ATTACHMENT 1

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Special Committee Regulatory/Procedural Text for Agenda Item 1.13

> **1.13:** *on the basis of the results of the studies in accordance with Resolutions 130 (WRC-97), 131 (WRC-97) and 538 (WRC-97):*
>
> **1.13.1:** *to review and, if appropriate, revise the power limits appearing in Articles **S21** and **S22** in relation to the sharing conditions among non-GSO FSS, GSO FSS, GSO broadcasting-satellite service (BSS), space sciences and terrestrial services, to ensure the feasibility of these power limits and that these limits do not impose undue constraints on the development of these systems and services;*
>
> **1.13.2:** *to consider the inclusion in other frequency bands of similar limits in Articles **S21** and **S22**, or other regulatory approaches to be applied in relation to sharing situations;*

This document contains modifications to **S22.5C** and **S22.5E**, along with corresponding changes to **Table S22-1** and **Table S22-3**. The modifications incorporate a dual mask approach for application of Equivalent Power Flux Density ("EPFD") levels to NGSO FSS systems.

Background Information: The ITU-R is tasked to determine epfd limits to protect GSO FSS links from NGSO FSS interference. ITU-R S.1323 provides criteria to protect GSO FSS systems from NGSO FSS interference and indicates that, *inter alia*, the aggregate interference produced by NGSO FSS networks should be responsible for at most 10% of the time allowance for the given BERs (or *C/N* values) as specified in the short-term performance objectives of the desired network. In order to satisfy this requirement, JTG 4-9-11 has been working to develop an aggregate EPFD mask that meets the 10% unavailability criteria. The aggregate mask would then be disaggregated in order to produce a single entry EPFD mask that would be applied to all NGSO systems.

It has become evident, however, that adoption of just one aggregate EPFD mask and just one single entry mask would be unnecessarily restrictive on NGSO networks. Different NGSO network designs can have significantly different EPFD interference characteristics without a disproportionate impact on the underlying 10% unavailability criteria. Therefore, the draft CPM text included herein provides two aggregate EPFD masks for NGSO networks operating in the Ku-band. Each aggregate EPFD mask would be developed to satisfy the 10% unavailability criteria. Each mask would then be disaggregated using the total value for "N" to produce two single entry masks, either one of which could be utilized by NGSO systems to protect GSO networks.

MOD **ARTICLE S22**

Space services

Section II – Control of interference to geostationary-satellite systems

* * *

MOD **22.5C** § 5 1) The equivalent power flux-density[2], at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Tables **S22-1A and S22-1B**, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in either Tables **S22-1A or S22-1B** for the given percentages of time. A non-geostationary-satellite system subject to Tables **S22-1A** and **S22-1B** must comply with the limits provided in either Table **S22-1A** or Table **S22-1B**, but not both, nor a combination of values from each Table. The~~se~~ limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth specified in Tables **S22-1A and S22-1B**, for all pointing directions towards the geostationary-satellite orbit. (WRC-97)

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[2] **S22.5C.1** The equivalent power flux-density is defined as the sum of the power flux-densities produced at a point on the Earth's surface by all space stations within a non-geostationary-satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing towards the geostationary-satellite orbit. The equivalent power flux-density is calculated using the following formula:

$$epfd = 10 \cdot \log_{10}\left[\sum_{i=1}^{N_s} 10^{pfd_i/10} \cdot \frac{G_r(\theta_i)}{G_{max}}\right]$$

where:

N_s: number of non-geostationary space stations visible from the point considered at the Earth's surface, within an elevation angle greater than or equal to 0°;

i: index of the non-geostationary space station considered;

pfd_i: power flux-density produced at the point considered on the Earth's surface in dB(W/m^2) in the reference bandwidth;

θ_i: angle between the direction considered towards the geostationary-satellite orbit and the direction of the interfering space station in the non-geostationary-satellite system;

$G_r(\theta_i)$: gain (as a ratio) of the receive reference antenna to be considered as part of a geostationary-satellite network;

G_{max}: maximum gain (as a ratio) of the above receive reference antenna;

$epfd$: computed equivalent power flux-density in dB(W/m^2) in the reference bandwidth.

NOTE – Tables **S22-1** to **S22-4** and Nos. **S22.26** to **S22.29** contain provisional limits corresponding to an interference level caused by one non-geostationary fixed-satellite service system in the frequency bands to be applied in accordance with Resolutions **130 (WRC-97)** and **538 (WRC-97)**. These provisional limits are subject to review by ITU-R and are subject to confirmation by WRC-99. (WRC-97)

MOD

TABLE S22-1A (WRC-97)

Frequency band allocated to the broadcasting-satellite service	**Antenna diameter (cm)**	**Equivalent pfd level (dB(W/m²/4Khz)) which may not be exceeded during the percentage of time shown**		**Reference antenna radiation pattern**
		99.7%	100%	
11.7-12.5 GHz in Region 1, 11.7-12.2 GHz and 12.5-12.75 GHz in Region 3	30 60 90	–172.3 –183.3 –186.8	–169.3 –170.3 –170.3	Recommendation ITU-R BO.1213
12.2-12.7 GHz in Region 2	45 100 120 180	–174.3 –186.3 –187.9 –191.4	–165.3 –170.3 –170.3 –170.3	§ 3.7.2 of Annex 5 of Appendix **S30**
17.3-17.8 GHz in Region 2	For further study*			

* The interference from non-geostationary fixed-satellite service (non-GSO FSS) systems into geostationary broadcasting-satellite service (GSO BSS) systems operating in the frequency bands 17.3-17.8 GHz relates to the two following sharing situations:

– non-GSO FSS transmit earth station into GSO receive earth station;

– GSO BSS transmit space station into non-GSO FSS receive space stations.

Both situations need to be studied, in particular since coexistence of receive BSS earth stations and large numbers of transmit non-GSO FSS terminals would not be feasible within the same country

ADD

TABLE S22-1B

Frequency band allocated to the broadcasting-satellite service	Antenna diameter (cm)	Equivalent pfd level (dB(W/m²/4kHz)) which may not be exceeded during the percentage of time shown	Reference antenna radiation pattern
		100%	
11.7-12.5 GHz in Region 1, 11.7-12.2 GHz and 12.5-12.75 GHz in Region 3	30 60 90	–[ ] –[ ] –[ ]	Recommendation [ ]
12.2-12.7 GHz in Region 2	45 100 120 180	–[ ] –[ ] –[ ] –[ ]	§ 3.7.2 of Annex 5 of Appendix **S30**
17.3-17.8 GHz in Region 2	For further study*		

* The interference from non-geostationary fixed-satellite service (non-GSO FSS) systems into geostationary broadcasting-satellite service (GSO BSS) systems operating in the frequency bands 17.3-17.8 GHz relates to the two following sharing situations:

– non-GSO FSS transmit earth station into GSO receive earth station;

– GSO BSS transmit space station into non-GSO FSS receive space stations.

Both situations need to be studied, in particular since coexistence of receive BSS earth stations and large numbers of transmit non-GSO FSS terminals would not be feasible within the same country

* * *

MOD **S22.5E** 3) The equivalent power flux-density[4], at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Tables **S22-3A** and **S22-3B**, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in either Table **S22-3A** or Table **S22-3B** for the given percentages of time. A non-geostationary-satellite system subject to Tables **S22-3A** and **S22-3B** must comply with the limits provided in either Table **S22-3A** or Table **S22-3B**, but not both, nor a combination of values from each Table. The~~se~~ limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions into all the reference antennas and in the reference bandwidths specified in Tables **S22-3A and S22-3B**, and for all pointing directions towards the geostationary-satellite orbit. (WRC-97)

MOD

TABLE **S22-3A** (WRC-97)

~~PART A~~

Frequency band (GHz)	**Equivalent pfd dB(W/m²)**	**Percentage of time during which equivalent pfd level may not be exceeded**	**Reference bandwidth (kHz)**	**Reference antenna diameter, and reference radiation pattern**
10.7-11.7; 11.7-12.2 in Region 2; 12.2-12.5 in Region 3 and 12.5-12.75 in Regions 1 and 3	–179	99.7	4	60 cm, Rec. ITU-R S.465-5
	–192	99.9	4	3 m, Rec. ITU-R S.465-5
	–186	99.97	4	3 m, Rec. ITU-R S.465-5
	–195	99.97	4	10 m, Rec. ITU-R S.465-5
	–170	99.999	4	60 cm, Rec. ITU-R S.465-5
	–173	99.999	4	3 m, Rec. ITU-R S.465-5
	–178	99.999	4	10 m, Rec. ITU-R S.465-5
	–170	100	4	≥ 60 cm, Rec. ITU-R S.465-5

[4] **S22.5E.1** See No. **S22.5C.1**. (WRC-97)

ADD

TABLE **S22-3B**

Frequency band (GHz)	**Equivalent pfd dB(W/m²)**	**Percentage of time during which equivalent pfd level may not be exceeded**	**Reference bandwidth (kHz)**	**Reference antenna diameter, and reference radiation pattern**
10.7-11.7; 11.7-12.2 in Region 2; 12.2-12.5 in Region 3 and 12.5-12.75 in Regions 1 and 3	–172.1	100	4	60 cm, Rec. [_____]
	–178.1	100	4	1.2 m, Rec. [_____]
	–181.6	100	4	1.8 m, Rec. [_____]
	–186.7	100	4	3 m, Rec. [_____]
	–194.1	100	4	7 m, Rec. [_____]
	–197.2	100	4	10 m, Rec. [_____]

ADD **S22.5E.1** 4) The equivalent power flux-density[4], at any point on the Earth's surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service in the frequency bands listed in Table **S22-3.1**, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Table **S22-3.1** for the given percentages of time. The limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions into all the reference antennas and in the reference bandwidths specified in Table **S22-3.1**, and for all pointing directions towards the geostationary-satellite orbit. (WRC-97)

[4] **S22.5E.1** See No. **S22.5C.1**. (WRC-97)

MOD

TABLE **S22-3.1** (WRC-97)

~~PART B~~

Frequency band (GHz)	Equivalent pfd dB(W/m^2)	Percentage of time during which equivalent pfd level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern
17.8-18.6	–165 –151	99.0	40 1 000	30 cm, Rec. ITU-R S.465-5
	–165 –151	99.0	40 1 000	70 cm, Rec. ITU-R S.465-5
	–165 –151	99.5	40 1 000	90 cm, Rec. ITU-R S.465-5
	–167 –153	99.8	40 1 000	1.5 m, Rec. ITU-R S.465-5
	–180 –166	99.9	40 1 000	5 m, Rec. ITU-R S.465-5
	–184 –170	99.9	40 1 000	7.5 m, Rec. ITU-R S.465-5
	–188 –174	99.9	40 1 000	12 m, Rec. ITU-R S.465-5
	–165 –151	100	40 1 000	30 cm to 12 m, Rec. ITU-R S.465-5
19.7-20.2	–154 –140	99.0	40 1 000	30 cm, Rec. ITU-R S.465-5
	–164 –150	99.9	40 1 000	90 cm, Rec. ITU-R S.465-5
	–167 –153	99.8	40 1 000	2 m, Rec. ITU-R S.465-5
	–174 –160	99.9	40 1 000	5 m, Rec. ITU-R S.465-5
	–154 –140	100	40 1 000	30 cm to 12 m, Rec. ITU-R S.465-5

Reasons: In establishing appropriate EPFD limits for NGSO networks operating in the Ku-band, it has become evident that the adoption of just one aggregate EPFD mask and just one single entry mask would be unnecessarily restrictive on NGSO networks. Different NGSO network can produce significantly different EPFD interference characteristics without a disproportionate impact on the underlying 10% unavailability criteria. For example, the interference characteristics of one proposed NGSO network, USAKUM1, results in only a 0.6% increase in unavailability for GSO networks – just a small fraction of the 10% aggregate increase in unavailability allowable for all NGSO systems. Despite this small impact on unavailability, however, USAKUM1 may not be able to comply with the EPFD mask currently under consideration by JTG 4-9-11 because the mask was modeled using a significantly different NGSO network, USAKUL1.

Adoption of two EPFD masks could significantly increase the spectral efficiency of NGSO networks by permitting network operators to design constellations based on the best means available to achieve the networks' mission requirements, rather than on satisfying an EPFD mask that was optimized for a different network. The additional flexibility could also ease the burden on NGSO FSS operators attempting to develop efficient spectrum sharing regimes with other NGSO FSS systems – particularly systems that may be developed at a later date following the launch of one or more initial NGSO networks. Finally, the use of two EPFD masks to regulate NGSO networks would result in little or no increase in administrative burden for the ITU-R.

Certificate of Service

I, Elizabeth Allen, do hereby certify that on this 14th day of April, 1999 I have caused a copy of the foregoing "Reply Comments Of The Boeing Company" in ET Docket No. 98-206 to be served either by hand delivery or First Class U.S. Mail upon the persons listed below.

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