both the desired carrier and interfering signals have equivalent bandwidths and modulation types.									X	
C13		**CLASS OF OBSERVATIONS**										
C13		The class of observations to be taken on the frequency band shown in item C.3 b). Class A observations are those in which the sensitivity of the equipment is not a primary factor. Class B observations are those of such a nature that they can be made only with advanced low-noise receivers using the best techniques.										X
C15		**DESCRIPTION OF THE GROUP(S) REQUIRED IN THE CASE OF NON-SIMULTANEOUS EMISSIONS**										
C15		If an exclusive operation group its identification code							X	X		

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary-satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
D		**OVERALL LINK CHARACTERISTICS**										
		To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite. In the case of fixed-satellite service networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§§ 1), 2) and 3) of the frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau.										
D1		**CONNECTION BETWEEN EARTH-TO-SPACE AND SPACE-TO-EARTH FREQUENCIES IN THE NETWORK**										
		To be provided only when simple frequency-changing transponders are used on the space station onboard a geostationary satellite. In the case of fixed-satellite service networks using the frequency bands specified in No. **9.7** (GSO/GSO) of Table 5-1 of Appendix **5**, (§§ 1), 2) and 3) of the frequency band column), the data specified in this section of the Appendix is not mandatory and should not be submitted to the Bureau.										
D1		The connection between uplink and downlink frequency assignments in each transponder for each intended combination of receiving and transmitting beams. Required for the case of Appendices 30 and 30A in Region 2.				X			X (28)	X (28)		
D2		**TRANSMISSION GAINS AND ASSOCIATED EQUIVALENT SATELLITE LINK NOISE TEMPERATURES**										
D2		**For each entry under D.1:**										

1		2	3	4	5	6	7	8	9	10	11	12
D2a	1	The lowest equivalent satellite link noise temperature ~~and the associated transmission gain~~. These values shall be indicated for the nominal value of the angle of elevation. ~~The transmission gain is evaluated from the output of the receiving antenna of the space station to the output of the receiving antenna of the earth station.~~				X						
D2a	2	The associated transmission gain of the lowest equivalent satellite link noise temperature. These values shall be indicated for the nominal value of the angle of elevation. The transmission gain is evaluated from the output of the receiving antenna of the space station to the output of the receiving antenna of the earth station.				X						
D2b	1	The values of transmission gain ~~and associated equivalent satellite link noise temperature~~ that correspond to the highest ratio of transmission gain to equivalent satellite link noise temperature.				X						
D2b	2	The values of associated equivalent satellite link noise temperature that corresponds to the highest ratio of transmission gain to equivalent satellite link noise temperature.				X						

Table Notes

Explanation of changes to Annexes 2A and 2B to RR Appendix 4

(1) Not used.

(2) Not used.

(3) Explanation: currently combined with the earth station antenna's name which can apply to both specific and typical antenna and shown in RR Appendix 4 as mandatory: the name of the locality only applies to a specific earth station.

(4) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is supplied with the notifying administration's name.

(5) Addition: currently not listed in RR Appendix 4: this data item is required for notification under Article 8 of RR Appendix 30 B - see BR Circular Letter CR/158c1.

(6) Addition: currently not listed in RR Appendix 4: the notifying administration's correspondence address is required for the special section relating to the advance publication.

(7) Addition: currently not listed in RR Appendix 4: this data item is required for RR Appendix 30B - see BR Circular Letter CR/158.

(8) Modification: currently shown as mandatory in RR Appendix 4: at WRC-97 the requirement for this data item was changed to optional.

(9) Addition: currently not listed in RR Appendix 4: this data item is required for RR Appendix 30B when the satellite network is not derived from the Allotment Plan - see BR Circular Letter CR/158.

(10) Comment: currently shown as mandatory in RR Appendix 4: this data item listed under A.4.b.1 is duplicated for non-geostationary satellites subject to No. 9.11A to the RR as the identical data is recorded under A4b5.

(11) Comment: currently shown as mandatory in RR Appendix 4: this data item is not necessary for non-geostationary satellites subject to No. 9.11A as more detailed data supplied under A4b5 makes it superfluous.

(12) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is used in non-geostationary satellite network filings for identifying the reference body on which the orbit characteristics are based.

(13) Not used.

(14) Addition: currently not listed in RR Appendix 4 for advance publication: this data item is required on the notice forms, including for non-geostationary networks not subject to coordination under Section II of Article 9 as they may operate in one or more orbital planes.

(15) Comment: currently not listed in RR Appendix 4 for notification of non-geostationary networks not subject to coordination under Section II of Article 9: the requirement for this data item is based on Note (14) and would then be required for confirmation of any changes from the advance publication stage.

(16) Not used.

(17) Deletion: the requirement for this data item was deleted at WRC-2000: - see BR Circular Letter CR/158c1.

(18) Not used.

(19) Modification: currently shown as mandatory in RR Appendix 4: the assigned frequency is the mandatory requirement and the channel number is only optional.

(20) Deletion: the requirement for this data item was deleted at WRC-97: - see BR Circular Letter CR/158.

(21) Modification: the requirement for cross-polar gain does not apply to Appendix 30B and the RR Appendix 4 footnote quoted in table note (69) should also apply to Ap. 4 data item B3g1 - see BR Circular Letter CR/158.

(22) Deletion: currently listed as mandatory in RR Appendix 4: the regulatory provision does not apply to non-geostationary space stations.

(23) Modification: currently listed in RR Appendix 4 with the footnote "Not required for coordination under No. 9.7A or 9.7B"; however, 9.7B applies to non-geostationary satellite systems and not to earth stations hence the footnote should read, "Not required for coordination under No. 9.7A".

(24) Deletion: currently listed as mandatory in RR Appendix 4: the regulatory provision only applies to the space station and is therefore not required for notification of earth stations.

(25) Not used.

(26) Addition: currently not listed in RR Appendix 4: this data item is required for Appendix 30B if part of a sub-regional system - see BR Circular Letter CR/158.

(27) Comment: this data item is requested to be included within the plots of antenna contours.

(28) Addition: currently not listed in RR Appendix 4: the requirement for this data item was added at WRC-97 - see BR Circular Letter CR/158.

(29) Not used.

(30) Explanation: alignment with RR Appendices 30 and 30A - see BR Circular Letter CR/158.

(31) Explanation: currently listed in RR Appendix 4 with the footnote "Only the value of maximum power density is mandatory".

(32) Deletion: currently listed in RR Appendix 4 as mandatory: this data item was inadvertently added at WRC-97 and the information to which it refers is only applicable to non-geostationary satellites subject to coordination under Section II of Article 9. The RRB have issued a Rule of Procedure that states "the Bureau, in the completeness examination of the submitted data, will disregard the requirement for the characteristics B.4.b and C.9.c in the case of the advance publication of those non-GSO satellite systems which are not subject to the coordination procedures of Section II of Article 9". Therefore it is proposed that this data should be deleted from RR Appendix 4.

(33) Not used.

(34) Comment: in Appendix 30/30A circular polarization is defined as viewed in the direction of propagation. In RR Appendix 4 Circular Polarization is defined as viewed from the satellite. In the Preface to the IFL, both circular polarization and linear polarization are quoted as viewed in the direction of propagation. This is likely to cause confusion with the possible swapping of co/cross polarization during the notification process.

(35) Explanation: currently listed in RR Appendix 4 with the footnote "For space-to-space relay only": this text is now included in the description.

(36) Modification: currently listed as mandatory in RR Appendix 4: this data item is only required for sub-regional systems.

(37) Modification: currently shown as required for coordination in RR Appendix 4 with a footnote that states "only the total peak envelope power is required for coordination under Nos. 9.15, 9.17 and 9.17A": this statement is incorrect and should refer to the maximum peak envelope power.

(38) Modification: currently listed as mandatory in RR Appendix 4: this data item is only required in specific cases (e.g. when communicating with geostationary space stations).

(39) Not used.

(40) Explanation: currently listed in RR Appendix 4 with the footnote "Required, if applicable, for the type of transmission. If not applicable, a reason why it is not applicable is required": this text is now separately listed under the respective data item.

(41) Addition: currently not listed in RR Appendix 4: this data item is required if the associated space station is in the geostationary orbit.

(42) Addition: currently not listed in RR Appendix 4: this data item is included to identify if the associated earth station is typical or specific.

(43) Modification: currently shown as mandatory in RR Appendix 4: this regulatory provision and Resolution 33 only apply to the Broadcasting-Satellite Service, where it is not subject to a plan.

(44) RR Appendix 4, footnote: "Not required for coordination under Nos. **9.15**, **9.17** or **9.17A**."

(45) Not used.

(46) RR Appendix 4, footnote: "One or the other of C.8.a or C.8.b is mandatory, but not both."

(47) Not used.

(48) Not used.

(49) RR Appendix 4, footnote: "Only the list of country or geographic designators or a narrative description of the service area shall be supplied."

(50) Deletion: currently listed as mandatory in RR Appendix 4: the Radiocommunication Bureau propose to align this data with the Appendix 30A data requirements listed in A1c - see BR Circular Letter CR/158.

(51) Addition: currently not listed in RR Appendix 4: the Radiocommunication Bureau propose to align with Appendix 30A data requirements listed in A1c - see BR Circular Letter CR/158.

(52) Deletion: currently listed with circular beams in RR Appendix 4: the Radiocommunication Bureau propose to align with non-plan services where circular beams are recognized as special form of elliptical beam - see BR Circular Letter CR/158.

(53) RR Appendix 4, footnote: "In the case of coordination under No. 9.7A, the reference radiation pattern is to be provided".

(54) Addition: currently not listed in RR Appendix 4 - deleted at WRC-2000: the Radiocommunication Bureau state this data item is still required for checking the pfd limits of Section 4 Annex 1 to RR Appendix 30 - see BR Circular Letter CR/158.

(55) Explanation: this value will be used for calculation of the C and D parameters in the case of a transmitting space station or the A and B parameters in the case of a transmitting earth station, under RR Appendix 30B, Annex 1, Section B - see BR Circular Letter CR/158.

(56) Deletion: currently listed as mandatory in the Final Acts WRC-2000: this data item only applies to non-geostationary systems and is not applicable to the BSS Plan - see BR Circular Letter CR/158.

(57) Deletion: currently listed as mandatory in RR Appendix 4: the Radiocommunication Bureau propose to align with data requirements of RR Appendices 30/30A/30B - see BR Circular Letter CR/158.

(58) Deletion: currently listed as mandatory in RR Appendix 4: this data item only applies to non-geostationary systems subject to No. 9.11A and is not applicable to non-geostationary systems not subject to Section II of Article 9 - see BR Circular Letter CR/158.

(59) Modification: currently listed in RR Appendix 4 with the following footnote "Not required for coordination under No. 9.7A or 9.7B"; this statement is incorrect as the country symbol of the notifying administration is always mandatory.

(60) Modification: In the Final Acts to WRC-2000, RR Appendix 4 references in Item A17a provision No. 5.444C, this reference is incorrect and should, instead, refer to No. 5.443B "*Additional allocation:* The band 5 010-5 030 MHz is also allocated to the radionavigation-satellite service (space-to-Earth) (space-to-space) on a primary basis. In order not to cause harmful interference to the microwave landing system operating above 5 030 MHz, the aggregate power flux-density produced at the Earth's surface in the band 5 030-5 150 MHz by all the space stations within any radionavigation-satellite service system (space-to-Earth) operating in the band 5 010-5 030 MHz shall not exceed –124.5 dB (W/m^2) in a 150 kHz band. In order not to cause harmful interference to the radio astronomy service in the band 4 990-5 000 MHz, the aggregate power flux-density produced in the 4 990-5 000 MHz band by all the space stations within any radionavigation-satellite service (space-to-Earth) system operating in the 5 010-5 030 MHz band shall not exceed the provisional value of –171 dB (W/m^2) in a 10 MHz band at any radio astronomy observatory site for more than 2% of the time. For the use of this band, Resolution **604 (WRC-2000)** applies."

(61) Addition: Neither No. 5.443B nor Resolution **604 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits apply to out-of-band emissions it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this

data item has been added to the requirements for RNSS geostationary space networks - see BR Circular Letter CR/171.

(62) Addition: Neither No. 5.551G nor Resolution **128 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits apply to out-of-band emissions it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this data item has been added to the requirements for FSS and BSS geostationary space networks - see BR Circular Letter CR/171.

(63) Addition: Neither No. 5.328A nor Resolution **605 (WRC-2000)** limit the application of this data item to non-geostationary space networks and as the pfd limits are aggregated across all space stations it is not possible for potentially affected administrations to calculate the aggregate pfd value hence, this data item has been added to the requirements for RNSS geostationary space networks.

(64) Explanation: currently listed in RR Appendix 4 with the footnote "For transmission from the space station only": the text has been added to the description.

(65) Deletion: there appears to be no requirement for this data item to be associated with this type of mask.

(66) Not used.

(67) Not used.

(68) Explanation: currently listed in RR Appendix 4 with the footnote "For transmission from the earth station only": the text has been added to the description.

(69) Explanation: currently listed in RR Appendix 4 with the footnote "Only information on co-polar antenna characteristics is required".

(70) Deletion: currently listed in RR Appendix 4 as mandatory: this data item used to be listed as B3g6 which only applied to Appendix 30A; at WRC-2000 it was merged into B3g5 which applies to both RR Appendix 30 and 30A however the requirement for this data item is still limited to Appendix 30A.

(71) Modification: currently listed with the RF bandwidth shown as (24 MHz For Region 2 or 27 MHz for Regions 1 and 3): however the bandwidth may not conform to these specified limits and the power density averaged over the total bandwidth is required.

(72) RR Appendix 4, footnote: "required for networks operating in the bands defined in Nos. **22.5C**, **22.5D** or **22.5F**".

(73) Modification: currently listed as mandatory in RR Appendix 4: the regulatory provision only applies to FSS earth stations operating in frequency bands in the Appendix 30A Plan.

(74) Addition: noting Table Note 71 and the introduction of strapping for Region 2 this data item may also be required for RR Appendix 30 in Region 2.

(75) Modification: Plan modification, coordination and notification for FSS systems under RR Appendix 30B are all performed using the data requirements under column 11 "Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8)" - see BR Circular Letter CR/158c1.

(76) Modification: notification of an earth station operating in the BSS feeder-link plan or the FSS plan is performed using the data requirements under column 8 headed "Notification or coordination of an earth station (including notification under Appendices 30A and 30B)" - see BR Circular Letter CR/158c1.

(77) Modification: Plan modification, coordination and notification for BSS systems under RR Appendix 30 are all performed using the data requirements under column 9 headed "Notice for a satellite network in the broadcasting satellite service under Appendix 30" - see BR Circular Letter CR/158c1.

(78) Modification: Plan modification, coordination and notification for BSS feeder links under RR Appendix 30A are all performed using the data requirements under column 10 headed "Notice for a satellite network (feeder-link) under Appendix 30A" - see BR Circular Letter CR/158c1.

(79) Not used.

(80) Modification: noting Table Note 75, the information only relates to sub-regional systems and is now required under column 11 headed "Notice for a satellite network in the FSS under Appendix 30B (Articles 6 and 8)".

(81) Modification: for earth stations under the BSS Appendix 30A Plan these values shall include the maximum range of power control - see BR Circular Letter CR/158c1.

(82) Deletion: discussions with the BR indicate that the maximum power density over the worst 5 MHz, and the maximum power density over the worst 40 kHz are no longer required.

(83) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms.

(84) Addition: currently not listed in RR Appendix 4: this data item is required following revision of the Radio Regulations.

Existing RR Footnotes

The footnotes to Annex 2B to Appendix 4 are shown below. Following the changes to the table and its contents these footnotes are no longer required as indicated by the text in italic font. The figure in parenthesis identifies the relevant table note.

1 Only the value of maximum power density is mandatory.
The separation of the compound data elements in C8a and C8b into individual components allows the footnote to be deleted. (31)

2 For transmission from the space station only.
The text has been added to the description so the footnote could be deleted. (64)

3 For space-to-space relay only.
The text has been added to the description so the footnote could be deleted. (35)

4 For transmission from the earth station only.
The text has been added to the description so the footnote could be deleted. (68)

5 Not required for coordination under Nos. **9.15**, **9.17** or **9.17A**.
The text has been added to the description so the footnote could be deleted. (44)

6 Required, if applicable, for the type of transmission. If not applicable, a reason why it is not applicable is required.
The text of the footnote has been added to the table as a separate data element under C8c and C8e and so the footnote could be deleted. (40)

7 One or the other of C.8.a or C.8.b is mandatory, but not both.
The mandatory indicatory associated with these data elements has been changed to "+" which represents "mandatory under specified conditions" and so the footnote could be deleted. (46)

8 Only the value of total peak envelope power is required for coordination under Nos. **9.15**, **9.17** or **9.17A**.
The meaning of this text needs to be confirmed and then the description of the data could be modified so the footnote could be deleted. (37)

9 Only information on co-polar antenna characteristics is required.
The separation of the compound data elements into individual components allows the footnote to be deleted. (69)

10 Only the list of country or geographic designators or a narrative description of the service area shall be supplied.
The text has been added to the description so the footnote could be deleted. (49)

11 Not required for coordination under No. **9.7A** or **9.7B**.
The text has been added to the description so the footnote could be deleted. (23)

12 In the case of coordination under No. **9.7A**, the reference radiation pattern is to be provided.
The text has been added to the description so the footnote could be deleted. (53)

13 Required for networks operating in the bands defined in Nos. **22.5C**, **22.5D** or **22.5F**.
The text has been added to the description so the footnote could be deleted. (72)

Annex 3.4.1-4

Example of a revised structure for non-geostationary orbit parameters in Appendix 4

Characteristics to be submitted for stations in the space and radio astronomy services

1		2	3	4	5	6	7	8	9	10	11	12
Items in Appendix	**Extra code field**	**Data Description**	**Advance publication of a geostationary-satellite network**	**Advance publication of a non-geostationary-satellite network subject to coordination under Section II of Article 9**	**Advance publication of a non-geostationary-satellite network not subject to coordination under Section II of Article 9**	**Notification or coordination of a geostationary - satellite network (75)**	**Notification or coordination of a non-geostationary-satellite network**	**Notification or coordination of an earth station (including notification under Appendices 30A and 30B) (76)**	**Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (77)**	**Notice for a satellite network (feeder-link) under Appendix 30A (78)**	**Notice for a satellite network in the fixed satellite service under Appendix 30B (Articles 6 and 8) (75)**	**Radio astronomy**
A4b		**For the case of space station(s) onboard non-geostationary satellite(s):**										
A4b – bis [A4b5 a]		number of orbital planes;		X (14)	X (14)		X (15)					
A4b – ter [A4b5 b]		number of satellites in each orbital plane;		X	X		X					
A4b1 [A4b5 d]		the angle of inclination of ~~the~~ each orbital plane;		X	X		X					
		In addition for advance publication of non-geostationary satellite(s) and notification of stations not subject to coordination under Section II of Article 9.										
A4b2		the period;		X	X		X (11)					
A4b3	a	the altitude in kilometres of the apogee ~~and perigee~~ of the space station(s);		X	X		X (11)					
A4b3	b	the altitude in kilometres of the perigee of the space station(s);		X	X		X (11)					
~~**A4b4**~~		~~the number of satellites used.~~		~~X~~	~~X~~		~~X~~					
Not in Ap. 4		Reference body code (12)		X	X		X					

1		2	3	4	5	6	7	8	9	10	11	12
A4b5		**In addition, if the stations operate in a frequency band subject to the provisions of No. 9.11A: ~~new~~ data elements required to characterize properly the orbital statistics of non-GSO satellite systems:**										
~~A4b5 N_p~~	~~a~~	~~number of orbital planes;~~					~~X (15)~~					
~~A4b5 N_s~~	~~b~~	~~number of satellites in each orbital plane;~~					~~X~~					
A4b5 Ω_j	c	right ascension of the ascending node for the j-th orbital plane, measured counter-clockwise in the equatorial plane from the direction of the vernal equinox to the point where the satellite makes its South-to-North crossing of the equatorial plane ($0° \le \Omega_j < 360°$);					X					
~~A4b5 i_j~~	~~d~~	~~inclination angle for the j-th orbital plane with respect to the reference plane, which is taken to be the Earth's equatorial plane ($0° \le i_j < 180°$);~~					~~X~~					
A4b5 ω_i	e	initial phase angle of the i-th satellite in its orbital plane at reference time t = 0, measured from the point of the ascending node ($0° \le \omega_i < 360°$);					X					
A4b5 α	f	semi-major axis;					X					
A4b5 e	g	eccentricity ($0 \le e < 1$);					X					
A4b5 ω_p	h	argument of perigee, measured in the orbital plane, in the direction of motion, from the ascending node to the perigee ($0° \le \omega_p < 360°$).					X					
X - Mandatory; + Mandatory under specified conditions; O - Optional; C - Mandatory if used as a basis to effect coordination with another administration												

See Annex 2 for a description of the table structure and presentation.

Table Notes

Explanation of changes to Annexes 2A and 2B to RR Appendix 4

(11) Comment: currently shown as mandatory in RR Appendix 4: this data item is not necessary for non-geostationary satellites subject to No. 9.11A as more detailed data supplied under A4b5 makes it superfluous.

(12) Addition: currently not listed in RR Appendix 4: this data item is required on the notice forms and is used in non-geostationary satellite network filings for identifying the reference body on which the orbit characteristics are based.

(13) Not used.

(14) Addition: currently not listed in RR Appendix 4 for advance publication: this data item is required on the notice forms, including for non-geostationary networks not subject to coordination under Section II of Article 9 as they may operate in one or more orbital planes.

(15) Comment: currently not listed in RR Appendix 4 for notification of non-geostationary networks not subject to coordination under Section II of Article 9: the requirement for this data item is based on Note (14) and would then be required for confirmation of any changes from the advance publication stage.

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3.4.2 Automation of examination of space filings for compliance with RR Article 5

3.4.2.1 Summary of technical and operational studies

The ITU-R has examined automation of the regulatory examination for checking compliance with the RR Table of Frequency Allocations and the footnotes thereto.

3.4.2.2 Analysis of the results of studies

Contributions from administrations and Sector Members, as well as information provided by the Bureau, have provided sufficient material for the development of a draft Recommendation. This Recommendation contains the specification for automating the examination for compliance with the provisions of RR Article 5. These examinations are carried out by the Bureau in its processing of satellite network coordination requests and notifications, as well as by administrations in their preparation of space filings. The ITU-R work does not address specifications for automating those functions that are already implemented by existing BR software modules.

3.4.2.3 Regulatory and procedural considerations

The efforts to specify an automation of Article 5 examination do not seek to modify the Radio Regulations, but simply to automate existing manual processes. There is, therefore, no need for WRC-03 to introduce any new regulations in this regard. However, the specification contained in the draft Recommendation, and the related databases, may require systematic review and possible updating to reflect changes to Article 5 of the Radio Regulations based on Conference decisions.

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3.4.3 FSS earth stations deployed in large numbers

3.4.3.1 Summary of technical and operational studies

The purpose of studies is to address the regulatory situation of the FSS systems deploying large numbers of earth stations in respect of terrestrial services or earth stations operating in the opposite

direction of transmission, which may involve the use of typical earth stations as opposed to specific earth stations.

3.4.3.2 Analysis of the results of studies

3.4.3.2.1 Coordination between satellite networks in co-directional frequency bands

In the framework of the coordination between satellite networks (e.g. under No. **9.7**), administrations may send notices to the Bureau relating to typical earth stations located anywhere within the service area of the satellite network. Successful coordination of the satellite network and its subsequent notification and recording in the Master Register will in this case result in the protection of these earth stations from interference caused by other satellite networks operating in the same direction of transmission. As a consequence, the protection of typical earth stations, with respect to satellite networks in co-directional frequency bands, is by the satellite network coordination, notification and recording.

3.4.3.2.2 Coordination and notification of typical FSS earth stations with respect to terrestrial services

Under the present regulatory provisions, where coordination is required, the coordination of FSS typical earth stations is generally not permitted (Nos. **9.17**, **9.17A**), and whilst this coordination can be conducted with FSS typical earth stations in some cases (No. **9.15**), the notification and recording of such FSS typical earth stations is in any case precluded by Article **11**.

3.4.3.2.3 Coordination and notification of typical MSS earth stations

Mobile earth stations are by nature typical and therefore their regulatory situation may be of interest for the development of possible provisions for typical FSS earth stations. With respect to terrestrial services, MSS earth stations may be coordinated, notified and recorded as typical earth stations. This is possible at the notification stage (Article **11**), because No. **11.17** exempts mobile earth stations from the need to be notified on the basis of specific notices, which is understood as allowing notification of typical mobile earth stations.

In respect of earth stations operating in the opposite direction of transmission, No. **9.17A** precludes the coordination of typical MSS earth stations.

3.4.3.2.4 Conclusion of the analysis

Because the status of assignment to earth stations in respect of terrestrial stations or earth stations operating in the opposite direction of transmission is derived from the application of the relevant coordination procedure (No. **8.3**), the conclusion is that, under the current regulatory provisions, where coordination among earth stations and terrestrial stations is required (i.e. Appendix 5, Table 5-1 is triggered):

- receiving FSS earth stations may not be ensured to be protected from harmful interference from terrestrial stations or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- transmitting FSS earth stations will have to take steps to eliminate harmful interference caused to existing and future terrestrial or earth stations operating in the opposite direction of transmission unless coordination, notification and recording are conducted for specific earth stations;
- the coordination, notification and recording of typical mobile earth stations is currently possible in frequency bands shared on an equal basis between the MSS and terrestrial services;

- with respect to terrestrial networks or earth stations operating in the opposite direction of transmission, protection may be achieved, in the absence of any applicable provisions in the Radio Regulations, through bilateral agreements between the administrations using typical earth stations as a basis.

Should a large number of FSS earth stations be deployed, their coordination, notification and recording as specific earth stations (i.e. on a site-by-site basis for all earth stations) may result in a rather long process.

3.4.3.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

No change to the Radio Regulations.

Advantage:

This method would keep the current relation of sharing between FSS and terrestrial services, allowing to take due account of the actual and expected (within the next 3 years) terrestrial deployment and of the geographical situation.

Disadvantage:

Applying the procedure for specific earth stations to a large number of FSS earth stations may be a long process.

Other considerations:

It was noted, that the interfering situation between typical earth stations and mobile service deployment is not entirely different, than the interference situation between the mobile networks of the two administrations. This later situation is, however, currently handled on a bilateral basis, outside the scope of the RR.

The existing Radio Regulations **9.17**, **9.17A**, and **9.18** call for the coordination of specific stations in the FSS and FS for bands allocated above 100 MHz with equal rights to these services. Both of these services are implementing large numbers of stations in certain frequency bands and the current requirement to coordinate specific stations for these services is likely to result in a rather long process. An option in the Radio Regulations permitting, subject to the agreement of concerned administrations, the coordination of typical stations as an alternative to specific site coordination of every station for these services could help to reduce the potentially long process associated with site-by-site coordination in these cases. Possible solutions to this situation were discussed within ITU-R.

Under one concept presented, countries that are adjacent to each other and in the service area of a particular satellite network could conduct coordination on the basis of typical earth stations or typical stations when they are implementing high-density applications of the FSS and/or FS in certain specific allocations. The possibility of permitting such coordination would be introduced in Article 9 (**9.17**, **9.17A** and **9.18**) and would be conditioned upon the explicit agreement of the administrations involved. Further, under this concept, upon completion of a coordination agreement, countries involved in such coordinations would send notices to BR for annotating the satellite network notification with which the satellite earth terminals would operate, and changes would be made to Article 11 to allow the Radiocommunication Bureau to accept the notification of these agreements. Such notifications would be the responsibility of the administration on whose territory the terminals are located and which were involved in the coordination.

As related to the concept of coordination of typical stations, an alternative concept that was suggested was to consider modifying provision **9.50.1** to allow, based upon the agreement between

the concerned administrations, coordination to be done on a typical basis for the FSS and FS in those cases where an administration is deploying many stations that would need to be coordinated. This would be analogous to the case in **9.50.1** where, in the absence of specific provisions in the Regulations relating to the evaluation of interference, the methods and criteria to be used can be agreed between the administrations concerned. As a second alternative concept in this area, it was suggested that some changes to Appendix 5 may allow the flexibility sought in coordinating large numbers of typical stations over a given geographical area.

During the course of discussion on this topic, it was pointed out that the notification of typical stations in relation to terrestrial stations and earth stations operating in the opposite direction of transmission could create a number of other complexities within the Radio Regulations. Given the need to resolve this situation, administrations are encouraged to consider the details of any solutions and submit relevant proposals to WRC-03.

Method B

Modifications of the Radio Regulations to provide for typical FSS earth stations a regulation similar to typical mobile earth stations. On this basis, the coordination area around these types of earth stations could be determined by a new methodology, which would be incorporated into Appendix 7.

Advantage:

This would address the need to provide protection to FSS earth stations deployed in large numbers, or to terrestrial stations as appropriate, and avoid the situation where such stations would have to be coordinated and/or notified as specific earth stations or operate on a "non-interference" or "non-protected" basis.

Disadvantages:

- This change in the provisions of the Radio Regulations would modify the current regulatory situation of band sharing between services in Article 5 of the Radio Regulations in favour of one service and may need reciprocal change for the other services so as to ensure a balanced situation.
- After an administration has coordinated, notified and recorded typical FSS earth stations, coordination of a specific terrestrial station or earth station operating in the opposite direction of transmission by a neighbouring administration is likely to be difficult. This could impose significant restriction for this administration in its terrestrial deployment, in particular with regard to mobile networks, whose stations use omni-directional antennas.
- This method is based on the provisions applicable to MSS earth stations, however, it should be noted that most uplink MSS bands are shared with terrestrial services only to a very limited extent because coordination between MSS earth stations and terrestrial services is difficult in practice.

Other considerations:

It was noted, that the interfering situation between typical earth stations and mobile service deployment is not entirely different, and may not be more constraining to the mobile service than the interference situation between the mobile networks of the two administrations. This later situation is, however, currently handled on a bilateral basis, outside the scope of the RR.

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3.4.4 BSS frequency bands not subject to Appendix 30

3.4.4.1 Summary of technical and operational studies

Protection of unplanned receive BSS earth stations against interference caused by terrestrial or FSS transmit earth stations operating in the opposite direction of transmission is ensured by No. **9.19** and its associated method for determining the need for a coordination (i.e. pfd limit at the edge of the BSS service area). The purpose of this study is to clarify the possibility of applying No. **9.19** to BSS receive earth stations other than on a case by case basis (i.e. using specific BSS earth stations) on BSS frequency bands not subject to Appendix **30**.

3.4.4.2 Analysis of the results of studies

The only coordination procedure where typical earth stations may be taken into account is No. **9.19**. However, No. **9.19** can only be applied to protect BSS earth stations if the symmetrical coordination procedure has been started to start establishing the rights of the BSS earth station for protection against terrestrial stations, i.e. if No. **9.17** has been started. Since No. **9.17** only refers to specific earth stations, this means No. **9.19** cannot be applied on a typical BSS earth station basis.

In all cases, at the notification stage (Article **11**), Nos. **11.22.1** and **11.22.2 specify that** individual notices of frequency assignments (i.e. notices relating to specific earth stations, as opposed to typical earth stations) are required for frequency bands allocated with equal rights

- to terrestrial and space services where coordination is required under Appendix **5**, Table 5-1;
- to space services, in the opposite direction of transmission, where coordination is required under Appendix **5**, Table 5-1.

In summary, it appears that under the present regulatory provisions, this coordination cannot be conducted with typical earth stations. In addition, the notification and recording of such typical earth stations in these cases is precluded by Article **11**.

However, in the framework of the coordination between satellite networks (e.g. under Nos. **9.7**, **9.12**, **9.12A** and **9.13**), administrations may send notices to the Bureau relating to typical earth stations located anywhere within the service area of the satellite network. Successful coordination of the satellite network and its subsequent notification and recording in the Master Register will in this case result in the protection or international recognition of these earth stations in relation to the interference they may cause to or receive from other satellite networks operating in the same direction of transmission.

3.4.4.3 Methods to satisfy the agenda item and their advantages and disadvantages

Method A

Protection/recognition of typical BSS earth stations in respect of terrestrial stations or in respect of earth stations operating in the opposite direction of transmission, may be covered, in the absence of any applicable provisions in the Radio Regulations, by bilateral agreements which may be established between the administrations concerned, on the basis of typical earth stations.

Method B

The coordination, notification and recording of typical mobile earth stations is currently possible in frequency bands shared on an equal basis between the MSS and terrestrial services. This example may offer a possible solution to the difficulties identified by ITU-R. Extending this solution to the case of BSS typical earth stations in respect to terrestrial service or in respect to FSS earth stations operating in the opposite directions of transmission requires further study.

While it is noted that such coordination of at least one MSS system was reported by the BR to have been successfully completed, it was also noted that the given example was related to a geographical location where, given the particular frequency and the sparsely populated geographical location, the number of fixed links was very limited.

The solution envisaged could be further studied, however, it was noted that the current band sharing in RR Article 5 is based on regulations allowing a balanced access to the spectrum by different services in adjacent administration's territories. As a consequence, any significant change in the provisions of the RR that would break this balanced situation in favour of one service would need reciprocal change for the other services so as to find a new balanced situation. In that respect, it was suggested that if coordination procedure with typical BSS earth stations were to be developed, the possibility for terrestrial services, and in particular for the FS, that terrestrial stations be also coordinated and notified on a typical basis be investigated.

It was noted by some administrations that Method B would not theoretically exclude the terrestrial services in a zone, from the border, inside an administration territory *A,* which is close to an administration *B* which had coordinated and notified typical BSS earth stations in its whole territory. The administration *A* could still attempt to coordinate and notify specific terrestrial stations. It was however noted that such a coordination of a specific terrestrial station with an administration *B*'s typical BSS earth station could impose significant restriction for administration A in its terrestrial deployment.

3.4.4.4 Regulatory and procedural considerations

ITU-R noted that, for the coordination of terrestrial stations or FSS transmit earth stations under No. **9.19** in respect of typical BSS earth stations, Section 1.4.5 of Appendix **7** already specifies how the coordination area method should be applied in respect of the protection of typical BSS earth stations. It was also noted however, that this provision was not currently enabled since Appendix **7** is not called by Appendix **5** in respect of No. **9.19**. Instead, Appendix **5** refers to protection of BSS earth stations by a pfd limit at the edge of the BSS service area.

3.4.5 Review of Resolution 49

3.4.5.1 Summary of technical and operational studies

The Conference Preparatory Meeting (CPM) considered input documents relating to work by the ITU-R on possible modifications to Resolution 49.

3.4.5.2 Analysis of the results of studies

The CPM reviewed Resolution 49 (WRC-2000) and expressed two views. One view was that Resolution 49 (WRC-2000) has not been efficient in addressing the problem of reservation of orbit and spectrum capacity without actual use. Another view was that sufficient time has not passed to adequately evaluate the effectiveness of this Resolution.

Two methods were identified:

Method A

No change to Resolution 49.

Method B

Modify Annex 2 to Resolution 49 so that it is clearly specified that the frequency range(s) for the frequency assignments of the satellite network that have to be provided by the administrations are the ones that are intended to be brought into use in the space station in conformity with the Radio Regulations.

MOD

ANNEX 2 TO RESOLUTION 49 (REV.WRC-2000)

A Identity of the satellite network

a) Identity of the satellite network

b) Name of the administration

c) Country symbol

d) Reference to the advance publication information or to the request for modification of the Region 2 Plan or for additional uses in Regions 1 and 3 under Appendices **30** and **30A**

e) Reference to the request for coordination (not applicable for Appendices **30** and **30A**)

f) Frequency ranges for the frequency assignments of the satellite network transponder(s) that are intended to be brought into use in conformity with the relevant time-limits included in the Radio Regulations

g) Name of the operator

h) Name of the satellite

i) Orbital characteristics.

B Spacecraft manufacturer*

a) Name of the spacecraft manufacturer

b) Date of execution of the contract

c) Contractual "delivery window"

d) Number of satellites procured.

C Launch services provider

a) Name of the launch vehicle provider

b) Date of execution of the contract

c) Launch or in-orbit delivery window

d) Name of the launch vehicle

e) Name and location of the launch facility.

3.4.5.3 Regulatory and procedural considerations

The text in §3.4.5.2 could be used as the basis for updating Resolution 49.

3.4.6 Resolution 34

3.4.6.1 Summary of technical studies

Resolution **34** contains regulatory provisions which apply to the use of the BSS in Region 3 in the band 12.5-12.75 GHz, in respect of the space and terrestrial services in all Regions.

* NOTE – In cases where a contract for satellite procurement involving the frequency assignments concerned covers more than one satellite, the relevant information shall be submitted for each satellite.

It has been considered whether the provisions contained in Resolution **34** are still necessary or whether they could be reflected in a simple way in the main body of the Radio Regulations.

3.4.6.2 Analysis of the results of studies

The band 12.5-12.75 GHz is allocated to the broadcasting-satellite service in Region 3 on a primary basis. This allocation is not subject to a Plan.

As far as terrestrial services allocated on a primary basis are concerned in Regions 1, 2 and 3:

- the band 12.5-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services in some countries of Region 1 listed in Nos. **5.494** and **5.496**; and
- the band 12.5-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services in Region 3; and
- in Region 2, the band 12.2-12.75 GHz is allocated to the fixed and mobile, except aeronautical mobile, services and the band 12.2-12.7 GHz is allocated to the broadcasting service.

The band 12.5-12.75 is also allocated to the FSS in Regions 1 and 3; the band 12.5-12.7 GHz is allocated to the planned BSS in Region 2 and the band 12.7-12.75 GHz is allocated to the FSS in Region 2.

Besides, attached to the allocation to the BSS in Region 3 in the band 12.5-12.75 GHz, No. **5.493** specifies a hard limit of –111 dB(W/(m^2·27 MHz)) on the power flux-density produced at the Earth's surface by a station in the broadcasting-satellite service in Region 3 at the edge of the service area.

Resolution **34** contains regulatory provisions which apply to the use of the BSS in Region 3 in the band 12.5-12.75 GHz, in respect of the space and terrestrial services in all Regions.

– *resolves* 1 states that, until a plan is established for this allocation, Resolution **33** (Rev.WRC-97) and Article **9** apply with respect to space stations in the BSS and in the FSS in all Regions and terrestrial services in all Regions. Hence, it is understood that when the provisions of Article **9** need to be applied, No. **9.7** applies with respect to GSO networks in the FSS and the BSS of all Regions, and No. **9.11** applies with respect to terrestrial of all Regions.

– *resolves* 2 calls for technical studies to develop appropriate provisions for the sharing between stations in the BSS service in Region 3 and space and terrestrial stations in Regions 1 and 2.

– *resolves* 3 provides criteria to be applied until the studies in *resolves* 2 are completed, in order to describe the sharing between this allocation to the BSS in Region 3 and terrestrial services in all Regions.

  - *resolves* 3.1) specifies a hard limit which is the same than the one in No. **5.493** i.e. –111 dB(W/(m^2·27 MHz)) at the edge of the service area;
  - *resolves* 3.2) specifies that the hard limits of Table **21-4**, currently applicable to the FSS in the band 12.5-12.75 GHz, also apply to this BSS allocation in the countries mentioned in Nos. **5.494** and **5.496**;
  - *resolves* 3.1) also states that *resolves* 3.2) only applies with respect to the protection of the broadcasting service; but, since the services mentioned in *resolves* 3.2) through Nos. **5.494** and **5.496** are only the fixed and the mobile services, the statement seems to have no clear meaning and two views have been suggested to interpret it. The first view is that the statement should be ignored on the basis that it is inconsistent with the

remaining part of *resolves* 3, whereas the second view is that it may be taken into account so as to disable the provisions of *resolves* 3.2). Under this latter viewpoint, it is therefore not clear why *resolves* 3.2) exists and which procedure applies with respect to the terrestrial services allocated in the Region 1 countries mentioned in Nos. **5.494** and **5.496**;

- *resolves* 3.3) specifies that these limits may be exceeded on the territory of any country provided the administration of that country has so agreed, which paraphrases No. **21.17**.

As far as the protection of terrestrial services in all Regions from the unplanned BSS in Region 3 in the band 12.5-12.75 GHz are concerned, the apparent discrepancy between *resolves* 1 and *resolves* 3 was outlined:

- *resolves* 1.2) specifies that the BSS stations apply the provisions of Resolution **33 (Rev.WRC-97)** and Article **9** with respect to terrestrial services of all Regions;
- whereas *resolves* 3.1), *resolves* 3.2) and No. **5.493** provide power-flux density hard limits.

The same situation in other bands has led to the adoption of a Rule of Procedure on No. **9.11** (see circular letter CR/181 dated 16 July 2002) stating that, in such cases, a finding resulting from the examination under No. **11.31** based on the respect of hard limits established for the sharing between BSS and terrestrial services is provided to the BSS assignment, i.e. a favourable finding if the limits are not exceeded, or an unfavourable finding otherwise.

Relying upon this conclusion, one view was emphasized that the protection of terrestrial services in all Regions from the BSS allocation in the band 12.5-12.75 GHz was assured as described hereafter:

– To protect the stations in the terrestrial services in the Region 1 countries mentioned in Nos. **5.494** and **5.496**, according to *resolves* 3.2), the limits of Table **21-4** of Article **21** apply and could be reflected in a simple way by modifying Table **21-4**. It should be noted that, as Resolution **506 (Rev.WRC-97)** precludes the operation of BSS stations in the non-geostationary-satellite orbit in the 12 GHz band, such a modification to Table **21-4** would apply only to the BSS stations in the geostationary-satellite orbit.

– Terrestrial services in Region 3 are protected by:
  - the limit of –111 dB(W/(m^2·27 MHz)), which applies at the edge of the service area, if they are allocated in countries out of the service area of the BSS network; or
  - coordination under No. **9.11** if they are allocated in countries included in the service area of the BSS network.

– Terrestrial services in Region 2 are protected by the limit of –111 dB(W/(m^2·27 MHz)) since Region 2 is out of any service area of a BSS network operating in Region 3.

Another view was that there is a remaining discrepancy between the provisions of the *resolves* 1 and 3 of Resolution **34** and also that, regarding terrestrial services in Region 3, the current mention of the band 12.5-12.75 GHz for Region 3 in Table **5-1** of Appendix **5** under No. **9.11** may not be clear enough to specify that it may only apply with respect to Region 3 countries included in the service area.

3.4.6.3 Methods to satisfy this agenda item

WRC-03 may wish to consider the views expressed in the previous section, that the suppression of Resolution **34** together with some modifications to the Radio Regulations might be considered. An example of modified Table **21-4** of Article **21** and Resolution **34,** which reflects one view on how to apply the provisions of Resolution **34**, is given below.

MOD

TABLE **21-4** *(continued)*

Frequency band	Service*	Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
…					
12.5-12.75 GHz[7] (Region 1 countries listed in Nos. **5.494** and **5.496**)	Broadcasting-satellite (geostationary- satellite orbit)	–148	–148 + 0.5(δ – 5)	–138	4 kHz
…					

SUP

RESOLUTION 34

Relating to the establishment of the broadcasting-satellite service in Region 3 in the 12.5-12.75 GHz frequency band and to sharing with space and terrestrial services in Regions 1, 2 and 3

3.4.7 Rule of Procedure on No. 9.35 provisionally adopted to reduce the backlog in the processing of satellite filings under Article 9 of the RR

3.4.7.1 Summary of activities performed in relation to the reduction of the backlog

Council-01 adopted Resolution 1182 recommending the Board to develop, as a matter of urgency, a set of Rules of Procedure, consistent with the Radio Regulations, intended to eliminate the backlog. The reason for this was the increasing backlog in the processing of satellite filings, identified already in 1994 by the Kyoto Plenipotentiary Conference in the adoption of Resolution 18. Since 1994, the issue has also been considered by WRC-97, PP-98, WRC-2000 and WGR. The problem of the backlog is still not solved and is under consideration by SATBAG (an action group of the Council, established by Council Resolution 1182, which prepares and oversees a coordinated approach for treating the complex and related factors contributing to the backlog in the Bureau's processing of satellite network filings). SATBAG will submit a report to WRC-03.

The Board adopted during its 25th meeting (3-7 December 2001) a Rule of Procedure on the suspension, within the No. **9.35** examinations, of examinations[3] other than conformity with respect to the Table of Frequency Allocations. A "qualified favourable" finding, as described in Circular Letter CR/180, is issued, which will need to be confirmed at the notification stage. The "suspended" examinations will be made in the No. **11.31** notification phase. The Board indicated that these above measures would be used on a provisional basis until further decisions by WRC-03. The Rule has been applied to those networks for which complete coordination information has been received by the Bureau on and after 1 June 1999.

The provisional adoption of the Rule of Procedure on No. **9.35** drew comments from several fora.

3.4.7.2 Analysis of the impact of the provisional application of the Rule of Procedure

The Bureau made available to the Board, at its 25th meeting, an estimate on the reduction of time requirements in the examination of a coordination request under the provisional Rules on Nos **9.35** and **9.36**. While the Bureau estimated that the adopted rules could reduce the time needed to examine a coordination request by 13.6%, (ref. Benchmark b) of Doc. RRB2001/289(Rev.1)), the Bureau also conditioned this estimate with the following potential implications of the rules if they were adopted:

- an increase of the Bureau's work pursuant to Nos **9.41**/**9.42** particularly due to the suspension of pfd calculation under No. **9.35**;
- transfer of work from the Bureau to administrations, having to do their own analysis;

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[3] Examinations with respect to:

i) Any power limits referred to in applicable footnotes, Resolutions or Recommendations;
ii) The power limits for earth stations as specified in Nos **21.8**, **21.10**, **21.12** and **21.13**;
iii) The limits of power flux-density from space stations produced at the Earth's surface as specified in Table **21-4** (**21.16**), as well as in Tables **22-1A** to **22-1D** (**22.5C**);
iv) The limits of power flux-density from space stations produced at the geostationary orbit as specified in Nos **22.5** and **22.5A**;
v) The limits of power flux-density from earth stations produced at the GSO as specified in Table **22.2** (**22.5D**);
vi) The limits of power flux-density from space stations produced at any point in the geostationary orbit as specified in Table **22.3** (**22.5F**); and
vii) The off-axis power limits of earth stations in the fixed-satellite service specified in Nos **22.26** to **22.39**.

– possible increase of requests for assistance to the Bureau; and
– affording all the assignments in compliance with the Table of Frequency Assignments the status "qualified favourable" at the coordination stage and their potential impact on Bureau's records.

ITU-R sent a liaison statement to the SATBAG and the RRB which contrasted the regulatory situation prior to the adoption of the provisional Rule, in that, an assignment receiving unfavourable findings under No. **9.35** causes the assignment to have no regulatory right, to the "qualified favourable" status afforded to all the assignments treated pursuant to the provisional Rule and raised the following issues of concern:

– the rule shifts the backlog in processing satellite filings from the coordination stage to the notification stage;
– the analysis of conformity with the mandatory technical provisions of the Radio Regulations, instead of being done once by the Bureau on behalf of all administrations, will have to be done by any administration which wishes and even by the Bureau at a request for assistance; and
– the introduction of the status "qualified favourable" assignments under No. **9.35** raises concerns on how the Bureau will deal with the status of coordination requests at the notification stage of a network, being complicated by options available, under the rule, to administrations in pursuing the coordination and notification of their systems.

During the CPM meeting, some administrations indicated that they do not agree with these issues of concern, in that they have not been experienced in the months that the provisional Rules have been applied. Since the application of the provisional Rules as well as other factors, as the backlog at the coordination stage has started to be reduced, they are of the view that the provisional Rules are having the desired effect without any serious practical negative implications that some had predicted.

3.4.7.3 Methods to satisfy this issue and their advantages and disadvantages

The advantages and disadvantages listed hereafter have been subject to considerable discussions and not all administrations agreed to all of them.

3.4.7.3.1 Method A

WRC-03 does not endorse the provisional Rule of Procedure on No. **9.35**.

Advantages:

The advantages of not endorsing the provisional Rule on No. **9.35** would include:

– avoiding the possibility of work increase for the Bureau pursuant to Nos **9.41/9.42**, as well as due to requests for assistance;
– avoiding the characterization of all the assignments with a "qualified favourable" status at the coordination stage will maintain the credibility of Bureau generated reports, which are of critical importance to administrations;
– avoiding the situation where the work, instead of being done once by the Bureau on behalf of all administrations, will have to be done by the administrations and even by the Bureau as a result of requests for assistance;
– avoiding the transfer of the backlog problem in processing satellite filings from the coordination stage to the notification stage;

– avoiding that the number of coordination be higher because of the surplus generated by assignments that are not in conformity with the provisions of Radio Regulations;

– avoiding that administrations be required to coordinate with preceding assignments that are not in conformity with the Radio Regulations and consequently not be able to carry out in due time the higher number of required coordination to meet the regulatory time limit (5+2 years) to bring into use frequency assignments.

Disadvantages:

– Loss of the benefit of a reduction in the time required for the examination of coordination requests at the coordination stage by the Bureau.

– The time used by BR to re-examine all filings that have been processed under the provisional Rules, if so instructed by WRC-03.

– It maintains duplicate workload of BR for those filings that are notified as well as maintaining the examination of the "paper" filings that are never notified.

3.4.7.3.2 Method B*

WRC-03 incorporates the essence of the provisional Rules into the Radio Regulations, either in Article 9 or by a Resolution.

Advantages:

– This option solves the concern of some administrations about the unconstitutional aspect of the decision by the RRB, and does not necessitate the re-examination of filings processed under the provisional Rules.

– It removes duplicate workload of BR for those filings that are notified as well as removing the examination of the "paper" filings that are never notified.

– For those assignments that are never notified, any work done at the coordination phase is a wasted effort as these notices will eventually be cancelled.

– Under the present RR any excess of pfd in the examination at the coordination phase results in an unfavourable finding under No. **9.35/11.31**, resulting in the network not being protected by subsequent filings. A subsequent modification to the filing which brings the frequencies into compliance with the pfd limits will result in a new date of receipt and the need to coordinate with filings submitted between the date of the original filling and the date of the modified filing. Having no finding on these technical limits at the coordination phase results in the network being protected as of the original filing, with adequate time to seek agreement in accordance with No. **21.17** and other similar provisions or reduce the pfd prior to notification, even though it was not the main intent of the provisional Rule of Procedure.

Disadvantages:

– This could create more workload in BR.

– Possibility of work increase for the Bureau pursuant to Nos **9.41/9.42**, as well as due to requests for assistance.

– The report of examinations (see the list in footnote 1 above) by BR will not be available to administrations.

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* All Arab administrations and the administration of Iran object to Method B.

- The work, instead of being done once by the Bureau on behalf of all administrations, will have to be done by any administration which wishes so and even by the Bureau as a result of requests for assistance.
- The number of coordinations is higher because of the surplus generated by assignments that are not in conformity with the provisions of Radio Regulations.
- Administrations are required to coordinate with preceding assignments that are not in conformity with the Radio Regulations and consequently may not be able to carry out in due time the higher number of required coordinations to meet the regulatory time limit (5+2 years) to bring into use frequency assignments.
- Possible increase of requests for assistance to the Bureau.
- Affording all the assignments in compliance with the Table of Frequency Assignments the status "qualified favourable" at the coordination stage and their potential impact on Bureau's records.
- By shifting the workload in processing satellite filings from the coordination stage to the notification stage, this method might simply transfer the backlog.

3.4.7.4 Regulatory and procedural considerations

Depending on how Method B is implemented, some advantages (resp. disadvantages) may be added or may disappear.

Should WRC-03 adopt Method A, it would need to instruct RRB to take necessary action. A draft Resolution to this effect is attached. Some administrations do not agree with this course of action.

DRAFT RESOLUTION

Rules of Procedure

The World Radiocommunication Conference (Geneva, 2003),

considering

a) that the duty of the Radio Regulations Board, *inter alia*, is the approval of the Rules of Procedures in accordance with the Radio Regulations (CS94 and CS95);

b) that these Rules of Procedures shall be used by the Director and the Bureau in application of the Radio Regulations to register the assignments made by the Member States (CS95);

c) that the Board shall approve a set of Rules of Procedure to govern its own activities and those of the Bureau in the application of the Radio Regulations, to ensure the impartial, accurate and consistent processing of frequency assignment notices and to assist in the application of these Regulations (RR No. **13.12**),

having been informed

that some administrations have objected to the Rules of Procedure relating to application of No. **9.35** of the Radio Regulations adopted at the 25th meeting of the RRB (3-7 December 2001) as not being in conformity with the Radio Regulations,

noting

that in case the approved Rules of Procedure are not fully in conformity with the Radio Regulations, the findings adopted on this basis would affect the interests of administrations,

resolves to instruct the Radio Regulations Board

1 to review the above-mentioned Rules of Procedure with the view to bringing them into full conformity with the Radio Regulations;

2 to review, where appropriate, the findings given in applying the adopted Rules of Procedure to take account of the modification of the Rules of Procedure as results of action taken under *resolves* 1 above.

3.5 Agenda item 1.34

"to review the results of studies in response to Resolution **539 (WRC-2000)** concerning threshold values for non-GSO BSS (sound) in the band 2 630-2 655 MHz, and to take actions as required"

3.5.1 Summary of technical and operational studies related to non-GSO BSS (sound), including a list of relevant ITU-R Recommendations

The band 2 535-2 655 MHz is additionally allocated to the broadcasting-satellite service (sound) on a primary basis in nine countries in Region 1 and 3 in accordance with the provisions of No. **5.418**. Use of the band 2 630-2 655 MHz by this service is subject to Resolution **528 (WARC-92)** and is exempt from the pfd limits indicated in RR Table 21-4 of Article **21**. At least one country has filed for a non-GSO BSS (sound) system to operate in the 2 630-2 655 MHz band and this system is expected to be operational in the near future.

The band 2 630-2 655 MHz is also allocated to the fixed and mobile services on a primary basis and WRC-2000 identified this band as an additional band for IMT-2000 per No. **5.384A**, which states "The bands, or portions of the bands, 1 710-1 885 MHz and 2 500-2 690 MHz, are identified for use by administrations wishing to implement International Mobile Telecommunications (IMT-2000) in accordance with Resolution **223 (WRC-2000)**. This identification does not preclude the use of these bands by any application of the services to which they are allocated and does not establish priority in the Radio Regulations". It is noted that this band is intended to be used for IMT-2000 systems by around the year 2010.

WRC-2000 introduced Resolution **539** for non-GSO BSS (sound) in the band 2 630-2 655 MHz (in Table 5-1 of Appendix **5** of the RR, Resolution **539** is shown as also applying as stated in the threshold condition column in the application of No. **9.11**). WRC-2000 also adopted as part of Resolution **539** limits on non-GSO BSS (sound) systems to national services (unless agreement has been reached to include the territories of other administrations in the service area) to be operated such that the minimum elevation angle over the service area is not less than 40° for the purposes of sharing with terrestrial services. The Resolution also contains the following provisional power flux-density (pfd) threshold levels for non-GSO BSS (sound) systems:

-128	$dB(W/m^2$ per MHz)	for $0° \le \theta \le 5°$
$-128+0.75(\theta-5)$	$dB(W/m^2$ per MHz)	for $5° \le \theta \le 25°$
-113	$dB(W/m^2$ per MHz)	for $25° \le \theta \le 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

It is noted that some administrations understand that the pfd values in Resolution **539** are thresholds to be used in the identification of administrations with which coordination is to be effected under 9.11. Other administrations are of the view that the pfd values in Resolution **539** are thresholds to be used in the identification of administrations with which the process of seeking of agreement is to be effected. In this CPM text, the phrase "pfd threshold levels" is used. See section 3.5.4.

ITU-R conducted studies regarding the appropriate satellite pfd threshold values for non-GSO BSS (sound) in Resolution **539** with a view to avoid placing undue constraints on either non-GSO BSS (sound) or terrestrial services.

Relevant ITU-R Recommendations: P.681-3, M.1036, F.1245-1, F.1336-1, BS.1114, BS.1547, BO.789, BO.1130, BO.1504, DNR ITU-R F.[9/118]* and DNR ITU-R M.[8/106].**

3.5.1.1 Non-GSO BSS (sound) system parameters

Non-GSO BSS (sound) systems envisaged for operation with high elevation angles (with a minimum of 40°) over the service area in the band 2 630-2 655 MHz in accordance with Resolution **539** are generally those employing highly elliptical orbits (HEO) in which a constellation consists of a number of satellites and only one satellite becomes active at any time, providing a continuous service. For the non-GSO BSS (sound) high availabilities are required for a viable implementation and these availabilities can only be ensured if there are high link margins. In the mobile operation envisaged for the non-GSO BSS (sound) the link margins can be reduced without impacting on availability provided high elevation angles to the satellite are maintained and this can only be achieved in medium to high latitude countries with a highly elliptical orbits type of implementation.

Users of sound broadcasting services expect and often demand very high levels of availability under all manner of reception conditions including mobile within the designated service area because this has become normal for sound broadcasting in the MF and VHF bands. In cases of large service areas, such as within all the territory within national borders, ubiquitous coverage can only be achieved via a combination of direct to user satellite and complementary terrestrial repeaters.

Non-GSO BSS (sound) system design is driven by the need to achieve an optimized balance between satellite and terrestrial repeater coverage and these in turn determine the required satellite e.i.r.p. and number of terrestrial repeaters. These elements in combination determine the total system deployment cost and hence the potential viability of the system.

For medium to high latitude countries, HEO signals can be received at high elevation angles within the service area and this significantly reduces the probability of total blockage of the satellite signal from natural or man-made obstructions in the path of the satellite signal and hence significantly increases the probability of direct reception from the satellite. Under these circumstances the desired availability can be achieved when the network is deployed with a modest number of terrestrial repeaters provided an adequate margin is provided for the satellite link to overcome partial blockage such as that introduced by foliage and certain man-made obstacles.

Operating with high elevation angles provides advantages for the operation of non-GSO BSS (sound) systems and may also reduce the impact of the non-GSO BSS (sound) on other services in the band. The ITU-R study taking into account the geographical distribution of these countries shows that, at the maximum, four active satellites may operate at the same frequency, and taking into account the geographical location of countries in Region 3 in practical terms there is an expectation that no more than three active satellite systems will operate in the same frequency sub-band. The longitudinal difference between adjacent active satellites will not be uniform. This factor has been taken into account in some of the ITU-R sharing studies.

The parameters of non-GSO BSS (sound) systems used in sharing studies are given below:

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* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

** Some administrations expressed their objection to and concern regarding this DNR in ITU-R.

Orbital Parameter	
Altitude of Apogee (km)	44 640.5
Altitude of Perigee (km)	26 931.55
Orbital Inclination Angle (°)	42.5 *
Active Arc	4.5 hours before apogee to 3.5 hours after apogee
Number of Satellites	3
Number of Satellites Active at one time	1
Transmitting Parameter	
Minimum e.i.r.p. density (dB(W/Hz))	–6.3
Earth Station Receive Antenna Gain (dB)	7.0
Polarization	Circular
*NOTE – Some of the studies also considered a non-GSO BSS (sound) system with an orbital inclination angle of 50°.	

Based on the above parameters, taking into account the minimum required C/N of 6 dB including implementation loss of 1.8 dB and small link margin of 1.4 dB, a power flux-density at the surface of the Earth in the service area of non-GSO BSS (sound) systems of –110.3 (dBW/(m^2 · MHz)) is required under an ideal reception environment. Since non-GSO BSS (sound) systems are intended to operate with mobile receiving terminals, it is also necessary to consider the effects of fading depth due to shadowing by trees, etc. The effects of fading depth due to shadowing with respect to the elevation angle (70 degrees), in accordance with Recommendation ITU-R P.681-3, are estimated as 15 dB for availability objective of 97% and 7 dB for 95%. Taking into account the link power margin regarding the fading depth, the minimum required pfd levels for non-GSO BSS (sound) systems are calculated as follows:

Availability objective	Fading depth	Minimum required pfd in the non-GSO BSS (sound) service area
97%	15 dB	–95.3 dB(W/(m^2 · MHz))
95%	7 dB	–103.3 dB(W/(m^2 · MHz))

High pfd levels would provide tangible benefits in terms of increased availability and a potential reduction in the number of terrestrial repeaters, but would impose increased technical and cost constraints on the satellite component particularly for large service areas, and in these cases additional satellites must be employed.

Outside the service area, the pfd is expected to be reduced to facilitate the sharing situation with the terrestrial services of neighbouring countries. A maximum pfd mask was assumed in studies to evaluate the level of interference received by terrestrial stations. However, it should be noted that this is a worse case approach since each satellite will not be producing its pfd at the levels given in the mask for some terrestrial station locations.

3.5.1.2 IMT-2000 system parameters

Since this band has been identified for IMT-2000, most studies concerning protection of the mobile service have focused on the protection of IMT-2000. IMT-2000 is a cellular mobile

telecommunication system, characterized by very high levels of Quality of Service, allowing to offer interactive and very high bit rates data communication to the end user. IMT-2000 is felt to offer very innovative and spectrum efficient telecommunication services and is recognized to take beneficial advantage from international harmonization of the spectrum and commonality of technologies.

The pfd thresholds in the frequency band 2 630-2 655 MHz are intended to protect IMT-2000 systems with a view to avoid placing undue constraints on non-GSO BSS (sound) systems in this specific frequency band. Therefore, they have to take into account the direction of the IMT-2000 link that is planned for the use of these 25 MHz. Recommendation ITU-R M.1036 on channelization plans for IMT-2000 systems is to be revised by 2004. Therefore, it is not known if this band is to be utilized for uplink (mobile station to base station links), downlink (base station to mobile station links), or both. The final determination of the direction of operation for the IMT-2000 systems may have an impact on the appropriate thresholds.

The deployment of terrestrial IMT-2000 in the 2 520-2 670 MHz band is expected to encompass urban and rural areas. Some administrations indicated their expectation that this frequency band will be first used in urban areas where there is spectrum congestion and demand for high speed mobile data services which would result in small, heavily loaded cells. It has been noted the rural areas are considered the most difficult to cover, given the low but important traffic density. Rural areas will be covered by macrocells designed for a coverage efficiency whereas urban areas will encompass every type of cell, from macro to picocells. The different types of cells may also be layered in these urban areas to better fit to capacity needs and demands: this being a particularity of IMT-2000 deployment schemes. Pico cells are designed for indoor coverage and service.

Further, it would be desirable that deployment in rural areas (which are coverage limited as opposed to traffic limited) be accommodated in lower frequency bands as coverage will decrease with increased frequency.

3.5.1.2.1 Receiver parameters for IMT-2000 mobile and base stations

The receiver parameters for mobile stations used in sharing studies are given in the following:

Receiver Noise Figure (dB)	9.0
Maximum Antenna Gain (dBi)	0.0
Polarization	Linear

The receiver parameters for base stations used in sharing studies are given in the following:

	Macro-rural	Macro-urban	Micro
Typical receiver noise figure (dB)	5.0	5.0	5.0
Maximum antenna gain (dBi)	17.0-18.0	18.0 (NOTE 1)	8.0
Antenna type	120° Sector (See NOTE 3)	120°/60° Sector (See NOTES 2 and 3)	120° Sector (See NOTE 3)
Antenna height	15.0 metres	Assume 24.0 metre building and antenna is 6 metres above top of building	Assume 24.0 metre building and antenna is 6 metres below top of building
Tilt angles (°)	2.5	6.0	6.0
Typical feeder loss (dB)	2.0	2.0	2.0
Polarization	Linear	Linear	Linear
NOTE 1 – Maximum antenna gains of 9 dBi, 13 dBi and 17 dBi have also been considered for macro-urban cells in one of the studies. NOTE 2 – The sector size is dependent on the capacity requirements for the cell. At the start of implementation of IMT-2000 systems, three 120° sectors would be used. If the particular cell needs more capacity, six 60° sectors could be used. NOTE 3 – For IMT-2000 base stations that employ multiple sector antennas in order to cover 360°, the systems are assumed to be designed such that each sector antenna will have its own receiver.			

Picocells are expected to be located in-doors, so the interference effect from satellite systems is not expected to be a factor and these systems were not taken into account in the studies.

A key IMT-2000 parameter from the viewpoint of sharing with non-GSO BSS (sound) systems is the IMT-2000 station antenna characteristics. Many contributions were made to the ITU-R on this subject. From these contributions it is clear that using IMT-2000 antennas that have good performance in terms of side-lobe suppression significantly enhances the probability of successful sharing with satellite services. Given the extended time-frame for the IMT-2000 deployment and the availability of such antennas, it was agreed that it is reasonable to conduct the sharing studies on the basis of IMT-2000 base station antennas with a performance that can reasonably be expected within the deployment period.

3.5.1.3 Fixed service system parameters

There are several types of FS systems operating in the band 2 630-2 655 MHz including point-to-point (P-P) system, point-to-multipoint (P-MP) system and electronic news gathering system (ENG). Since system characteristics of these systems are very much different, they have to be studied separately.

Details of parameters for the fixed service are given in DNR ITU-R F.[9/118].*

Fixed service system parameters important from the viewpoint of sharing with BSS (sound) systems are antenna characteristics, receiver parameters, Isat/Nth criteria and the acceptable percentage of fixed service links potentially exceeding the Isat/Nth criteria. Recommendation ITU-R F.1245 and the draft revision of Recommendation ITU-R F.1336 were used as fixed service antenna radiation patterns.

* This DNR has been objected to by five administration at the stage of adoption in ITU-R.

3.5.2 Analysis of the results of studies

The ITU-R studies concentrated on developing appropriate pfd threshold levels, which would be acceptable to both terrestrial and non-GSO BSS (sound) systems, noting that it has proven difficult so far to agree on such levels.

The ITU-R also recognized that the pfd limits in Table **21-4** of RR Article **21**, which apply to BSS systems operating in the 2 520-2 670 MHz band under No. **5.416**, provide adequate regulatory protection to existing terrestrial systems operating in the same frequency band.

3.5.2.1 Protection of terrestrial systems from non-GSO BSS (sound) systems

3.5.2.1.1 Case of IMT-2000 systems

The ITU-R studies addressed the appropriate power flux-density thresholds that would adequately protect both base and mobile stations of IMT-2000 systems with a view to avoid placing undue constraints on non-GSO BSS (sound) systems.

IMT-2000 can be deployed in different ways as already identified above. The tolerance to external interference is related to the nature of the deployment. There is agreement that the rural coverage limited FDD uplink scenario would require the most protection from non-GSO BSS (sound) systems, although protection of mobile stations may become important at high elevation angles. FDD downlinks, urban micro and picocells in either the uplink or downlink direction and TDD deployments are expected to be more tolerant to external interference, therefore, studies were focused primarily on the rural coverage limited up-link case.

3.5.2.1.1.1 Case of IMT-2000 base stations

The ITU-R reviewed several sharing studies relating to the appropriate pfd threshold levels with respect to non-GSO BSS (sound) systems sharing with IMT-2000 systems. The ITU-R was unable to agree upon one set of acceptable pfd threshold levels. The studies proposed the following two alternative pfd threshold levels for sharing between non-GSO BSS (sound) systems and the IMT-2000 uplink case that, for the masks considered, is the most susceptible to interference in the band 2 630-2 655 MHz:

A)[**]

-128	dB(W/(m^2 · MHz))	$0° \le \theta \le 5°$
$-128 + 0.75\ (\theta - 5)$	dB(W/(m^2 · MHz))	$5° \le \theta \le 25°$
-113	dB(W/(m^2 · MHz))	$25° \le \theta \le 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees. It may be noted that the above thresholds are identical with the pfd thresholds given in Resolution **539 (WRC-2000)**.

**NOTE – A further study considering different angle of arrival break points and different pfd levels.

B)[***]

−132	dB(W/(m^2 · MHz))	0° ≤ θ ≤ 5°
−132 + 0.5 (δ–5)	dB(W/(m^2 · MHz))	5° ≤ θ ≤ 25°
−122	dB(W/(m^2 · MHz))	25° ≤ θ ≤ 90°

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

***NOTE – A further study resulted in pfd levels that are 2 dB higher than these values for all elevation angles and another resulted in pfd levels up to 4 dB tighter at low elevation angles and relaxed by 1 dB for high angles.

There were several different assumptions used in these studies that led to the differences in appropriate pfd masks. These assumptions and the differences are summarized below:

a) Reference radiation antenna patterns for the IMT-2000 base stations

The study that developed the levels given in **B)** used the antenna pattern for sectoral antennas that is contained in Recommendation ITU-R F.1336-1. It is noted that the pattern given in this Recommendation for sectoral antennas does not include any discrimination in the azimuth plane (i.e. the model only contains a pattern in the vertical plane, although in practice this azimuthal discrimination will occur). It is noted that further studies considered azimuthal antenna discrimination and a vertical pattern modelled with Recommendation ITU-R F.1336-1 and resulted in the pfd levels given in the note to mask **B)**. The two studies used in the development of the levels given in A) used reference antenna patterns that accounted for discrimination in the azimuth plane. It is noted that these two studies used different models for the horizontal gain pattern. One of these studies used two antenna patterns: one with the vertical pattern from Recommendation ITU-R F.1336-1 and the other with a different model for the vertical pattern. DNR [8/106]* states that the azimuth gain pattern outside the sector can be modelled as the maximum vertical gain minus 30 dB.

b) Maximum antenna gains for the IMT-2000 base stations

The studies used in the development of the levels given in **A)** assumed a mixture of maximum base station antenna gains of 8 dBi, 9 dBi, 13 dBi and 17 dBi for the base station antenna. The different antenna gains used in the analyses take into account that the implementation plan for this band has not yet been defined and the gain values correspond to all of the different possible deployment scenarios for IMT-2000 systems. The study used to develop the levels given in B) assumed a maximum base station antenna gain of 18 dBi focusing on the rural FDD uplink scenario.

c) Shaping factor "k" for the IMT-2000 base stations

Recommendation ITU-R F.1336-1 contains a shaping factor "k", which is the parameter that accounts for the vertical side-lobe levels (i.e. in the elevation plane) of the antennas. It is noted that a lower value for k indicates improved side-lobe performance. The study that developed the levels given in B) used a k value of 0.2. One of the studies used to develop the levels in A) used "k" values of 0, 0.1 and 0.2. The second study used in the development of the levels in A) used values of 0 and 0.1. It is noted that one contribution that contained measured antenna patterns for IMT-2000 base stations that have been extensively deployed concluded that a k value of 0 is appropriate. Another

* Some administrations expressed their objection to and concern regarding this DNR in ITU-R.

contribution contained measured antenna patterns for IMT-2000 base station that meet k factors of 0.4 and 0.7. Given that this is a very sensitive parameter to the studies under consideration every effort should be made to accurately model base station antennas that will be deployed in the 2008 time frame, which may use advances in antenna technology. One study has demonstrated that the "k" shaping factor may not affect the low angle pfd requirement, but does affect the high angle pfd requirement (5 dB difference in the case of k=0.0 *vs.* k=0.2).

d) I/N levels

For the development of a given pfd threshold level for the protection of IMT-2000 base stations, the studies assumed different values for the I/N criterion. It is noted that "I" is the interference due to the non-GSO BSS (sound) satellites and "N" is the thermal noise of the IMT-2000 base station receiver. The study that developed the levels given in **B)** used an I/N of –10 dB. One of the studies that developed the levels given in **A)** used an I/N criterion of –6 dB. The second study that developed the levels given in **A)** used an I/N criterion of –6 dB, but it is noted that the results were not significantly different if an I/N of –10 dB had been used due to other assumed factors. There were some discussions in the ITU-R about the need to consider the effect of satellite interference in conjunction with other sources of interference in addition to the thermal noise of the receiver, which was taken into account in some of the studies.

e) Percentage of base stations where a given I/N level is exceeded

In the assessment of the adequacy of the pfd masks for the protection of IMT-2000 uplinks, some studies presented the results as the probability that a percentage of base stations would receive I/N levels that exceeded a certain value. The studies assumed different allowable percentages of base stations where the I/N threshold could be exceeded. One of the studies that developed the levels given in **A)** used 10% as the acceptable percentage of stations where the I/N criterion could be exceeded. In this study, an I/N level of –6 dB was exceeded at 6.2% of the base stations. The other study used in the development of the levels in **A)** assumed that an acceptable percentage of base stations where the I/N criterion is exceeded is 10 to 20%. Although the study that developed the levels given in **B)** did not focus only on presenting the results using such probabilities but on an assessment of the interference levels received at base stations evenly located around the Earth, it can be noted that the I/N criterion was exceeded at certain base stations, generally representing 4% or less of base stations. One study that resulted in low angle pfd levels tighter than mask **B)** considered that no stations should exceed the I/N criterion.

f) Polarization isolation

As the non-GSO BSS (sound) satellite antennas use circular polarization and the IMT-2000 base stations use linear polarization, there may be a polarization loss that should be taken into account in the analyses. One view was that polarization losses of 1.5 dB should be included in the studies. Another view was that no/minimal polarization loss should be taken into account since the interference would arrive at elevation angles far from antenna boresight. One of the studies used to develop the levels given in **A)** assumed a polarization loss of 1.5 dB. The other three studies assumed 0 dB polarization loss.

g) Averaging and aggregating of interference into base stations

One of the studies used in the development of the levels in **A)** considered the probability that a sector antenna at given latitudes and varying longitudes and azimuth angles would experience different Isat/N levels. The other study used in the development of the levels in **A)** considered the probability that a sector antenna at different latitudes and varying antenna "k" factors and maximum

antenna gains would experience different Isat/N levels. This study also looked at the situation where all of the results are averaged together. The study used in the development of the levels in **B)** which modelled the base station antenna patterns using Recommendation ITU-R F.1336-1, assessed the I/N levels received at base stations located at a given latitude for varying longitudes, and presented cumulative distributions of these results. One of the further studies related to the levels in **B)**used the same type of approach in terms of results. This further study used two methods for calculating the interference received at an IMT-2000 base station: one method assumed that all three sectors of the base station would be impacted in terms of loss of coverage to the same level as the sector that received the greatest impact; the second method assumed that the impact on the base station was a tuned average of the impact on each of the three individual sectors. It is noted that the results reported above related to this further study used the second method, as did the other study referred to in the note to mask **B**). Both methods have considered varying azimuth angles for the base stations.

h) Number of satellites assumed in the studies

The four studies used different assumptions for the number of BSS (sound) satellites.*

The first study used in the development of the levels given in **A)** assumed three different cases: seven BSS (sound) satellites equally spaced around the geostationary orbit, three satellites equally spaced around the geostationary orbit and one GSO satellite and two non-GSO satellites. The assessment of the adequacy of the pfd mask was based on the results using seven BSS (sound) satellite equally spaced around the geostationary orbit.

The second study used in the development of the levels given in **A)** considered three different cases:

- Six non-GSO systems: three of the systems have their "active arc" located in the northern hemisphere and three have their "active arc" located in the southern hemisphere. The constellations separated in longitude by 120 degrees.
- Four non-GSO systems: two of the systems have their "active arc" located in the northern hemisphere and two have their "active arc" located in the southern hemisphere. The constellations separated in longitude by 180 degrees.
- Three non-GSO systems: All have their "active arc" located in the northern hemisphere. The constellations separated in longitude by 120 degrees.

The results of this study were based on the six non-GSO system case.

The third study used to develop the mask given in **B)** investigated several cases:

- Seven satellites uniformly distributed around the geostationary orbit.
- Three satellites uniformly distributed across 40° of the geostationary orbit.
- Three satellites uniformly distributed across 100° of the geostationary orbit.
- Four non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude.

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* These studies are for the purpose of studying sharing between non-GSO BSS (sound) systems and terrestrial systems, including also GSO BSS (sound) systems, in order to assess the environment that future terrestrial systems may experience. However, refinement of the modelling of GSO BSS (sound) is necessary to reflect the GSO BSS (sound) characteristics more accurately. Any assumptions and results of these studies may be used only for appropriate pfd levels for NGSO BSS (sound) systems and must not be considered for any purpose beyond this agenda item.

- Three non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude (two of the non-GSO systems" orbits had inclination angles of 42.5° and the other had an inclination angle of 50°).
- One non-GSO satellite system and four GSO satellites. The GSO satellites were distributed uniformly around the geostationary orbit and the non-GSO satellite was located at the midpoint between 2 of the GSO satellites (i.e. GSO longitudes were 10°, 100°, 190° and 280°. The non-GSO longitude was 50°).

A fourth study that resulted in a pfd mask 4 dB tighter at low angle and 1-3 dB more relaxed at high angle than mask **B)** considered several cases:

- Seven satellites uniformly distributed around the geostationary orbit.
- Three satellites uniformly distributed across 40° of the geostationary orbit.
- Three non-GSO satellite systems with active arcs in the northern hemisphere uniformly distributed across 360° of longitude with orbital parameters as in § 3.5.1.1.
- One non-GSO satellite system and four GSO satellites. The GSO satellites were distributed uniformly around the geostationary orbit and the non-GSO satellite was located at the midpoint between 2 of the GSO satellites (i.e. GSO longitudes were 10°, 100°, 190° and 280°. The non-GSO longitude was 50°).

3.5.2.1.1.2 Case of IMT-2000 mobile stations

For the case of the downlink from a base station to a mobile station, the ITU-R considered the results of two studies. These studies assumed an isotropic 0 dBi gain antenna and an I/N_{th} criterion of −10 dB. Considering a maximum of three visible satellites in the same frequency band, the pfd threshold value would be −120 dB(W/(m^2 · MHz)), for all elevation angles. With only two visible satellites the pfd would be −118.2 dB(W/(m^2 · MHz)). Opinions were expressed that the assumptions used in these analyses were not correct. The following text explains the questions relating to the assumptions:

The major consideration in assessing the relative sensitivity of the upstream link and the downstream link is that in the design of the downstream sufficient margin must be included to penetrate buildings and other enclosures where some mobile users may be located. Recommendation ITU-R M.1225, states that the guideline for the design of a cellular system is 95% signal availability indoors and that the structure penetration loss should be modelled as a log-normal distribution with 12 dB mean and 8 dB standard deviation. The cellular system downlink must include sufficient margin to overcome the penetration loss.

In order to maintain this indoor availability, the downlink design must include at least 20 dB of margin. The satellite signal will be attenuated by building loss, resulting in very low Isat/Nth indoors. Downlink power control is used to provide a constant QoS (Quality of Service) to the end user (mobile terminals). When a user goes from indoor to outdoor usage, the margin is reused by the base-station to be distributed over other users (some of whom also go from outdoors to indoors). This additional power may be used to compensate against interference unless the base-station is already operating at its maximum power. The impact of interference on fully loaded cells has to be further studied taking into account the impact of increased intra-cell interference and power control.

An additional consideration in studies is that the number of satellites visible to a mobile terminal will be three, a factor of 5 dB. This will only occur for a very small number of cases due to probable blockage of signals coming from different satellites by natural terrain, man-made objects and other factors. Accordingly, having more than two interfering sources is improbable.

These above considerations should be taken into account in developing the appropriate downlink pfd mask.

3.5.2.1.2 Case of fixed service systems

Based on the above considerations and DNR ITU-R F.[9/118], *the following pfd threshold levels at the surface of the Earth should apply with respect to station in the fixed service operating in the band 2 630-2 655 MHz:

-128	dB(W/(m^2 · MHz))	$0° \le \theta < 5°$
$-128 + 0.6\ (\theta - 5)$	dB(W/(m^2 · MHz))	$5° \le \theta < 25°$
-116	dB(W/(m^2 · MHz))	$25° \le \theta < 35°$
$-116 + 1.5\ (\theta - 35)$	dB(W/(m^2 · MHz))	$35° \le \theta < 37°$
-113	dB(W/(m^2 · MHz))	$37° \le \theta < 90°$

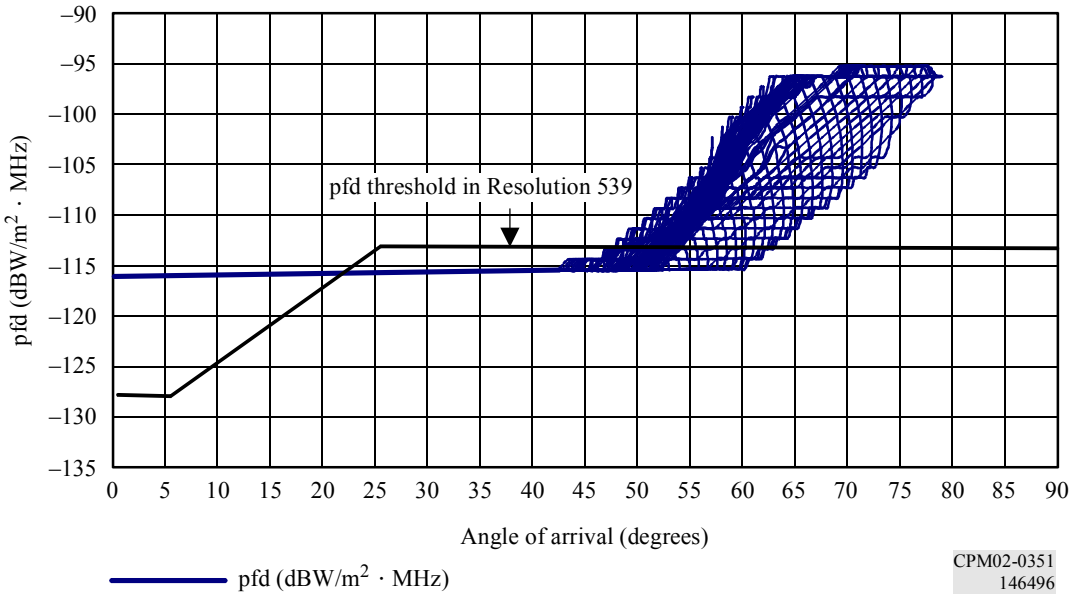
where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

3.5.2.2 Impact on the non-GSO BSS (sound) systems

The minimum required power flux-density levels for non-GSO BSS (sound) systems within the service area are shown in § 3.5.1.1. Figures 3.5-1 and 3.5-2 show the relationship between the elevation angle over the visible surface of the Earth and the pfd produced by a non-GSO BSS (sound) system meeting availability objectives of 97% and 95%, respectively.

FIGURE 3.5-1

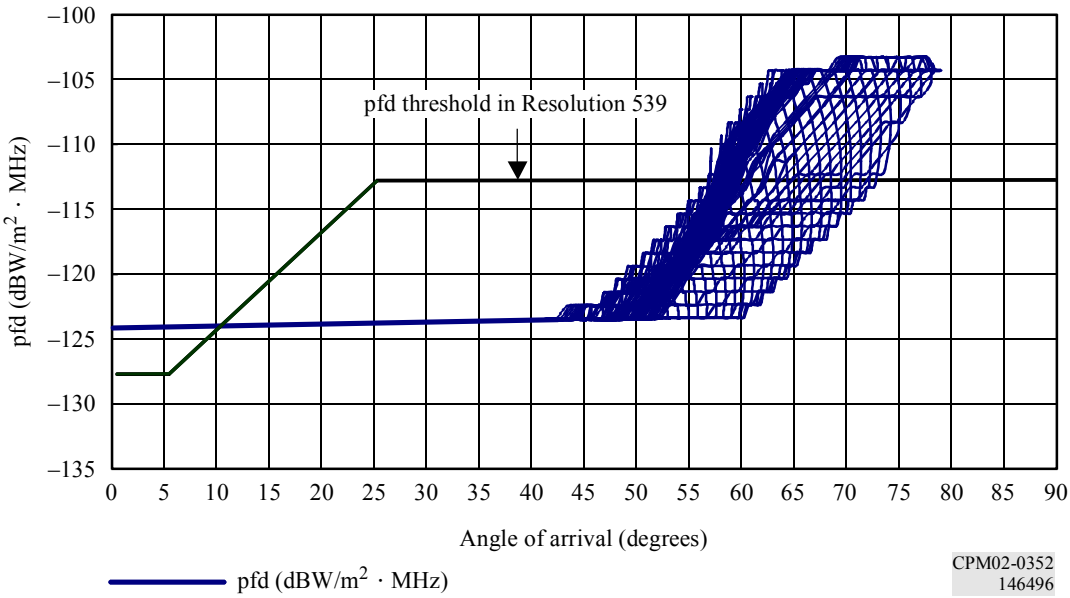
Relationship between the elevation angle and the pfd (availability objectives = 97%)



* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

FIGURE 3.5-2

Relationship between the elevation angle and the pfd (availability objectives = 95%)

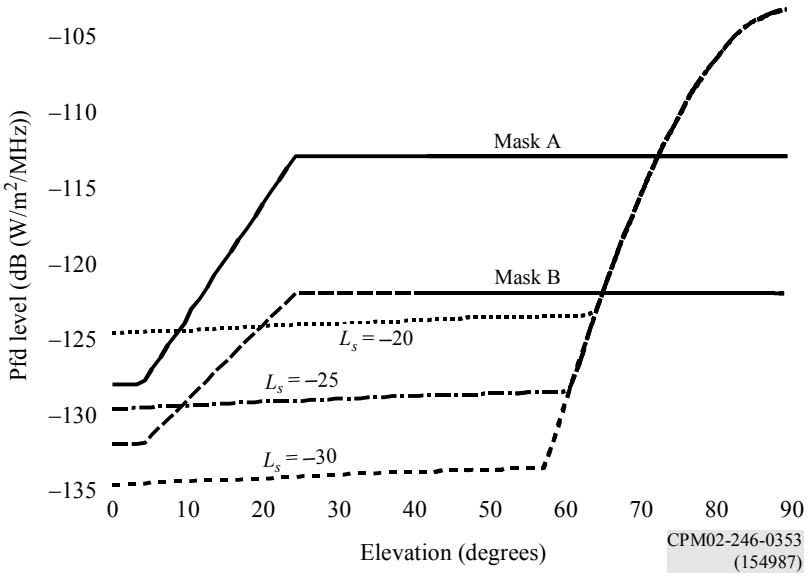


NOTE – These figures were developed using the antenna pattern information submitted in the App. 4 form for a non-GSO BSS (sound) satellite system, which only provided for side lobes that are 20 dB below the maximum gain. It is expected that the actual antenna roll-off for non-GSO BSS (sound) satellite antennas would perform better in the side lobes than the pattern submitted and therefore would improve the pfd mask.

There would be spectrum utilization advantages for both the non-GSO BSS (sound) and terrestrial services if higher performance satellite antennas with improved roll-off characteristics could be implemented in practice. Figure 3.5-3 shows examples of calculated pfd levels for a non-GSO BSS (sound) system transmitting with a maximum pfd level of –103.3 dB(W/(m^2 · MHz)) and using an antenna pattern conforming to ITU-R Recommendation S.672 with L_s parameters in the range of –20 dB to –30 dB and the relationship between these pfd levels and masks **A** and **B**.

FIGURE 3.5-3

Calculated pfd levels for non-GSO BSS (sound) satellite using Recommendation ITU-R S.672 with L_s between –20 dB and –30 dB compared to mask A and B



The impact of tightening the power flux-density levels in the low and high elevation angles would increase the area of the Earth's surface in which these levels could be exceeded (the impact in such terms would be greater at the lower elevation angles), thus increasing the number of countries identified as likely to be affected.

Depending on the maximum pfd levels produced at the surface of the Earth by the non-GSO space station at a given angle of arrival, the pfd threshold mask may or may not be practically met (see Figures 3.5-1, 3.5-2 and 3.5-3). In order to meet the pfd threshold mask at any elevation angle (or in a very limited portion of elevation angles), a non-GSO BSS (sound) system would require improved antenna side-lobe performance, and this may pose a serious challenge for the satellite manufacturers.

At this time, there is no actual implementation of practical antennas in the 2.6 GHz band on board non-GSO BSS (sound) space stations, leading to uncertainties on the actual expected roll-off performance and the degree of constraints that such threshold may cause to non-GSO BSS (sound) systems.

Studies are continuing in ITU-R in this matter. One administration emphasized that simulations of antennas performed up to now have peak envelope side lobe performance capabilities down to –25 dB at best at the lower elevation angles.

3.5.2.3 Impact on the IMT-2000 systems

In the studies, the values used for $I_{sat}/N_{thermal}$ ranged from –10 dB to –6 dB. It is appropriate to consider the potential impact of this range of $I_{sat}/N_{thermal}$ on the performance of IMT-2000 base station uplink performance. The following table presents the impact in terms of either system margin, increase in number of base stations, or signal availability.

$I_{sat}/N_{thermal}$(dB)	Reduction in system margin (dB)	Increase in number of base stations (%) (NOTE 1)		Availability loss (%) (NOTES 2 and 3)	
		IMT-2000 System Loading		EOC (NOTE 4)	Overall (NOTE 3)
		20%	50%		
		Rural	Urban		
–10	0.41	5	2.5	0.56	0.18
–6	0.97	11	5	1.38	0.46
NOTE 1 – Dependent on IMT-2000 system loading. NOTE 2 – Availability loss is Independent of IMT-2000 System Loading NOTE 3 – Based on an IMT-2000 system designed with an edge of coverage availability of 95% and an "overall" availability averaged over the cell of 98.56%. NOTE 4 – "EOC" is at the edge of coverage.					

Two studies considered the impact in terms of the increase of the number of base stations that would be required to maintain a constant quality of service over a given area for an assumed system loading. Another study considered the impact in terms of the loss of signal availability. The impact is one or the other, as given in the table, or a combination of reduced effects of each.

3.5.2.4 Impact on both, the non-GSO BSS (sound) and the IMT-2000 system

With respect to sharing between non-GSO BSS (sound) systems and IMT-2000 systems an overly conservative pfd threshold would be unnecessarily and prohibitively constraining on the development of non-GSO BSS (sound) systems, and would have the effect of inhibiting the implementation of this service. Conversely, an overly optimistic threshold would increase the risk of interference to terrestrial services.

3.5.2.5 Evaluation of the most adequate pfd thresholds

a) With respect to sharing between non-GSO BSS (sound) systems and fixed service systems, based on the above considerations and the study results described in DNR ITU-R F.[9/118], *the following pfd threshold levels at the surface of the Earth should apply with respect to station in the fixed service operating in the band 2 630-2 655 MHz:

-128	dB(W/(m^2 · MHz))	$0° \le \theta < 5°$
$-128 + 0.6\ (\theta - 5)$	dB(W/(m^2 · MHz))	$5° \le \theta < 25°$
-116	dB(W/(m^2 · MHz))	$25° \le \theta < 35°$
$-116 + 1.5\ (\theta - 35)$	dB(W/(m^2 · MHz))	$35° \le \theta < 37°$
-113	dB(W/(m^2 · MHz))	$37° \le \theta < 90°$

where θ is the angle of arrival of the incident wave above the horizontal plane, in degrees.

b) With respect to sharing between non-GSO BSS (sound) systems and IMT-2000 systems, the ITU-R was unable to develop a single set of agreed upon pfd threshold levels. Further study is required in order to develop the appropriate levels.

* This DNR has been objected to by five administrations at the stage of adoption in ITU-R.

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3.5.3 Methods to satisfy agenda item 1.34 for WRC-03

A number of methods have been used in the Radio Regulations to establish the regulatory regime applying to situations where transmit space stations may affect terrestrial stations, and each of these methods would provide a different degree of flexibility to non-GSO BSS (sound) systems and a different degree of protection to terrestrial networks, which takes into account the expected development of terrestrial and space services in the band when this regulatory approach was adopted for this particular case. These methods may be grouped into the following:

– Method 1: Pfd limits in Article **21**, Table **21-4**

– Method 2: Agreement seeking procedure of No. **9.21**

– Method 3: Coordination procedure of No. **9.11**

– Method 4: A procedure combining two or more of these methods

Each of the methods may be adapted to take account of the special sharing situation between non-GSO BSS (sound) and terrestrial services that applies in the band with a view to avoid placing undue constraints on any of the services, which may involve variants or adjustments to the existing regulatory implementation of these methods.

In particular, the procedures in Methods 2 and 3 may be applied with or without pfd threshold masks. Having the mask (which is the approach taken in the annexed examples) has the potential advantage of limiting the number of administrations likely to be affected.

Each of these methods, including its variations or adjustments, may be reflected in the body of the Radio Regulations in order to avoid the proliferation of new and complex procedures outside this body. Alternatively, these methods may be reflected in a modified version of Resolution **539 (WRC-2000)**, which may be easier to specify and may avoid undue complexity in the general procedure to cover a very specific case.

In order to ensure harmonious development of the greatest range of terrestrial and non-GSO BSS (sound) systems in this band, it would be appropriate to devise regulatory solutions which clarify the sharing situation, optimize the use of the spectrum and give regulatory certainty in this band.

It was agreed that acceptance of any of these methods was closely related to the values of the pfd thresholds that will be decided by WRC-03. However, if none of these methods provides an appropriate regulatory solution, the conference would need to take necessary action, as appropriate.

Method 1: Pfd limits in Article 21 with no examination under No. 9.35

Under this approach, the values of the pfd mask would be included as limits in Article **21** of the Radio Regulations, Table 21-4, and compliance of the non-GSO BSS (sound) system with these limits would be verified by the Bureau under No. **11.31**. Pursuant to No. **21.17**, these limits might be exceeded on the territory of any country whose administration has so agreed . In order for the non-GSO BSS (sound) system to continue to be protected by subsequent systems until its notification, examination of the conformity of the limits under No. **9.35** would not be performed. If all the agreements required have not been obtained at the stage of notification, the non-GSO BSS (sound) system may be operated only under the provisions of Nos **4.4** and **8.5** (not cause harmful interference nor claim protection to any assignments in conformity with the RR and immediately eliminate such interference upon receipt of advice thereof).

Advantages:

- Clear protection is given to existing and future terrestrial services if appropriate levels are selected.

- There is no need for administrations with terrestrial services to get involved in coordination activities with administrations planning to deploy non-GSO BSS (sound) systems.
- This method would allow discussions to take place until notification between the concerned administrations, without loss of rights for the non-GSO BSS (sound) with respect to third parties.

Disadvantages:

- It has been difficult so far to agree on limits to be used under this option and which would ensure adequate protection of terrestrial services and can be met by non-GSO BSS (sound) systems.
- One single administration on the territory of which the pfd is exceeded could prevent the non-GSO BSS (sound) system to be recorded with a favourable finding under **11.31** and thus be protected.
- This method, if it was applied for all angles of arrival at too stringent levels, would not be compatible with the intent of Resolution **539 (WRC-2000)**.

Method 2: Agreement seeking procedure of No. 9.21

Under this approach, the agreement seeking process of No. **9.21** would be followed, together with its associated Rules of Procedure[1]. The pfd mask adopted by WRC-03 would be used as a threshold in this process, and the Bureau would identify the administrations on the territory of which these thresholds are exceeded and publish their names together with the characteristics of the non-GSO BSS (sound) system. Among these administrations, only those having commented within four months of this publication would be considered affected. Only those assignments in conformity with the Radio Regulations and already in service or to be brought into service within three years of this publication may constitute a basis for disagreement. In case of such disagreement(s), the terrestrial administration is required to provide details of its assignments likely to be affected to the non-GSO BSS (sound) administration in order to maintain its rights. In addition, in this case, the examination by the Bureau under No. **11.31** would result in a favourable finding except in respect of the disagreeing administration(s), and the assignment to the non-GSO BSS (sound) system could be brought into service only under the conditions of No. **11.36** with respect to the services of the disagreeing administration(s), i.e. provided it does not cause harmful interference to, nor claim protection from assignments of that (these) administration(s) which are in conformity with the RR and if such interference occurs, it is immediately eliminated upon receipt of advice thereof. The assignments to the non-GSO BSS (sound) system would be protected from the date of the coordination request with respect to any subsequent assignment, except those of the disagreeing administration(s).

As a variant to this method, there would be no limitation to the period within which assignments to terrestrial stations are to be taken into account in the procedure. Also, in order to recognize the incompatibility of terrestrial services with non-GSO BSS (sound) operating in the same service area, administrations having assignments to non-GSO BSS (sound) space stations serving their territory in the overlapping bandwidth would not be considered affected. This variant could be implemented by a simple modification to Section **2** of Appendix **5**, as given in the annex.

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[1] There would be a need to reflect these Rules of Procedure in the body of the Radio Regulations, which has not been done in the example given.

Advantages:

- This approach would ensure long term protection of terrestrial services in this band for the administrations having responded within four month of the non-GSO BSS (sound) system publication and having terrestrial services in operation or to be brought into use within three years of that publication (for the variant, the latter time limitation is removed).
- Compared with Method 1, this method would have the advantage that one single administration on the territory of which the pfd is exceeded could not prevent the non-GSO BSS (sound) system to be recorded with a favourable finding under No. **11.31** and thus be protected.
- For the variant, it would prevent administrations having non-GSO BSS (sound) systems objecting to other non-GSO BSS (sound) systems by requesting for their terrestrial services a level of protection that their own non-GSO BSS (sound) system does not provide within their own territory.

Disadvantages:

- An administration which has not commented within four months of the publication of the non-GSO BSS (sound) system would be deemed to have accepted the interference. Depending on the excess pfd radiated by the non-GSO BSS (sound) space station, this may preclude the deployment of terrestrial services in countries not equipped for timely response to such publications.
- If an administration already operates or brings into service terrestrial stations within three years of the publication of the non-GSO BSS (sound) system (or without this time limitation in case of the variant), it may object to that system and in this case, all its terrestrial stations would be protected in the future, independently from their date of bringing into use. Depending on the stringency of the mask and on the degree of excess of the pfd levels produced by the non-GSO BSS (sound) system, this may entail an element of risk, and thus make deployment of such systems difficult.

Method 3: Coordination procedure of No. 9.11

Under this method, non-GSO BSS (sound) systems would be subject to the coordination procedure of No. **9.11.** The pfd mask adopted by WRC-03 would be used as a threshold in this process, the Bureau would identify the administrations on the territory of which these limits are exceeded and publish their names together with the characteristics of the non-GSO BSS (sound) system. Among these administrations, only those having commented within four months of this publication would be considered affected. Only those terrestrial station assignments already in service or to be brought into service within three years of this publication may constitute a basis for disagreement. Pursuant to No. **9.50.2**, this time limitation of three years may be extended, but only by agreement between the administrations concerned. In case of such a disagreement, the non-GSO BSS (sound) system might be brought into service only if the Bureau has concluded that there is no probability of causing harmful interference (No. **11.32A**) or if it does not cause harmful interference to the assignments which were the basis of the disagreement and are recorded in the MIFR, and if such interference is immediately eliminated upon receipt of advice thereof (No. **11.41**).

As variants to this method, it would be possible to include an explicit agreement, or extension of the period within which assignments to terrestrial stations are to be taken into account in the procedure. This may remove some disadvantages of this method.

Advantages:

- It provides increased flexibility to implement non-GSO BSS (sound) systems.
- It encourages the administrations with terrestrial systems to cooperate with the non-GSO BSS (sound) administration.
- No. **9.11** of the Radio Regulations has been included since several decades to govern the coordination procedure of all non-planned BSS bands for both non-GSO and GSO, in application of Resolutions **507 (WARC-79)** and **528 (WARC-92)** and has been applied by administrations and the Bureau.
- No. **11.41** of the Radio Regulations has been included since several decades to be used in occasional cases in non-planned bands to avoid terrestrial or space systems assignments not yet in operation preventing a real system from being recorded in the MIFR and has helped in the area of non-planned bands in that context.

Disadvantages:

- An administration which has not commented within four months of the publication of the non-GSO BSS (sound) system would be deemed to have accepted the interference. Depending on the excess pfd radiated by the non-GSO BSS (sound) space station, this may preclude the deployment of terrestrial services in countries not equipped for timely response to such publications.
- An administration planning to deploy terrestrial stations may object to the non-GSO BSS (sound) system only on the basis of the characteristics of its terrestrial stations already in service or to be brought into service within three years of the publication of the non-GSO BSS (sound) system. However, this situation could happen in other cases in which the terrestrial service in the non-planned bands are involved and thus it is not a specificity of this very provision (No. **9.11**). Although No. **9.50.2** offers the possibility to extend this period, but only by mutual agreement, this limitation may not be compatible with the deployment of large scale terrestrial networks foreseen in the 2.6 GHz band (such as MMDS or mobile telecommunication networks), which require long-term spectrum redistribution.
- In case of disagreement, the application of No. **11.41** by the non-GSO BSS (sound) system leads to an unclear situation as to the effective level of protection given to the terrestrial services of the administration which has not agreed. This situation could occur in very occasional cases in which No. **11.41** has to be applied and thus it is not a specificity of this very provision (No. **9.11**).

Method 4: A procedure combining two or more of these methods

This method would be an appropriate combination of aspects of two or more of the above methods. The advantages and disadvantages would logically flow from the particular combination that is developed from the methods concerned. In particular, this method would have the advantage to provide more flexibility to resolve the difficulties highlighted in the three methods above.

3.5.4 Regulatory aspects

Resolution **539 (WRC-2000)** was developed in order to enable the development of non-GSO BSS (sound) systems in the band 2 630-2 655 MHz, whilst providing adequate protection to terrestrial services in this band, which was also identified by WRC-2000 for use by IMT-2000. The pfd thresholds in this Resolution have been reviewed by ITU-R, as reported in the previous sections.

Unlike the pfd limits in Article **21**, which give rise to an examination by BR with respect to the conformity of the non-GSO BSS (sound) system with No. **11.31** before publication of non-GSO

BSS (sound) system, the limits in Resolution **539 (WRC-2000)** are thresholds which are used by the Bureau to determine the administrations whose terrestrial services may be affected and from which agreement has to be sought by the non-GSO BSS (sound) administration. In contrast with the situation in the case of hard limits in Article **21**, Resolution **539 (WRC-2000)** therefore allows the non-GSO BSS (sound) system to start acquiring rights in respect of subsequent satellite or terrestrial systems, even if these thresholds are exceeded on the territories of many administrations.

The following Annexes provide possible examples of the regulatory implementation of the three specific methods described in Section 3.5.3. The development of regulatory text for Method 4 would be consequential to any decision on the type of combining of approaches from the other methods. These examples should be carefully reviewed by administrations in order that they fully reflect the methods described in Section 3.5.3 in their regulatory and procedural proposals to WRC-03.

ANNEX 1

Possible example of regulatory implementation of Method 1

(Limits in Article 21, with no examination under No. 9.35)

ARTICLE 5

Frequency allocations

MOD

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of No. ~~**5.416**~~**9.21** ~~and Table **21-4** of Article **21**~~, do not apply to this additional allocation and the provisions of Table **21-4** of Article 21 do not apply to GSO networks using this additional allocation. The u~~U~~se of this allocation by non-geostationary-satellite BSS (sound) systems ~~in the broadcasting-satellite service (sound) is subject to Resolution **539 (WRC-2000)**. (WRC-2000)~~is limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

ARTICLE 9

Procedure for effecting coordination with or obtaining agreement of other administrations[1, 2, 3, 4, 5, 6]

Sub-Section IIA – Requirement and request for coordination

MOD

9.35 *a)* examine that information with respect to its conformity with No. **11.31**[16, 16A]; (WRC-2000)

ADD

16A **9.35.2** When examining under No. **9.35** an assignment subject to No. **21.16.3B** with respect to its conformity with No. **11.31**, the Bureau shall identify and publish, under No. **9.38**, the names of the administrations on the territory of which the pfd limits in Table **21-4** are exceeded. Under this examination, any excess will be considered as in conformity with No. **11.31** until the assignment is examined by the Bureau under Article 11.

ARTICLE 21

Terrestrial and space services sharing frequency bands above 1 GHz

Section V – Limits of power flux-density from space stations

MOD

TABLE **21-4** (WRC-2000)

Frequency band	Service*	Limit in dB(W/m²) for angle of arrival (δ) above the horizontal plane			Reference bandwidth
		0°-5°	5°-25°	25°-90°	
2 500-2 690 MHz 2 520-2 670 MHz 2 500-2 516.5 MHz (No. **5.404**)	Fixed-satellite Broadcasting-satellite[9A] Radiodetermination-satellite	–152 [9]	–152 + 0.75(δ – 5) [9]	–137 [9]	4 kHz
2 630-2 655 MHz (No. **5.418**)	Broadcasting-satellite (sound) (non-geostationary satellite orbit)	–128 [9B, 9C]	–128 + 0.75 (δ – 5) [9B, 9C]	–113 [9B, 9C]	1 MHz
2 630-2 655 MHz (No. **5.418**)	Broadcasting-satellite (sound) (non-geostationary satellite orbit)	[TBD] [9B, 9D]	[TBD] [9B, 9D]	[TBD] [9B, 9D]	1 MHz

NOC

21.17 2) The limits given in Table **21-4** may be exceeded on the territory of any country whose administration has so agreed.

ADD

9A **21.16.3A** These limits do not apply to the BSS (sound) allocation under No. **5.418**.

9B **21.16.3B** In the band 2 630-2 655 MHz, an assignment to a non-geostationary space station in the broadcasting-satellite service (sound) under No. **5.418** shall be considered in conformity with No. **11.31** if all the agreements required under No. **21.17** have been received.

9C **21.16.3C** These values apply to assignments to non-geostationary satellite systems in the broadcasting-satellite service (sound) for which complete Appendix **4** coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000 and the due diligence information has been received by the Bureau before 9 June 2003.

9D **21.16.3D** These values apply to assignments to non-geostationary satellite systems in the broadcasting-satellite service (sound) for which complete Appendix **4** coordination or notification information, as appropriate, has been received by the Bureau after 2 June 2000 and the due diligence information has been received by the Bureau after 9 June 2003.

APPENDIX 5 (WRC-2000)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

1 For the purpose of effecting coordination under Article **9**, except in the case under No. **9.21**, and for identifying the administrations with which coordination is to be effected, the frequency assignments to be taken into account are those in the same frequency band as the planned assignment, pertaining to the same service or to another service to which the band is allocated with equal rights or a higher category[1] of allocation, which might affect or be affected, as appropriate, and which are:

MOD

a) in conformity with No. **11.31**[2]; and

---

2 For the purpose of effecting coordination, an assignment for which the process of obtaining agreement under No. **9.21** has been initiated or which is subject to No. **21.16.3B**, as appropriate, is considered to be in conformity with No. **11.31** with respect to Nos. **9.21** or No. **21.16.3B,** as appropriate.

MOD

TABLE 5-1 (WRC-2000)

Technical conditions for coordination
(see Article 9)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
...					
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz ~~2 520-2 655 MHz~~ ~~2 655-2 670 MHz~~ 2 535-2 655 MHz (GSO BSS (sound) in the countries mentioned in No. **5.418**) 12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	Bandwidths overlap; ~~Resolution **539** **(WRC-2000)** also applies~~	Check by using the assigned frequencies and bandwidths	
...					

ANNEX 2

Possible example of regulatory implementation of Method 2

(Agreement seeking under No. 9.21)

ARTICLE 5

Frequency allocations

MOD

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of ~~No. **5.416** and~~ Table **21-4** of Article **21**~~,~~ do not apply to this additional allocation and No. **9.21** does not apply to GSO networks using this additional allocation. The u~~U~~se of this allocation by non-geostationary-satellite systems in the broadcasting-satellite service (sound) is subject to ~~Resolution **539 (WRC-2000)**. (WRC 2000)~~ agreement obtained under No. **9.21** and limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

APPENDIX 5 (WRC-2000)*

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

2 For the application of No. **9.21**, except for assignments to non-geostationary BSS (sound) space stations subject to No. **5.418**, the agreement of an administration may be required with respect to the frequency assignments in the same frequency band as the planned assignment, pertaining to the same service or to another service to which the band is allocated with equal rights or a higher category of allocation, which may affect or be affected, as appropriate, and:

ADD

2*bis* For the application of No. **9.21** to assignments to non-geostationary BSS (sound) space stations subject to No. **5.418**, the frequency assignments to be taken into account are those in the same frequency band as the planned assignment, to a terrestrial service to which the band is allocated with equal rights and are already operating in conformity with No. **11.31** or planned to be so operated in the future. However, agreement is not required from an administration having an assignment in the same service as the planned assignment, which is also subject to No. **9.21**, and for which the thresholds given in Table **5-1** are exceeded over its own territory.

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* ~~This~~The modification to paragraph 2 in the introductory text of Appendix 5 applies only with respect of the implementation of the variant to Method 2 mentioned in Section 3.5.3.

MOD

TABLE 5-1 (WRC-2000)

Technical conditions for coordination
(see Article 9)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz 2 5~~20~~35-2 655 MHz (GSO BSS (sound) in the countries mentioned in No. **5.418**) ~~2 655-2 670 MHz~~ 12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	i) Bandwidths overlap; ~~Resolution **539** **(WRC-2000)** also applies~~	Check by using the assigned frequencies and bandwidths	

No. **9.21** Terrestrial, GSO, non-GSO/ terrestrial, GSO, non-GSO	A station of a service for which the requirement to obtain the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to No. **9.21**	Band(s) indicated in the relevant footnote	Incompatibility established by the use of Appendices **7**, **8**, technical Annexes of Appendices **30** or **30A**, pfd values specified in some of the footnotes, other technical provisions of the Radio Regulations or ITU-R Recommendations, as appropriate	Methods specified in, or adapted from, Appendices **7**, **8**, **30**, **30A**, other technical provisions of the Radio Regulations or ITU-R Recommendations	
	non-GSO BSS (sound)/ terrestrial	2 535-2 655 MHz (non-GSO BSS (sound) in the countries mentioned in No. 5.418)	i) Bandwidths overlap; ii) in the band 2 630-2 655 MHz, the pfd from a non-GSO BSS (sound) space station calculated under free-space propagation conditions exceeds at any point of the territory of an administration in Regions 1, 2 or 3 the following: a) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has been received by 9 June 2003, -128 dB(W/m^2/MHz) for $0° \le \delta \le 5°$ $-128 + 0.75(\delta - 5)$ dB(W/m^2/MHz) for $5° \le \delta \le 25°$ -113 dB(W/m^2/MHz) for $25° \le \delta \le 90°$ where δ is the angle of arrival above the horizontal plane; b) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has not been received by 9 June 2003, [pfd values to be developed]	Check by using the assigned frequencies and bandwidths	

ANNEX 3

Possible example of regulatory implementation of Method 3

(Coordination under No. 9.11)

ARTICLE 5

Frequency allocations

5.418 *Additional allocation:* in Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand, the band 2 535-2 655 MHz is also allocated to the broadcasting-satellite service (sound) and complementary terrestrial broadcasting service on a primary basis. Such use is limited to digital audio broadcasting and is subject to the provisions of Resolution **528 (WARC-92)**. The provisions of No. **5.416** and Table **21-4** of Article **21**, do not apply to this additional allocation. The u~~U~~se of this allocation by non-geostationary-satellite systems in the broadcasting-satellite service (sound) is ~~subject to Resolution **539 (WRC-2000)**. (WRC 2000)~~ limited to national systems unless agreement has been reached to include the territories of other administrations in the service area, and to operation with a minimum elevation angle over the service area of not less than 40°.

APPENDIX 5 (WRC-2000)

Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9

MOD

TABLE 5-1 (WRC-2000)

Technical conditions for coordination (see Article 9)

Reference of Article 9	Case	Frequency bands (and Region) of the service for which coordination is sought	Threshold/condition	Calculation method	Remarks
No. **9.11** GSO, non-GSO/ terrestrial	A space station in the broadcasting-satellite service (BSS) in any band shared on an equal primary basis with terrestrial services and where the BSS is not subject to a Plan, in respect of terrestrial services	620-790 MHz 1 452-1 492 MHz 2 310-2 360 MHz 2 52~~0~~35-2 655 MHz (No. **5.418**) ~~2 655-2 670 MHz~~ 12.5-12.75 GHz (Region 3) 17.3-17.8 GHz (Region 2) 21.4-22 GHz (Region 1 and 3) 74-76 GHz	i) Bandwidths overlap; ~~Resolution **539** **(WRC-2000)** also applies~~ ii) in the band 2 630-2 655 MHz, the pfd from a non-GSO BSS (sound) space station calculated under free-space propagation conditions exceeds at any point of the territory of an administration in Regions 1, 2 or 3 the following: a) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has been received by 9 June 2003,	Check by using the assigned frequencies and bandwidths	

				–128 dB(W/m^2/MHz) for $0° \le \delta \le 5°$ –128 + 0.75(δ – 5) dB(W/m^2/MHz) for $5° \le \delta \le 25°$ –113 dB(W/m^2/MHz) for $25° \le \delta \le 90°$ where δ is the angle of arrival above the horizontal plane; b) for a non-GSO BSS (sound) space station for which complete Appendix **4** coordination information, or notification information, as appropriate, has been received after 2 June 2000 and Resolution **49** information has not been received by 9 June 2003, [pfd values to be developed]		

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3.6 Agenda item 1.35

"to consider the report of the Director of the Radiocommunication Bureau on the results of the analysis in accordance with Resolution **53 (Rev.WRC-2000)** and take appropriate action"

Resolution **53 (Rev.WRC-2000)**

Updating of the "Remarks" columns in the tables of Article **9A** of Appendix **30A** and Article **11** of Appendix **30** to the Radio Regulations

In response to Resolution 53, BR has produced an initial Report. This Report to Member States of the Union is found in CR/183 dated 7 October 2002. It concerns partial implementation of Resolution 53 (Rev.WRC-2000), updating of the "Remarks" columns in the Tables of Article 9A of Appendix 30A and Article 11 of Appendix 30 to the Radio Regulations. The information made available by the Bureau in CR/183 includes compatibility analyses between R1 and R3 plans and the R2 plan, the R1 and R3 downlink plan to terrestrial services, R1 and R3 plans and FSS (including non-planned BSS), except compatibility analyses from R1 and R3 feeder-link plan earth stations to terrestrial services and FSS earth stations operating in the opposite direction. In Note 1 appearing on pages 9 and 17 of CR/183 of 7 October 2002, the Bureau has indicated that for some FSS satellite networks the relevant Rules of Procedure, including No. 9.35 (see CR/175 of 15 February 2002) have been applied*. Further reports are expected on the impact from terrestrial services, as well as other matters that may be required.

##########

3.7 Agenda item 1.37

"to consider the regulatory and technical provisions for satellite networks using highly elliptical orbits"

3.7.1 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations

The ITU-R has been considering the sharing aspects of highly elliptical orbit (HEO) satellite systems in a number of contexts and under a number of different names in recent years.

HEO systems are a subcategory of non-GSO systems, and hence are subject to all limitations, which may apply to non-GSO systems in the RR unless otherwise specified in the RR, HEO systems could conceivably be employed in any satellite service in any frequency band allocated to that service. The technical characteristics of these systems vary considerably. The ITU-R is studying the ability of HEO systems to co-exist with other HEO systems, with other types of non-GSO systems, with GSO networks and with terrestrial systems, as well as the regulatory provisions that may be applied to HEO systems.

HEO systems are at the stage of advance publication or coordination, or have been notified in the fixed-satellite, mobile-satellite, broadcasting-satellite, inter-satellite, space operations, and space research services in frequency bands from below 225 MHz to above 64 GHz. Some of these are in operation. Various regulatory provisions apply to these systems.

The ITU-R activity to date has focused on HEO type non-GSO FSS and BSS systems in frequency bands up to 30 GHz, and thus the CPM text that follows in this section is similarly focused.

* These Rules of Procedure were contested by some administration.

Relevant ITU-R Recommendations: S.1431, S.1560, S.1328-3, S.1593, S.1595 and DNR SF.[Hesat].

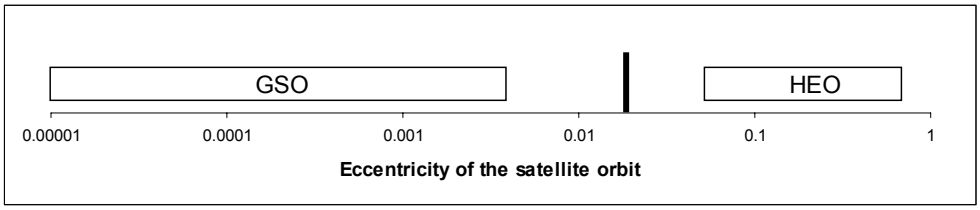
3.7.1.1 Characterization and typical examples of satellite systems using HEO

HEO systems/networks are non-GSO systems. As such, under the current Radio Regulations, a HEO satellite system is treated like any other non-GSO satellite system in the same band and service. However, they have specific characteristics, which have been considered in the ITU-R studies on this issue.

The orbits that have been considered in the ITU-R studies are:

1) an orbit with an eccentricity of at least 0.05 (see Figure below), an inclination between 35 and 145 degrees, an apogee altitude of at least 18 000 km, and a period that is the geosynchronous period (23 hours, 56 minutes) multiplied by m/n where m and n are integers (the ratio m/n may be less than, equal to, or greater than one); or

2) a circular orbit (with an eccentricity of at most 0.005), with the geosynchronous period (23 hours, 56 minutes) and an inclination between 35 and 145 degrees. The second category above has been included in the ITU-R studies because these orbits have characteristics for sharing with the GSO that are similar to HEO systems.



Each satellite in the two categories above has a repeating ground track and provides a space radiocommunication service (other than space operation services) only during a portion or portions of the orbit referred to variously as operational windows, active arcs, or high-latitude stationary arcs (all of these terms are referred to throughout Section 3.7 as "active arc"). The results discussed in the following subsections are intended to include both types of orbit categories described in the prior paragraph, unless otherwise expressly stated.

Studies in ITU-R have shown that many variations in HEO system design and operation are possible. These variations arise because HEO systems and networks have differing missions or differing optimization criteria. Examples of these variations are frequencies; space services; the size of the service area; minimum elevation angles; use of full-motion, limited-tracking, or fixed earth terminal antennas; the size of the active arcs; the number of satellites that operate simultaneously; and the number of active arcs within which a satellite operates. It is recommended that regulations not focus on a small subset or limited range of these characteristics but should be general so as to afford an opportunity for development of HEO systems.

Annex 3.7-1 contains Figures 3.7-1 to 3.7-3 that present the ground tracks of some Highly-Elliptical Orbits (HEO) satisfying the characteristics described in above.

3.7.1.2 Operational features common to HEO satellite systems

HEO systems have specific operational features, which are described hereafter.

a) **Active Arc** - Except for space operations functions, each satellite in an HEO system operates during a specific portion of its orbit. Depending on the orbit period, this portion of the orbit will recur over one or more location on the Earth. The sizes of these active arcs are a function of the particular system design. In order to provide continuous service, at least one satellite from a given HEO system will be in each active arc at all times.

b) **Repeating ground tracks** - Satellites in HEO orbits have repeating ground tracks that fix the active arcs in the sky. Depending on the size of the operational window and the number of satellites within the HEO system, this may help increase frequency reuse between separate systems using these types of orbits. The fixed operational windows in the sky may also result in near-constant look angles from the earth stations.

c) **Antennas of associated earth stations** - Depending on the band and service, earth station antennas may be more or less directional. Depending on the size of the active arc and the directionality of the antenna, the antenna's steerability may vary from full to non-steerable (Fixed).

d) **High elevation angles from HEO earth stations in medium to high latitude regions** - This allows locations that have low elevation angles to the GSO to obtain the benefits of high elevation angles.

e) **Low elevation angles for earth stations in tropical and sub-tropical regions**.

f) **Interval between handovers** - HEO satellites in the same active arcs are able to provide continuous coverage, with many hours between handovers.

g) **Angular discrimination from the geostationary-satellite orbit** - An HEO system can be designed such that there is a large angular discrimination from the geostationary-satellite orbit. For applications in which directional antennas are used and depending on the size of the operational window, this could enhance sharing between a satellite in its operational window and satellites in the geostationary-satellite orbit.

h) **Coverage area** - For certain regions of the world, in medium to high latitudes, a HEO system may serve a very large east-to-west portion of that region that could not be served by a single geostationary satellite.

3.7.2 Analysis of the results of studies

3.7.2.1 Sharing involving HEOs, other non-GSO systems, and GSO networks

The studies in ITU-R have shown that, where HEO earth stations use directional antennas, sharing between as many as nine HEO satellite systems would be possible by using similar orbit parameters and appropriate interleaving between satellites using similar orbital planes. (This conclusion is based on the assumption of an earth station antenna off-axis gain pattern of $36 - 25\text{Log}(\theta)$.) See Recommendation ITU-R S.1593. This however, would require that pre-defined orbital and transmission parameters be included in the RR. Given that ITU has already received filings for a variety of different HEO system designs, it is likely that agreement on the optimum configuration would be difficult to achieve.

Since the studies previously performed by ITU-R on the sharing between inhomogeneous non-GSO satellite systems included HEOs, the use of mitigation techniques would in principle facilitate this sharing. However, the significant difference in operating altitude between HEOs and other types of non-GSO system (particularly low-Earth orbit systems) potentially increases the severity of interference during "in-line" events, and hence increases the degree of mitigation required. The use of satellite diversity as described in Recommendation ITU-R S.1431, may be difficult. Most HEOs simply are not designed to have multiple satellites with multiple beams per satellite capable of simultaneously servicing a given earth station location. See Recommendation ITU-R S.1595. Where earth stations use directional antennas, most HEO systems have the potential for sharing with GSO networks without using satellite diversity, because their inherent design ensures maintenance of large separations between active non-GSO satellites and GSO satellites. As a result, the additional spacecraft and switching strategies necessary to effect satellite diversity are not typically part of the

design of HEO systems, and make its use by such systems in sharing with other types of non-GSO FSS systems (including dissimilar HEO systems) difficult.

The studies previously performed by ITU-R on the sharing between inhomogeneous non-GSO satellite systems assumed a maximum effective number of 3.5 for co-coverage, co-frequency, non-GSO systems, including HEO systems. These studies addressed the bands between 10.7 GHz and 30 GHz. In bands below 10.7 GHz, this number may be different, depending on factors such as the reduced earth station antenna discrimination, the smaller link margins and the deployment scenarios of non-GSO systems.

The ITU-R has developed a methodology for assessing the maximum interference produced by HEO systems at 6/4 GHz into GSO FSS networks (see Recommendation ITU-R S.1560). Application of this methodology shows that peak $\Delta T/T$ values produced into a representative GSO network by a particular type of HEO system at 6/4 GHz are very low (less than 1% in most cases, and always less than 2%). This methodology may also be used in other frequency bands to assess interference levels into GSO networks. However, the use of this methodology (including the $\Delta T/T$ criterion) as a basis for drawing conclusions on possible regulatory measures to protect GSO networks from non-GSO systems producing only long term interference requires further studies (see § 3.7.4.7). ITU-R has also been developing methodologies for assessing the maximum interference produced by HEO systems in the frequency band 10-31 GHz into GSO networks.

In the bands where earth stations (within HEO, other non-GSO systems or GSO networks) use antennas with small angular discrimination, the sharing potential of anyone of these systems is essential very limited.

3.7.2.2 Sharing between FSS systems using HEO satellites and the FS

ITU-R has undertaken initial sharing studies between HEO FSS systems and FS stations to develop the maximum allowable pfd at the surface of the Earth produced by FSS HEO satellites operating in the bands shared with the FS. In these studies, ITU-R recognized that HEO satellites are non-GSO satellites, but are different from the so-called low earth orbit (LEO) satellites and medium earth orbit (MEO) satellites, and that satellites in highly-elliptical orbits have the characteristics described in § 3.7.1.1. Also it was noted that in general only one satellite is active within each active window of a HEO system.

Analysis of the designs of present and future HEO FSS systems shows that, in most such systems, the maximum pfd value at the Earth's surface is produced by a HEO satellite only when it is entering to or exiting from an active window, i.e. when it is at the minimum distance from the Earth while transmitting.

In bands where the FSS is co-primary with the FS, the assessment of sharing conditions should take into account the requirements of both services on an equal basis.

3.7.2.2.1 Nature of interference into the fixed service from different types of satellite orbits

In principle, the interference produced by satellites in the GSO arc is long term in nature, but is limited to specific combinations of FS elevation and azimuth. Since the location of the GSO arc is well defined, it is possible for an FS receive station to mitigate the interference by avoiding the arc, if necessary. The interference produced by non-GSO satellites in low circular orbits is short term in nature, but occurs in a much greater number of combinations of FS elevation and azimuth. Non-GSO FSS satellites in highly-elliptical orbits may repeatedly appear within main beams of some FS antennas for significant durations of time. Unlike the GSO case, the combinations of affected FS elevation and azimuth are not limited to a single arc, but may occur in comparatively wide belts in the sky. It is not practicable for FS receive stations to avoid these belts. For some highly-inclined HEO systems this situation is potentially more critical for FS links which have

approximately North/South alignments and are located in low latitude areas. In addition, at high latitudes, interference into FS side lobes is a concern.

It is recognized that equal treatment should be given to HEOs compared to other non-GSO systems. On this basis, some administrations believe that the determination of the pfd masks should be based on protection of all FS links and that interference exceeding the FS protection criteria should only be accepted in exceptional cases. Some other administrations believe that some of the pfd levels being considered based on protection of all FS links would lead to undue constraints on the development and operation of HEO systems. These other administrations consider that this would be inconsistent with the principle of equal treatment among non-GSO systems and with the fact that FSS/FS sharing in co-primary bands should be based on pfd levels that would adequately, but not fully, protect the FS.

3.7.2.2.2 Power flux-density in the 4 GHz band

One of the features of FS systems operating in the 4 GHz band is that generally they are used for point-to-point (P-P) transmission with multi-state modulation (e.g. 64-QAM) achieving high spectral efficiency. In such systems, it is a general practice to use diversity reception techniques in many hops to overcome adverse effects of multipath fading. It is noted that part of this band is also used for point-to-multipoint (P-MP) systems. Recommendations ITU-R F.1108-2 and SF.1320 recognize that long-haul FS systems are susceptible to interference from satellites and have adopted a formula to calculate fractional degradation in performance (FDP) which is used for evaluating the effects of interference to FS systems employing diversity reception techniques.

ITU-R has been studying sharing between HEO FSS satellites and the FS. The studies showed that the interference produced by the HEO systems into the FS stations depends on the number of visible active satellites and on the orbital parameters. Several studies were performed involving multiple constellations of HEO satellites in 8-hour and 12-hour orbits. For the 8-hour orbit case, one study was based on a total of 45 active HEO satellites (30 in the northern hemisphere and 15 in the southern hemisphere) in a multi-constellation environment. Other studies were based on a total of 18 or 36 active satellites (all in the northern hemisphere) that use 12-hour orbits in a multi-constellation environment. The expected number of active HEO satellites, which should be taken into account while calculating the interference into a FS station, has not been agreed.

In addition, some studies were based on a 10% allowance of FS links exceeding the required criteria (FDP = 10%), while others were based on a ~0% allowance.

Some administrations are of the view that the following existing pfd limits in Table **21-4** of RR Article **21** for FSS in the 4 GHz band are sufficient to adequately protect FS systems from HEO satellite interference:

-128	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-128 + 0.5\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-118	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

On the other hand, some other administrations believe that a tightening of the current Article **21** pfd mask is necessary in order to ensure the protection of the FS, in particular with regard to low elevation angles. These administrations proposed the following pfd masks for the 3.7 to 4.2 GHz band:

Mask A

-136	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-136 + 0.5\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-126	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

or Mask B

-142	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-142 + 0.9\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-124	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

or Mask C

-147	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-147 + 1.15\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-124	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

or Mask D

-158	dB(W/m^2) in 1 MHz	for $0° < \theta \leq 5°$
$-158 + 1.65\ (\theta - 5)$	dB(W/m^2) in 1 MHz	for $5° < \theta \leq 25°$
-125	dB(W/m^2) in 1 MHz	for $25° < \theta \leq 90°$

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free-space propagation conditions.

In particular, it can be noted that Masks A and B are based on a 10% allowance of FS links exceeding the required criteria (FDP = 10%), while Masks C and D are based on a $\simeq$0% allowance. These latter masks (C and D) are intended by some administrations to protect the FS, which mainly operates at low elevation angles, and meet the need of high pfd level at high elevation for HEO satellites. These same administrations are of the view that current Article **21** pfd limits, as well as masks A and B, would unduly constrain existing and future FS links. Some other administrations are of the view that Masks C and D would unduly constrain the design of HEO satellites, and render HEOs impracticable in this band.

Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency band 3.7 - 4.2 GHz are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd mask that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.3 Power flux-density in the 11 GHz band

Unlike the bands below 10 GHz, usually FS systems in the 11 GHz band do not employ diversity reception techniques and, therefore, the effects of satellite interference in terms of FDP can be evaluated by averaging the interference-to-thermal noise ratio. Some sharing studies, based on a 10% or less allowance of FS links exceeding the required criteria (FDP = 10%), show that the existing pfd limits in Table **21-4** of RR Article **21** for non-GSO FSS systems are acceptable for HEO satellites, these being that the maximum pfd at the surface of the Earth by emissions of a HEO satellite should not exceed the following values:

in the band 10.7 to 11.7 GHz, in any 1 MHz band:

−126	dB(W/m^2)	for 0° $< \theta \leq$ 5°
−126 + 0.5 (θ – 5)	dB(W/m^2)	for 5° $< \theta \leq$ 25°
−116	dB(W/m^2)	for 25° $< \theta \leq$ 90°

in the band 11.7 to 12.7 GHz, in any 1 MHz band:

−124	dB(W/m^2)	for 0° $< \theta \leq$ 5°
−124 + 0.5 (θ – 5)	dB(W/m^2)	for 5° $< \theta \leq$ 25°
−114	dB(W/m^2)	for 25° $< \theta \leq$ 90°

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free space propagation conditions.

Some other administrations noted that the same assumption concerning the interference allowance was not considered when assessing the above Article **21** pfd limits for circular orbit non-GSO satellites in the previous study period. These same administrations are of the view that these current Article **21** pfd limits would unduly constrain existing and future FS links. On this basis, they identified additional pfd masks intended to protect the FS, which mainly operates at low elevation angles, and meet the need of high pfd level at high elevation for HEO satellites. These masks would apply to the entire 10.7-12.75 GHz range, as follows:

Mask E

−147	dB(W/m^2) in 1 MHz	for 0° $< \theta \leq$ 5°
−147 + 1.75 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \leq$ 25°
−112	dB(W/m^2) in 1 MHz	for 25° $< \theta \leq$ 90°

or Mask F

−149	dB(W/m^2) in 1 MHz	for 0° $< \theta \leq$ 5°
−149 + 3 (θ – 5)	dB(W/m^2) in 1 MHz	for 5° $< \theta \leq$ 15°
−119 + 3 (θ – 15)/10	dB(W/m^2) in 1 MHz	for 15° $< \theta \leq$ 25°
−116	dB(W/m^2) in 1 MHz	for 25° $< \theta \leq$ 90°

where θ is the arrival angle above the horizontal plane. The pfd values should be calculated under free space propagation conditions.

Those administrations supporting the continued application of the current Article **21** limits for non-GSO FSS systems to HEO systems are of the view that masks E and F would unduly constrain the design of HEO satellites and render HEOs impracticable in these bands.

ITU-R has not agreed on which of the masks stated above is adequate to protect the FS in the 11 GHz band from HEO satellite interference. Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency band 10.7-12.75 GHz are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd mask or masks that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.4 Power flux-density in other FSS bands shared with the FS

ITU-R studies on sharing between HEO FSS and the FS in other shared bands below 42.5 GHz have commenced.

For the 18 and 38/40 GHz bands, some Administrations are of the opinion that the current Article **21** pfd limits for non-GSO FSS are adequate to protect the FS from HEO satellite transmissions.

On the other hand, based on studies presented within ITU-R by one administration, some other administrations are of the view that tightening of the pfd limits compared to those for other non-GSO systems, mainly at low elevation angles, would be necessary in order to ensure the adequate protection of the FS.

Therefore, it was agreed that further sharing studies between HEO FSS and FS systems in the frequency bands above are required, if possible before WRC-03, in order to determine whether there is a need to modify the current Article **21** limits and, if there is, to determine the relevant pfd masks that will adequately protect the FS and, at the same time, will reflect HEO FSS satellite requirements.

3.7.2.2.5 Interference from FS systems to FSS HEO space stations

FSS systems comprised of constellations of HEO satellites may operate in the same frequency bands shared with the FS. FSS earth stations may be designed to operate at high elevation angles in medium to high latitude regions. As a consequence, satellite antenna patterns may be less sensitive in the direction of the Earth's limb and, therefore, FS stations might not need to avoid pointing at HEO satellites.

Proponents of FSS systems employing HEO satellites should be aware of the existing fixed service power limits in Nos. **21.3** and **21.5**.

3.7.2.2.6 Coordination between earth stations of FSS HEO systems and FS stations

RR Appendix **7**, which covers earth stations operating with non-GSO satellites, can be applied to the determination of coordination area for an earth station of FSS HEO systems in frequency bands shared with FS systems.

3.7.2.3 Sharing involving HEO BSS systems and terrestrial services

Analysis of results of studies of non-GSO, including HEO, BSS (sound) systems in the band 2 630-2 655 MHz are presented in Section 3.5 above, in response to WRC-03 agenda item 1.34.

The ITU-R discussions covered No. **5.311** of the Radio Regulations regarding the bringing into use of assignments to the broadcasting-satellite service in the band 620-790 MHz shared with equal rights with the broadcasting service. There are few GSO systems operating in accordance with No. **5.311**. There is no non-GSO system (HEO or not) currently operating in this band. Also, several systems (HEO and GSO) have recently been the subject of advance publications in this band. The RRB is expected to address this issue based on the conclusion of the ITU-R. The impact of such HEO systems on the broadcasting service is currently under study by ITU-R.

In relation to the pfd limits in No. **5.311** and in Recommendation **705 (WARC-79)**, ITU-R needs to determine the adequacy of these pfd limits to protect the terrestrial BS from single entry and aggregate interference caused by non-GSO HEO BSS systems and GSO BSS networks.

The use of the band 620-790 MHz by the broadcasting service in Region 1 and in a number of countries in Region 3 is subject to revision by RRC 04/05. Some administrations consider that no action should be taken regarding the sharing between HEOs and terrestrial broadcasting services until the conclusion of RRC 04/05.

The question of the protection of terrestrial services requires further study, noting that the current limits in No. **5.311** were developed as interim values. These studies are currently conducted by ITU-R and should take into account, in particular, the expected characteristics of the terrestrial and space systems in the band, the type of modulation used, the maximum number of HEO satellites that may be operated simultaneously, and the need for a single entry pfd limit and/or an aggregate pfd limit. Views were expressed that it would be inappropriate to draw conclusions regarding the form and levels of the protection criteria and their modes of application until all such information has been taken into account and the studies have been completed.

3.7.2.4 Other frequency bands and radio services

Combinations of frequency bands and radio services, other than those mentioned above, have not been studied. As a consequence, there are no analyses of results to report.

3.7.3 Methods to satisfy the agenda item

3.7.3.1 Background

Depending on the frequency band, three ways have been identified in the Radio Regulations in order to specify the regulatory framework for sharing between non-GSO (including HEO) systems and GSO networks.

- Application of No. **22.2** without specific additional regulatory provisions.
- Application of No. **22.2** with additional regulatory provisions to:
  a) quantify it (and thus clarify the status of non-GSO systems); and
  b) impose hard limits on the power radiated by non-GSO systems into GSO networks (and thus clarify the status of GSO networks).
- Replacement of No. **22.2** by coordination between GSO and non-GSO systems.

The applicability of any one of these approaches to HEO systems in any frequency band depends on the specific regulatory situation in that band, the current and expected use of the band by GSO networks and HEO systems, the possible burden on administrations and the Bureau, and the maturity of the ITU-R studies on the issue.

Some studies submitted to ITU-R concluded that, taking into account the characteristics of HEO systems, criteria and calculation methodologies different from those applied for other non-GSO systems may be applied to HEO systems to assess interference from these systems into other systems or networks.

Some administrations take the view that the intention of WRC-2000 in proposing the inclusion of this item in the agenda of WRC-03 was limited to a possible description of highly elliptical orbits and minimum regulatory provisions as a starting point which could be a way forward for further ITU-R studies and possible consideration at a future Conference. They believe that it was in no way intended that all regulatory and procedural aspects of HEOs should be addressed by ITU in one study period.

3.7.3.2 Definition of HEO systems in the Radio Regulations

Geostationary satellites and the GSO are defined in Nos. **1.189** and **1.190** of the Radio Regulations independent of use, design characteristics, radio service, frequency band, etc. Likewise, LEO and MEO are defined in Recommendation ITU-R S.673 solely in terms of their orbital characteristics. The description of HEO in Section 3.7.1.1 is the same; such a description does not and should not involve any system characteristics. This generality of description is important for HEOs since their current use is low and development should not be constrained by a description that restricts system design options. Consequently, there is no need to modify Article **1**.

3.7.3.3 Status of HEO systems in respect of GSO networks and other non-GSO systems

Satellite networks using HEOs should continue to be considered as non-GSOs, and have the same regulatory standing with regard to co-frequency GSO networks as other types of non-GSOs, such as MEOs and LEOs.

3.7.3.4 Data elements in Appendix 4

Some regulations applicable to HEO systems, as a subset of non-GSO systems, already exist in Articles **21** and **22** and Appendix **4**. It may be desirable to add/modify several data elements to Appendix **4** (mean motion; eccentricity; inclination; longitudes of apogees; arguments of perigees; active arc extents (may be specified as time relative to the time of highest latitude); the index position in each ground track (a mean anomaly at a cited epoch, from which all satellite positions are to be measured); and spacing in ground track (in mean anomaly, or alternatively, time of cited point crossing)).

If these data elements are added or modified, there should be no regulatory limitation on their values in order to allow full flexibility to the operator.

3.7.3.5 Sharing between HEO FSS systems and the fixed service

In the 3.7-4.2 GHz and 10.7-12.7 GHz bands, ITU-R studies have been carried out in order to identify appropriate maximum pfd levels for the protection of fixed service systems from interference produced by HEO FSS systems. However, ITU-R has been unable to reach a conclusion on this issue. Further study of the sharing situations in these bands is required.

3.7.4 Regulatory and procedural considerations

3.7.4.1 HEO MSS systems below 3 GHz

In the bands allocated to the MSS below 3 GHz, non-GSO and GSO MSS systems enjoy the same regulatory footing and are required to coordinate under No. **9.11A**. Thus there does not appear to be need for any regulatory change to these allocations to facilitate the introduction of HEO systems.

3.7.4.2 HEO BSS systems below 1 GHz

It was noted that, in addition to the other applicable procedures, No. **23.13** also applies to the operation of GSO BSS and non-GSO HEO BSS systems in bands below 1 GHz, and that some administrations consider that the current Rules of Procedure do not properly cover the case when an administration requests that its territory be excluded from the satellite service area in real terms.

3.7.4.2.1 Sharing between HEO BSS systems and GSO BSS systems below 1 GHz

The band 620-790 MHz is allocated to the BSS under the conditions No. **5.311**.

The use of this allocation by non-GSO BSS systems is also subject to the application of No. **22.2**, in order to protect GSO BSS systems.

Concerning the application of this provision and the relative status of HEO BSS and GSO BSS in this band, the discussions in the ITU-R lead to three different views:

a) In this band, it may be assumed that earth station antennas with no or very limited angular discrimination, will be used by GSO systems, HEO systems, and by other non-GSO systems. This means that the sharing potential of anyone of these systems is inevitably very limited and GSO systems do not provide, from this point of view, any specific advantage that would warrant any sort of priority. For this reason, it would be consistent to modify the radio regulations so that the same regulatory situation applies to all these satellite systems, i.e. to apply Nos. **9.12, 9.12A and 9.13** as a replacement for the application of No. **22.2**. It was noted that, in a similar case, coordination procedures between non-GSO systems and

GSO networks have been implemented (Nos. **5.418A, B** and **C** in the band 2 630-2 655 MHz).

b) In this band, HEO BSS systems have been allowed since WARC-71. However, no such systems have been implemented up to now. WRC-97 extended the application of No. 22.2 to protect GSO BSS networks from non-GSO systems and therefore GSO BSS systems should continue to be protected by No. **22.2**, and HEO systems should continue to protect GSO BSS networks irrespective of their date of receipt by the Bureau.

c) In this band, GSO BSS systems should continue to be protected by No. **22.2**, but there would be a need to quantify the level of interference that is considered acceptable under this provision, in order to clarify the regulatory status of both GSO networks and HEO systems in the band.

It was concluded however that, since the protection of the broadcasting-satellite service from the HEO broadcasting-satellite service is still under study in ITU-R, any decision to suppress the application of No. **22.2** in this band should be deferred until completion of the ITU-R studies.

3.7.4.2.2 Sharing between BSS systems and the broadcasting service below 1 GHz

Resolution 33 (Rev.WRC-97) on the bringing into use of space stations in the BSS, prior to the entry into force of agreements and associated plans for the BSS, resolves that for satellite networks for which the API has been received after 1 January 1999 the procedures of Article **9** shall be applied regarding the coordination procedure with terrestrial stations. Within these procedures, No. **9.11** applies to GSO and non-GSO transmit space stations in respect of terrestrial services.

No. **5.311** of the Radio Regulations indicates a pfd limit of –129 dBW/m^2 (see Rec. 705) for space stations at angles of arrival below 20° with no mention as to the orbit of the concerned BSS space station (GSO or non-GSO).

Concerning the procedures to be applied by BSS systems in order to protect the broadcasting service the following conclusions have been reached:

a) For angles of arrival below 20°, the limit of –129 dBW/m^2 per space station is a hard limit associated with examination under No. **11.31**. The value of this limit requires further study.

b) For angles of arrival above 20° the pfd mask contained in Recommendation 705 (WARC-79), possibly modified in view of the results of ITU-R studies, may be applied. Such ITU-R studies are proceeding, including consideration of possible regulatory procedures for the application of the pfd values.

3.7.4.3 Bands allocated to BSS (sound) between 1 and 3 GHz

The band 2 535-2 655 MHz is allocated to BSS (sound) in the nine countries covered by No. **5.418**, i.e. Bangladesh, Belarus, Korea (Rep. of), India, Japan, Pakistan, Singapore, Sri Lanka and Thailand.

In the sub-band 2 630-2 655 MHz, No. **22.2** no longer applies for the protection of GSO FSS or BSS networks received after 3 June 2000. The associated regulatory provisions applicable to the use of non-GSO BSS (sound) systems are specified in Nos. **5.418A, 5.418B** and **5.418C**. Application of Nos. **9.12A** and **9.13** is specified for coordinating between GSO and non-GSO in this band. No. **9.12** applies for the coordination between non-GSO systems.

The use of the other sub-band (2 535-2 630 MHz) in these nine countries is subject to the provisions of Resolution **528** (WARC-92), i.e. cannot be used by BSS sound until a planning conference has been convened.

The other bands allocated to BSS (sound) between 1 and 3 GHz are the following:

1 452-1 492 MHz in Regions 1, 2 and 3 (except in the USA)
2 310-2 360 MHz (in the countries covered by No. **5.393**, i.e. USA, India and Mexico)

In these bands, the use of BSS (sound) by GSO systems is protected from non-GSO systems by No. **22.2**, as a result of a change to this provision at WRC-97. Pursuant to Resolution **528 (WARC-92)**, the band 1 452-1 467 MHz cannot be used by BSS sound until a planning conference has been convened. This future planning conference may consider regulatory provisions to accommodate HEO systems in the 1 452-1 492 MHz, 2 310-2 360 MHz and 2 535-2 655 MHz bands.

In the band 2 310-2 360 MHz, both GSO and non-GSO systems are now operating. Its use has been successfully coordinated through the bilateral negotiation process under the current regulatory procedures, thus no further regulatory action is required. Moreover, it is noted that none of the administrations listed in No. **5.393** have expressed a need for any regulatory change with regard to GSO/non-GSO BSS (sound) sharing in the 2 310-2 360 MHz band.

In the band 1 467-1 492 MHz, consideration may be given to the introduction of non-GSO HEO systems on an equitable basis with GSO networks, for reasons similar to those given in Section 3.7.4.2 a) above. This may be done in a similar way as decided by WRC-2000 in the band 2 630-2 655 MHz in the countries covered by No. **5.418**, by replacing the application of No. **22.2** by coordination between non-GSO and GSO systems (Nos. **9.12, 9.12A** and **9.13**). Any changes to the Radio Regulations in the 1 467-1 492 MHz band should be made only after taking into account the technical and regulatory requirements of the HEO BSS (sound) systems proposed to operate in the band, operational GSO BSS (sound) networks in the band, and other allocated services.

3.7.4.4 HEO BSS (and not specifically BSS sound) or HEO FSS between 1 and 3 GHz

The following bands are allocated to the BSS or FSS between 1 and 3 GHz:

2 500-2 690 MHz	FSS (space-to-Earth) in Region 2
2 500-2 535 MHz and 2 655-2 690 MHz	FSS (space-to-Earth) in Region 3
2 520-2 670 MHz	BSS in Regions 1, 2 and 3

In these bands, No. **22.2** applies for the protection of GSO FSS and GSO BSS, with the exception of the band 2 630-2 655 MHz in the countries listed in No. **5.418**. The operation of FSS or BSS systems is limited by Nos. **5.415** and **S5.416**, to national and regional systems, subject to agreement obtained under **No. 9.21**. The power flux-density at the Earth's surface must not exceed the values given in Article **21**, Table **21-4**. These values are expected to require the use of receive earth station antennas with sufficient size to provide enough discrimination for sharing among GSO networks and HEO systems.

Two views have been expressed on this subject:

a) Facilitating the use of these bands by non-GSO HEO systems may be achieved by the adoption of sharing criteria specifying the level of acceptable interference, i.e. quantifying No. **22.2**, as was done by WRC-97 and WRC-2000 in some bands between 10.7 GHz and 30 GHz. Alternatively, No. **22.2** may be replaced by coordination between GSO networks and HEO systems, through Nos. **9.12, 9.12A** and **9.13.** This may be achieved with or without the establishment of thresholds to trigger these coordinations. In both cases, the sharing criteria could be based on epfd thresholds/limits which may be included, respectively in Article **22** or in Appendix **5**. These may be derived on the basis of a representative range of GSO transmissions (antenna sizes, patterns and system noise

temperatures), a maximum effective number of non-GSO systems and an agreed upon aggregate noise increase allowance. These aspects require further studies within the ITU-R and may be the subject of a WRC-03 resolution.

b) No specific regulatory action is required. Changes to the Radio Regulations should be made on the basis of an identified need, and taking into account the technical and regulatory requirements of systems proposed to operate in the band. No requirement has been identified within the ITU-R for the use of such frequency bands for HEO BSS (non-sound) and HEO FSS and therefore such systems in the 1-3 GHz band need not be considered under this agenda item.

3.7.4.5 HEO FSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and no epfd limits are given in Article 22

In the 6/4 GHz, HEO FSS systems (i.e. MOLNYA) have been operating for the last 30 years. There is also a recent filing (USAKU-H2) for a HEO system, and this system, which has been studied in the ITU-R, is one in which transmissions to or from the non-GSO satellite are not made within 40° of the GSO as viewed from any point on the Earth's surface (see Section 3.7.2.1 above). In this frequency range, the introduction of HEO FSS systems and networks may make it desirable to adopt sharing criteria quantifying the level of acceptable interference, hence facilitating compliance by administrations operating such systems or networks with the obligations under **22.2**.

These sharing criteria could take the form of epfd limits in Article **22**. These limits may be derived on the basis of a representative range of GSO transmissions (antenna sizes, patterns and system noise temperatures), a maximum effective number of non-GSO systems and an agreed upon aggregate noise increase allowance. These aspects require further studies within the ITU-R and may be the subject of a WRC-03 resolution. Depending on the results of studies obtained in time for WRC-03, WRC-03 may consider developing appropriate changes to the relevant Radio Regulations.

No studies have been conducted by the ITU-R in bands other than the 6/4 GHz bands where No. **22.2** applies and no epfd limits are given in Article **22**. Some administrations have expressed an interest in studying sharing conditions in other frequency bands that fall within the scope of this section. At this time, however, no need has been identified for any possible changes to the Radio Regulations in conjunction with HEO systems in these bands under this agenda item.

3.7.4.6 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 9.11A applies

In these frequency bands non-GSO and GSO systems enjoy the same regulatory status and are required to coordinate under No. **9.11A**. Thus there does not appear to be a need for any regulatory change to these allocations to facilitate the introduction of HEO systems.

3.7.4.7 HEO FSS, MSS and BSS systems in bands above 3.4 GHz where No. 22.2 applies and epfd limits are given in Article 22

In these bands, it is possible to use for HEOs the same interference assessment methodologies, regulatory approaches and limits already developed by the ITU-R for non-GSO systems. In the frequency bands where Nos. **22.5C** and **22.5D** apply, the FSS satellite systems using highly-elliptical orbits have to meet epfd↓, epfd↑ and $epfd_{is}$ limits.

These epfd↓ limits may also be expressed as a percentage increase of the GSO network link noise temperature ($\Delta T/T$) into a range of GSO earth station antenna diameters and associated example noise levels. In the band 10.7-12.7 GHz, the applicable long term epfd↓ limits correspond to $\Delta T/T$ levels ranging from 0.2 to 1.1%. In the band 17.8-18.6 GHz, they correspond to $\Delta T/T$ levels ranging

from 1.2 to 2.3%. In the band 19.7-20.2 GHz, they correspond to ΔT/T levels ranging from 0.04 to 0.09%.

There is therefore a large variation (more than 15 dB) between long term ΔT/T allowances which correspond to the applicable limits in the various frequency bands. These long-term epfd limits were based on previous ITU-R studies and decisions taken at WRC-2000 and were based on the assumption that non-GSO systems may produce both short term and long term interference. The epfd caused by many types of HEO system into GSO networks is almost time invariant. For these HEOs, compliance with the epfd↓ validation limits is dominated by the long-term epfd↓ limits. In the 10.7-12.7 GHz band and in the 17.8-18.6 GHz band studies have shown that HEO systems having orbital inclinations greater than about 30° are generally able to meet the single-entry epfd↓ limits in No. **22.5C** and there should be no need for changes to the current epfd↓ limits in these bands.

With respect to the 19.7-20.2 GHz band, however, some administrations have stated that it is difficult for some HEO systems to meet the epfd↓ limits which currently apply in this band. Some other administrations have stated that it can be shown that the existing epfd↓ limits at 19.7-20.2 GHz can be met by some HEO systems. ITU-R has concluded that further study is required to determine if the existing epfd↓ limits are overly constraining on HEO systems in the 19.7-20.2 GHz band.

It was suggested that in order to have a more consistent treatment of HEO systems (and possibly of other non-GSO systems) across the various frequency bands, epfd↓ limits be developed in the 19.7-20.2 GHz band, based on a ΔT/T or other possible long term allowance, which would more accurately characterize the interference produced by HEO systems into GSO networks, hence would be more appropriate for HEO systems whilst providing the same overall protection to GSO networks. However, before specific values can be proposed for such limits, more studies are required in the following areas:

- The applicability or otherwise of the antenna patterns in Recommendation ITU-R S.1428 to HEO/GSO interference;
- the maximum effective number ($N_{effective}$) of HEO systems that may share the same frequency band and contribute to the interference into any given GSO network;
- the aggregate long-term allowance for the noise increase produced by all non-GSO systems (including HEO systems);
- the combined effect of interference produced into GSO networks by HEO systems and other non-GSO systems;
- the potential consequential requirement to review the current epfd limits for other non-GSO systems in the 19.7-20.2 GHz band.

Depending on the results of studies obtained in time for WRC-03, WRC-03 may consider developing appropriate changes to the relevant Radio Regulations for the band 19.7-20.2 GHz.

Concerning the use of the Earth-to-space allocations by HEO systems, the ITU-R studies concluded that the current regulatory provisions (including epfd↑ and $epfd_{is}$ limits) in the bands 13.75-14.5 GHz and 17.3 to 30 GHz provide a satisfactory sharing scheme between GSO networks and any type of non-GSO systems, including HEO systems, hence no changes are needed within the scope of this agenda item.

The coordination approach for GSO networks with very large earth station antennas adopted by WRC-2000 in **9.7A** and **9.7B** applies to all bands subject to epfd↓ limits.

3.7.4.8 Other combinations of radiocommunication services and frequency bands

Combinations of frequency bands and radiocommunication services, other than those mentioned above, have not been studied under this agenda item. It is therefore premature to identify any possible changes to the Radio Regulations in conjunction with HEO system/network use of particular combinations of frequency bands and radio services.

3.7.5 General

It is considered that, should WRC-03 decide to suppress the application of No. **22.2** and to apply Nos. **9.12**, **9.12A** and **9.13** in a particular frequency band allocated to a space service, there would be a need to specify the associated transitional arrangements, e.g. in a footnote of Article **5** or in a WRC Resolution referred to by such a footnote. In such a case, a possible example of such transitional arrangements would be the following:

ADD

5.TTT In the band XX MHz, No. **22.2** shall continue to apply to assignments to non-geostationary satellite systems in the [specified space service] for which complete notification information is considered to have been received by the Bureau prior to [day following the end of WRC-03] in respect of assignments to geostationary satellite networks in the [specified space service] for which complete coordination information is considered to have been received by the Bureau prior to [day following the end of WRC-03]. In all other cases, the use of the band XX MHz by networks or systems in the [specified space service] is subject to the application of the provisions of Nos. **9.12**, **9.12A** and **9.13**, and No. **22.2** does not apply.

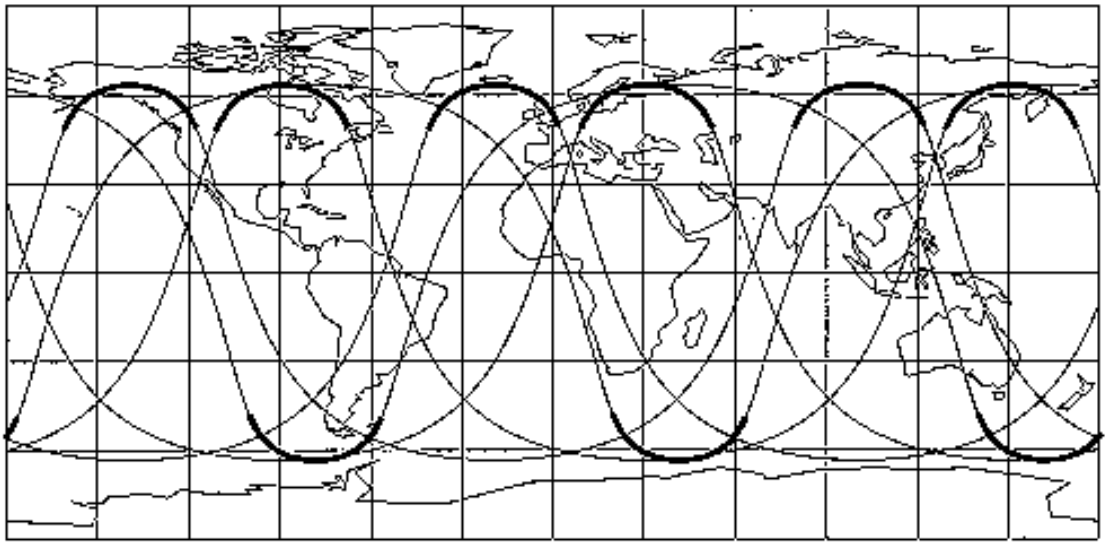
It was also considered that, should WRC-03 decide to suppress the application of No. **22.2** in a particular band, there may be other possible approaches to effect coordination between geostationary satellite networks and non-geostationary satellite systems in that band than applying Nos. **9.12**, **9.12A** and **9.13**.

Annex 3.7-1

Figures 3.7-1 to 3.7-3 present the ground track of some Highly-Elliptical Orbits (HEO) satisfying the characteristics described in Section 3.7.1 above:

FIGURE 3.7-1

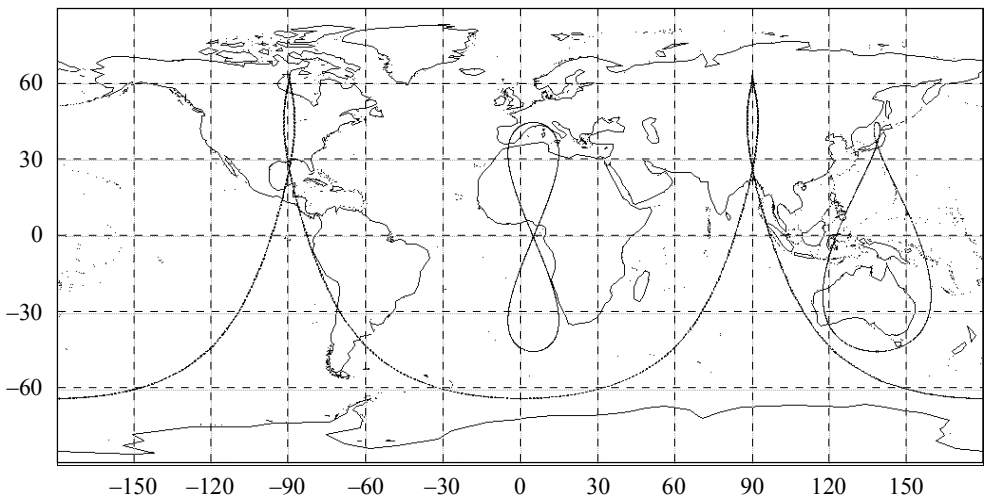
Ground tracks (two Northern Hemisphere, one Southern Hemisphere) of the USAKU-H2 sub-geosynchronous orbit system (period: 7 hours 59 minutes) (m = 1; n = 3)



CPM02-0371
146496

FIGURE 3.7-2

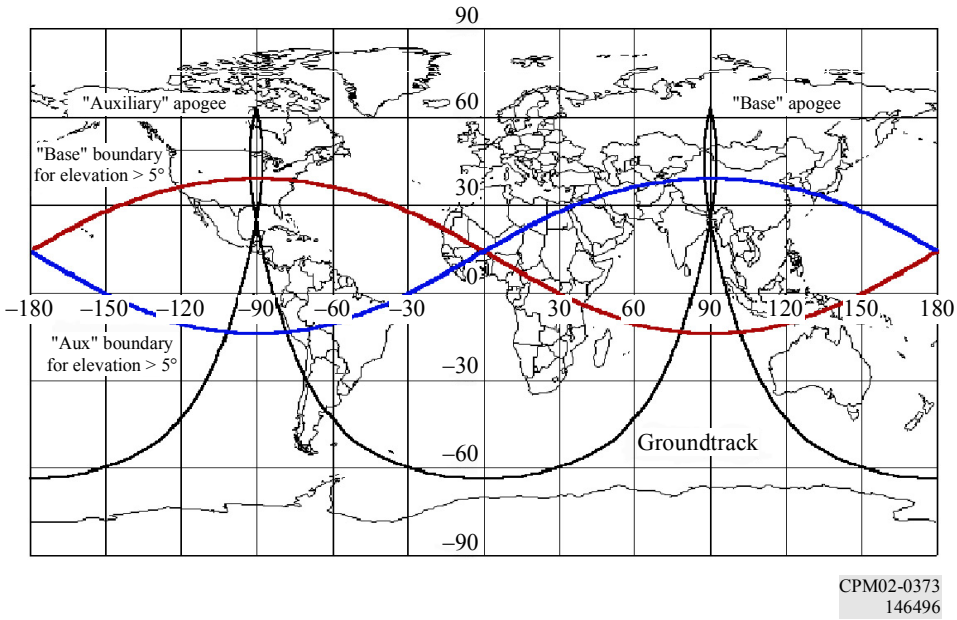
Example of a ground track of
geosynchronous elliptical orbit system (period: 23 hours and 56 minutes) (m = 1; n = 1)
geosynchronous circular orbit system (period: 23 hours and 56 minutes) (m = 1; n = 1)
super-geosynchronous sytem (period: 47 hours and 52 minutes) (m = 2; n = 1)



CPM02-0372
146496

FIGURE 3.7-3

Example of MOLNIYA orbit system (m = 1; n = 2) (period: 11 hours and 58 minutes)



Annex 3.7-2

Statement from Syria, Iran and India:

WRC-2000, in its Resolution 800, under further *resolves* 8 recommended to the Council that the additional budgetary and conference resources be provided so that 4 additional items (8.1-8.4) of that Resolution now appear on agenda item 1.36-1.39 in Resolution 1156 of the Council 2001 can be included in the agenda item for WRC-03.

When Council reviewed Resolution 800 (WRC-2000) at its 2001 session, it was stated that the inclusion of these 4 additional items in the agenda of WRC-03 would not have a great financial impact neither in budgetary terms nor in Conference resource terms.

The way ITU-R proceeding in this regard, in particular with respect to agenda item 1.37, has already had considerable amount of budgetary and meeting resources even before the matters being discussed at WRC-03.

Various ITU-R Study Groups including WPs 4A, 6S, 4-9S and other Working Parties have devoted enormous amount of time and resource to prepare draft CPM text.

At its 2002 April meeting, WP 4A spent tens of hours including Saturday and Sunday to embark upon this very broad agenda item.

Moreover, the intention of WRC-2000 of possible inclusion of this item in the agenda of WRC-03 was limited to a possible description of Highly Elliptical orbit and minimum regulatory provision as a starting point which could be a way forward for its further development and elaboration at future conference and ITU-R Study Groups.

WRC-2000 in no way intended to dwell on this very complex issue form all aspects, in all frequency bands and in every type of orbit. In no way it intended to study all regulatory and procedural aspects of HEO in one shot and by ITU-R Study Groups. The regulatory and procedural aspects of HEO are very broad, complex, multi-dimensional and are not normally within the mandate of Study Groups.

For these reasons, this administration reserves its right with respect of the inclusion of the premature text relating to regulatory matters of HEO in the draft CPM text.

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3.8 Agenda item 1.39

"to examine the spectrum requirements in the fixed-satellite service bands below 17 GHz for telemetry, tracking and telecommand of fixed-satellite service networks operating with service links in the frequency bands above 17 GHz"

3.8.1 Summary of technical and operational studies including a list of relevant ITU-R Recommendations

WRC-03 Agenda item 1.39 identifies the need to examine the spectrum requirements in the fixed-satellite service (FSS) service bands below 17 GHz for Telemetry, Tracking and Command (TT&C) of FSS networks operating in the frequency bands above 17 GHz. As a consequence, Question ITU-R 257/4 was revised to include the following issues:

1) What are the performance reliability criteria and objectives of TT&C subsystem operation for the FSS?

2) How do TT&C subsystems for networks using service links above 17 GHz differ from those for networks using service links below 17 GHz?

3) What is the additional coordination burden that must be taken into account in order to accommodate increased usage of spectrum in the bands below 17 GHz bands for TT&C subsystems for FSS networks with service links above 17 GHz?

4) What are the spectrum requirements for the telemetry, tracking and control of FSS satellites, both GSO and non-GSO, operating and planned to operate in the bands above 17 GHz?

3.8.1.1 Technical and operational characteristics of FSS TT&C systems

The results of a parametric analysis on some of the key elements that effect operations above 17 GHz show that it may be difficult to implement TT&C in-band for service links above 17 GHz since these operations are required to be reliable and the performance of TT&C links above 17 GHz is limited by a number of factors.

In the following parametric analysis of command uplinks and telemetry downlinks in the 30/20 GHz and the 50/40 GHz bands, a link in the 14/11-12 GHz range was used as a baseline.

On the uplink, the "threshold" pfd of the reference 11/14 GHz band satellite network was used to calculate the receive power level at the input to the command receiver on the spacecraft. This receive power level was assumed to be a constant required power level for nominal operations. The "threshold" pfd level for the 14 GHz band (reference domestic satellite network) was –90 dB(W/m²). Apart from the threshold pfd, the other parameters which were assumed to be the same across all three frequency bands were the command signal bandwidth, telemetry signal bandwidth and spacecraft transmit power, specified as 1 300 kHz, 300 kHz, and –20 dBW respectively.

The earth station transmitter power levels for the 30 GHz and 50 GHz bands were 600 W and 50 W respectively. Transmit and receive antenna gains of 52.4 dBi and 46.5 dBi were used for the 30 GHz and the 50 GHz bands respectively.

Based on a typical 11/14 GHz band link design, the availabilities achieved on the command uplinks and the telemetry downlinks for satellites are typically on the order of 99.98%. These availabilities are achieved in the 11/14 GHz band under normal operation and are used as guidelines for determining what achievable levels or performance would be acceptable in other frequency bands such as the 30/20 GHz and the 50/40 GHz bands. Note that only the "normal" mode of operation is considered in the sensitivity analysis since the performance achieved under emergency conditions is not the determining factor for TT&C links. Figure 3.8-1 shows the minimum elevation angles over which uplink command and downlink telemetry links may operate with a minimum availability of 99.98 % for rain rates ranging from a minimum of 10 mm/h to a maximum of 100 mm/h.

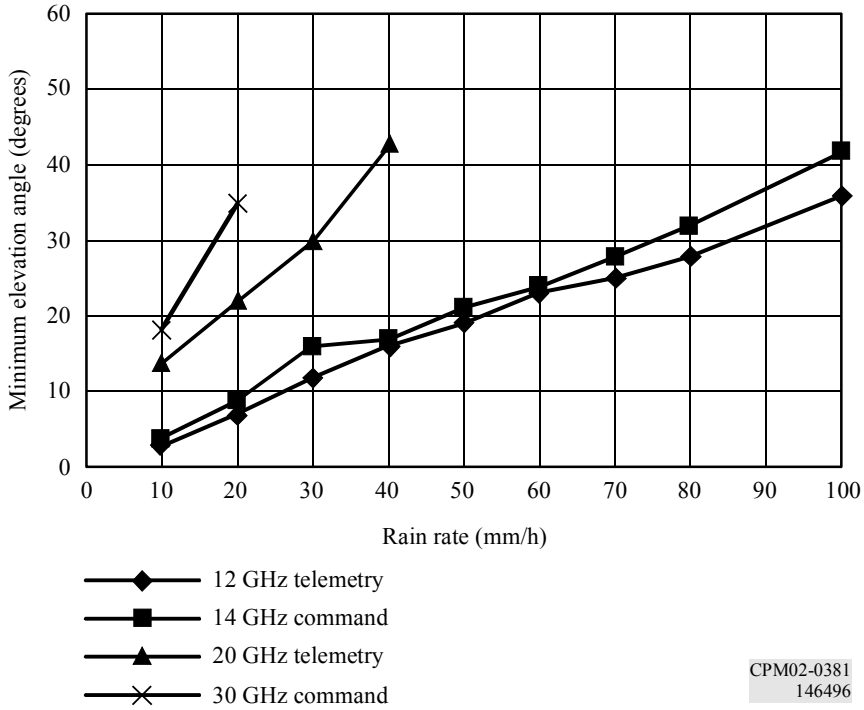
In the 40 GHz frequency band, an availability of only 99.97% could not be achieved for the lowest rain rate and elevation angle examined (10 mm/h and 60° respectively). For 50 GHz, the availability objective of 99.98% was not achieved by any rain rate or elevation angle. An availability of less than 99.9% in the best case was achieved in the 50 GHz frequency band for the command uplink.

It was concluded that there are constraints on TT&C carriers above 17 GHz to achieve availabilities greater than 99.98%, depending on the rain rate and on the elevation angle of the TT&C earth station.

FIGURE 3.8-1

Comparison of TT&C performance at 14/11-12 GHz versus frequencies above 17 GHz

Minimum elevation angle that permits an availability of 99.98% as a function of rain rate



3.8.1.2 Coordination of TT&C carriers

No specific ITU-R Recommendations specify the protection criteria for TT&C carriers. However Recommendation ITU-R BO.1505 contains coordination thresholds for space operation carriers operating in the guard-bands of the BSS Plan contained in Appendices **30** and **30A**.

3.8.1.2.1 Characteristics of TT&C carriers related to interference analysis

One study showed that the minimum and maximum power density levels of the TT&C carriers are not substantially more sensitive nor have more potential for causing interference than standard 64 kb/s QPSK 3/4 rate FEC digital carriers. In the study it was found that in the minimum TT&C carrier level case, the downlink telemetry carriers were more sensitive by approximately 5 dB, while in the case of the maximum carrier levels the uplink command carriers were generally more interference causing by about 4 dB. It should however be noted that two important considerations ease the coordination of the TT&C carriers of any two satellite networks:

a) TT&C carriers occupy a small portion of the satellite bandwidth and through appropriate frequency planning they are usually accommodated.

b) TT&C earth stations usually employ large antennas which reduce the input power requirements and interference susceptibility.

3.8.1.2.2 Coordination between communication carriers and TT&C carriers

Some operators have used a single entry criterion of C/I > 21 dB in intersystem coordination with other satellite networks. This criterion allows them to successfully coordinate their TT&C carriers for more than 20 years.

3.8.1.2.3 Coordination between TT&C carriers

A study used a threshold of 1 dB below the minimum sensitivity level to which a command receiver on the spacecraft can respond. This threshold was used as a basis to establish the minimum spacing of adjacent satellites. This minimum spacing is needed to ensure that under the condition where either the wanted carrier is not being transmitted or where it is severely attenuated due to a rain fade event, that the command receiver cannot be "captured" by the interfering satellite network.

The study calculated the aggregate interference from uplink earth stations transmitting to the four closest adjacent satellite networks spaced at multiples of 2° apart. Given a command receiver interference sensitivity of -125 dB(W/m^2) and an uplink antenna diameter (9 m) of the one 14/11 GHz band system analysed, the effect of varying the antenna size in increments of approximately 2 m up to a maximum of 15 m was examined to assess the impact of antenna diameter on the minimum satellite spacing.

The results of the study showed that for a 9 m uplink antenna, the spacing between satellites would have to be no less than 12° to permit frequency reuse. If the antenna size was increased to 15 m, the spacing between the satellites could be reduced to as little as 8°. Based on this fact, when both wanted and interfering command carriers are emitted with the same power levels, it leads to an aggregate C/I ratio of 52 dB.

However, based on a single entry C/I requirement of 30 dB and on the assumption that all TT&C carriers are emitted with the same power levels, another study showed that a co-frequency TT&C carrier could be reused on an adjacent satellite 3^o away.

3.8.1.3 TT&C carrier bandwidths

Typically the guard-bands at the upper and lower end of the spectrum used for communications links are used for TT&C operations. Thus, only 5 to 10 MHz of spectrum uplink and downlink are

usually available for pilot signals, beacons and TT&C operations. Increasing the amount of spectrum for use by TT&C operations could require some operators to incur reductions in capacity or costs associated with changing the frequency plans employed in their satellite infrastructures. Given that each command uplink occupies on the order of 1.25 MHz bandwidth, the available spectrum for in-band TT&C operations in the 14/11-12 GHz frequency band is already limited. Most GSO FSS spacecraft typically utilize two uplink command carriers, one primary and the other as backup, each may be transmitted on one or multiple polarizations. However, only one command carrier is transmitted at any given time. The allocated bandwidth of a command carrier generally ranges from 1.0 to 1.5 MHz.

Most spacecraft typically utilize two downlink telemetry channels (i.e. two carriers/frequencies) which are transmitted on one or multiple polarizations. Depending on the specific spacecraft, the telemetry information could be transmitted on one channel or simultaneously on both channels. The allocated bandwidth of a telemetry carrier generally ranges from 350 to 600 kHz.

For ranging, lower frequency sub-carriers are often included in the command channel and transmitted to the spacecraft, down-converted and retransmitted back to earth on the telemetry carrier. Therefore, in this case, no additional bandwidth is required for ranging carriers.

3.8.1.4 TT&C spectrum requirements based on satellite network filings

A review of the requests for coordination received by the Radiocommunications Bureau for assignments to the service links of satellites in the FSS primary allocations above 17 GHz, coupled with an assessment, based on the responses to Circular Letter CA/99, of the orbital spacing needed for frequency re-use by TT&C carriers, led to the following deductions:

i) To date there have been no request for assignments to FSS service links above 74 GHz, and hence this analysis examined only the FSS primary allocations between 17 and 74 GHz.

ii) Up to now about half of the FSS satellites with services above 17 GHz are designed to operate their TT&C carriers below 17 GHz.

iii) Based on the amount of spectrum currently available to the FSS the eventual number of satellites with service payloads between 17 and 74 GHz is estimated to be about twice the number with service payloads below 17 GHz.

iv) TT&C frequencies below 17 GHz can be re-used at intervals of about 3° around the GSO based on the typical antenna diameters provided in response to CA/99, the assumption that each TT&C carrier is emitted with the same power levels and a single entry C/I=30 dB.

v) Of the FSS satellites currently filed for service links above 17 GHz the maximum number per 3 degrees of the GSO is 21, and the average is about 10.

vi) The average satellite needs a bandwidth of about 4.5 MHz in an Earth-to-space band for telecommand, and about 3.3 MHz in a space-to-Earth band for telemetry.

Making the interpretation in i) and assuming that the trend in ii) continues, deductions iv), v) and vi) indicate that, to meet the TT&C needs of currently foreseen fixed-satellite services above 17 GHz the amount of spectrum required below 17 GHz is as follows:

- in heavily used parts of the GSO, $21/2 \times 4.5 \cong 47$ MHz up and $21/2 \times 3.3 \cong 35$ MHz down;
- in regions of average GSO use, $10/2 \times 4.5 \cong 22.5$ MHz up and $10/2 \times 3.3 \cong 16.5$ MHz down.

Experience suggests that the satellites in a significant proportion of the current filings will not actually be implemented, and this factor would reduce the estimates for TT&C spectrum. On the other hand, further filings for fixed-satellite services between 17 and 74 GHz and above may be expected in the future, and this would increase the estimates for TT&C spectrum. On the

assumption that these two effects will be of similar magnitude, the above estimates are considered to be of the right order.

However, it should be noted that in those regions of the GSO where the bands below 17 GHz allocated to the FSS (and also those allocated to Space Operations) are heavily used it may be difficult to coordinate additional TT&C links. Some FSS bands below 17 GHz are less heavily used than others: in certain countries the bands 3 400-3 600 MHz (space-to-Earth), 5 725-5 850 MHz (Earth-to-space), 7 025-7 075 MHz (Earth-to-space), 13.75-14.0 GHz (Earth-to-space) are currently such bands.

3.8.2 Analysis of results of studies

Under the current regulatory environment, TT&C links for FSS networks may be implemented in any FSS band, and thus far have been successful in meeting their TT&C spectrum requirements within the existing 6/4 GHz, 14/10-11 GHz, and higher frequency bands. However, future TT&C requirements for satellites operating above 17 GHz might put additional constraints on the bands below 17 GHz if they do not operate in their service link bands.

It was determined that the expected TT&C spectrum requirements below 17 GHz to meet the needs of currently foreseen fixed-satellite services operating above 17 GHz would be approximately 47 MHz uplink, and 35 MHz downlink in the heavily used parts of the GSO, and approximately 22.5 MHz uplink and 16.5 MHz downlink in those parts of the GSO with average use.

Multi-band satellites operating in bands below 17 GHz and having existing TT&C systems reduce the overall need for additional TT&C spectrum for GSO FSS networks operating above 17 GHz. In addition, most GSO FSS networks operate their TT&C carriers in the guard bands at the edges of their operating bands allowing for the successful coordination of these carriers between FSS networks.

The current flexibility to accommodate these additional spectrum requirements for TT&C command uplinks in bands below or above 17 GHz should meet the needs of FSS networks in the foreseeable future.

3.8.3 Methods to satisfy the agenda item and their advantages and disadvantages

In view of the above, it is considered that no action is required to satisfy this agenda item.

3.8.4 Regulatory and procedural considerations

Based on the current use of the existing FSS allocations, the studies do not indicate that any new regulatory/procedural provisions would be required to meet the spectrum requirements for the operation of TT&C below 17 GHz for FSS systems with service links above 17 GHz. Therefore, it is considered that no regulatory or procedural action is required to satisfy this agenda item.