GSOA
GLOBAL SATELLITE OPERATORS ASSOCIATION

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The 3rd India Spectrum Management Conference

WRC23 & WRC27 Satellite Agenda Items 1.15, 1.16, 1.17, 1.18, 7 & 10

18 October 2023

What are the pros of Satellite Communications?

Satcom to provide universal and meaningful connectivity everywhere, doubling the number of connected people by 2030

140% growth of satcom broadband users for APAC by 2030

By 2030 via Satcoms 81 million students will benefit from satcom tele-education
&
74 million people from satcom tele-medicine by 2030

Today's society relies on **connectivity**

Terrestrial infrastructure is limited and leaves a connectivity gap

Satcom to bridge gap and **provide universal** and **meaningful connectivity** to all

More than 500 million people will connect via Satcom by 2030

twice as much as today

* Sources: VVA elaboration based on ITU (2022); Statista (2022); CNBC (n.d); Satellite Industry Association (2022)

VVA Valdani Vicari & Associati

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The socio-economic impact of Satellite Communications

By 2030, global socio-economic benefits of Satcom to surpass $256 Billion

Broadband delivery for households, education, healthcare, emergency and critical services

$52 billion socio-economic benefits for **350 million** people by 2030*

Media broadcasting (satellite TV and radio)

Socio-economic benefits expected to stabilize at **$86 billion** by 2030**

Broadband on the move

Socio-economic benefits to skyrocket from **$15 billion** in 2022 to **$121 billion** in 2030***

The success of the industry depends on a favourable regulatory environment, assumed to be stable over the years to come

Sources: VVA elaboration based on * World Bank (2022); ITU (2022); ** Statista (2022); Satellite Industry Association (2022); *** Statista (2022); London School of Economics (2018)

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Agenda Item 1.17 (ISL)

- There are two methods: Method A (NOC) and Method B (conditions for ISL). Method B has various alternatives, summarised in the table below. The key issues are highlighted.

Issue	Alternatives
Type of allocation	**FSS (s-s) /** ISS
Concept of operation for NGSO-GSO links*	**Within the cone / extended cone.**
Types of services	**Any ISL / limited to SRS, SOS, EES and ISM .Any type of service should be allowed**
Protection of NGSO from NGSO-NGSO links	**9.12 coordination / hard limits.**
Protection of NGSO from NGSO-GSO links	**Hard EIRP limits in the range -17.5 to -15 dBW/Hz. Potentially larger reference bandwidth. Supports -15 dBW/Hz and/or a larger (e.g. 14MHz) reference bandwidth**
Protection of Iridium	**Very stringent hard PFD limit in the uplink and PFD limit in the downlink. Possible coordination in the downlink. These limits are unnecessarily stringent, and we can make them more reasonable.**
Altitude limit for NGSO user stations to protect OneWeb	**No user stations / tight EIRP limit in the 900-1290 km altitude range. Prefer to see minimum constraints on ISL operation**
Protection of GSO	**Operation within the envelope of the FSS network (no hard limit option).**
Protection of terrestrial	**Limits from: Article 21 / section 3.1 of Annex 3 to Res 169 / section 3.2 of Annex 3 to Res 169. Supports Art. 21 limits**

* Only operation within the cone is proposed for NGSO-NGSO links

Agenda Item 7 Topic A (NGSO tolerances)

Method	Description
A1	NOC
A2 (Option 1 and 2)	**Tolerances specified in Resolution, allowing temporary variations, non-compliant space stations discounted**
A2 (Option 2)	Updated orbital elements filed at notification stage, making it a 2-step approach
A3	Administrations file the tolerances for their systems
A4	Based on periodic reporting of orbital parameters, with deviation being subject to re-filing

Key issues:

- **Size of the tolerances**. promotes small tolerances to promote space sustainability
- Which services and bands should the tolerances apply to, e.g. those mentioned in Res 35
- What orbits the tolerances should apply to, e.g. should HEO or high orbits be excluded

Agenda Item 7 Topic J (Res 76 – aggregate EPFD limits)

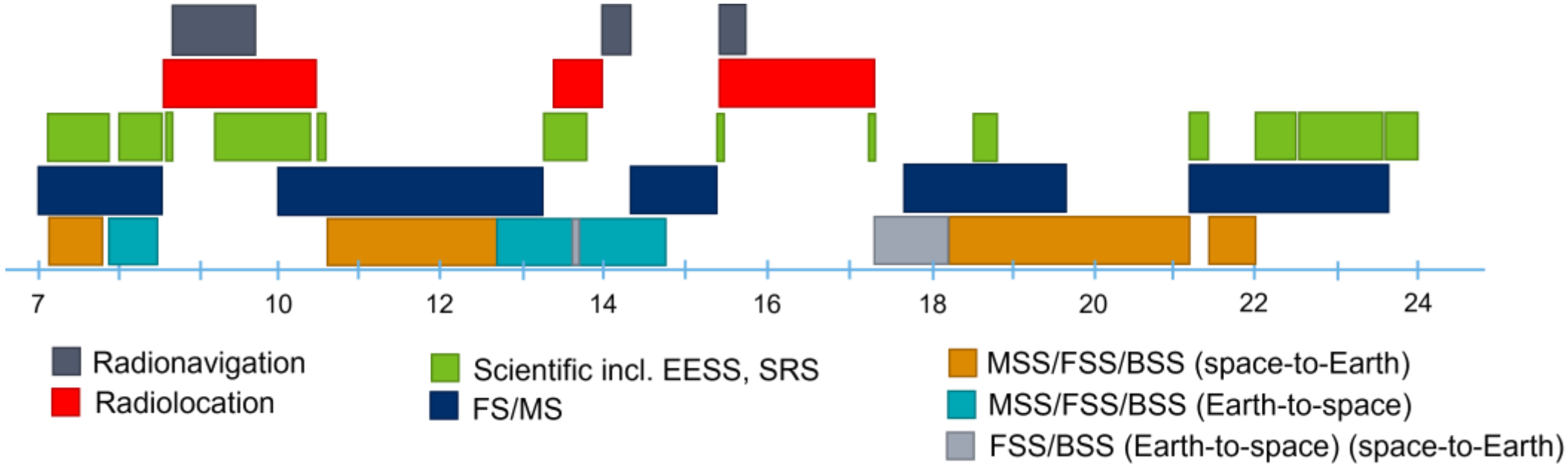
Method	Description
J1	NOC
J2, Option 1 CAN	**Hold regular consultation meetings once a methodology for calculating the aggregate EPFD is available. Only operational NGSO systems are considered**
J2 Option 2 CHN	Hold regular consultation meetings once a methodology for calculating the aggregate EPFD is available. Both operational and planned NGSO systems are considered
J3 Option 1 F	Similar to J2, Option 1, but also requires a second methodology on how to adjust the operation of systems in case the aggregate EPFD is exceeded. Includes ToR for consultation meetings
J3 Option 2	**Similar to J2, Option 1. Includes ToR for consultation meetings**
J4 ASMG, ATU	Same as J3 Option 1, but also considers planned NGSO systems. A note to address the gap before the availability of the recommendations
J5	Calls for further studies on the consultation process

Agenda Item 10 – WRC27

Some of the Key Agenda items under consideration:

- ISL in L-band and C-band
- Q/V-band ESIMs (probably for both GSO and NGSO)
- FSS in 43.5-45.5 GHz
- IMT in 7-15 GHz

Agenda Item 10: 7-15 GHz GSOA Position



GSOA disagrees with the proposal under AI10 for new IMT identification in the 7-15 GHz for WRC-27

- 7-15 GHz shared among various services & very congested
- Frequency range already considered for IMT in WRC-15, but no large continuous band as possible
- Since 2015, thousands more LEOs & new HTS, VHTS, & SDS GSO satellites using Ku & Ka bands came into service
- Several AIs in WRC-23 - ISL, ESIMs - show possible additional usage for satellite on those bands
- IMT obtained 17.5 GHz of mmWave, mostly unused, additional 2 GHz under consideration in WRC-23 AIs

RR 21.5 (Implementation of limits for AAS antennas)

- This issue was not discussed at the CPM

Issue	Options	Support
Bands	26 GHz and 28 GHz only All FS/MS bands used for satellite uplinks	CEPT GSOA
Method	TRP Apply limit per element	GSOA, CEPT GSMA, USA, KOR
Bandwidth adjustment factor	Yes No	GSOA CEPT, GSMA
Bandwidth (if used)	200 MHz for 26/28 GHz	GSOA

Agenda Item 9 Article 21 (RR21.5 and Table 21-2) GSOA position & Implementation

GSOA POSITION

- **RR21.5 power limits should apply to all stations in the fixed or mobile service including IMT stations**
- For the band 24.25 - 29.5 GHz, apply Article 21 to AAS antennas for stations in the fixed or mobile service including IMT stations through **confirmation of the RR21.5 limit of +10dBW using the Total Radiated Power (TRP) of the antenna with a reference bandwidth of 200MHz** (as per WRC-19 studies)
- **Update Table 21-2 to apply TRP** to frequency bands shared with equal rights with fixed or mobile services (including for IMT stations**)** & those not yet included:
  - FSS allocations in 24.65 - 25.25 GHz (Region 1), 24.75-25.25 GHz (Region 2), 42.5 - 43.5 GHz, 47.2 -50.2 GHz, 50.4 - 51.4 GHz and 81 - 86 GHz.
  - MSS allocations in 43.5 - 47 GHz, 66 - 71 GHz, and 81-84 GHz; ISS allocations to be assessed

IMPLEMENTATION

1. BR Director to issue guidance based on the TRP of the entire antenna array of active elements

2. Add definition of TRP for the "power delivered by the transmitter to the antenna" for AAS antennas through additions to **RR Art 21**, retaining the current limit +10dBW -> Apply to all fixed and mobile services, including IMT stations & in all frequency bands in Table **21-2**

3. Add to Table **21-2** the missing frequency bands & review the applicable limit in Art 21.5 (currently +10 dBW) to ensure that it continues to provide adequate protection to satellite uplinks.

4. The TRP parameter should also be used for these additional bands.

Timing: The actions in item **1.** should occur as with no delay, before WRC-23, since IMT or other mobile stations using AAS antennas are already being deployed. The actions in item **2.** could occur during WRC-23. The actions in items **3.** and **4.** can occur after WRC-23, based on a new agenda item for a future WRC.

AGENDA ITEM 10 – RELAXATION OF NGSO EPFD LIMITS

- **EPFD limits** were adopted into the **RR by WRC-2000,** in certain parts of Ku-band and **Ka-band** where **Art 22.2** applies

- These limits established technical conditions to ensure coexistence between **GSO** and **NGSO** systems

- Proposals are emerging that seek a new **WRC-27 agenda item**, to review and potentially replace the current **NGSO EPFD limits** in Ku-band and Ka-band with relaxed protection measures

22.2 § 2 1) Non-geostationary-satellite systems shall not cause unacceptable interference to and, unless otherwise specified in these Regulations, shall not claim protection from geostationary-satellite networks in the fixed-satellite service and the broadcasting-satellite service operating in accordance with these Regulations. No. **5.43A** does not apply in this case. (WRC-07)

[2] **22.5C.1** The equivalent power flux-density is defined as the sum of the power flux-densities produced at a geostationary-satellite system receive station on the Earth's surface or in the geostationary orbit, as appropriate, by all the transmit stations within a non-geostationary-satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing in its nominal direction. The equivalent power flux-density is calculated by the following formula:

$$epfd = 10 \log_{10}\left\{\sum_{i=1}^{N_s} 10^{\frac{P_i}{10}} \cdot \frac{G_i(\theta_i)}{4\pi d_i^2}\right\}$$

where:

N_s: number of transmit stations in the non-geostationary-satellite satellite system receive station considered on the Earth's surf

i: index of the transmit station considered in the non-geostation

P_i: RF power at the input of the antenna of the transmit statio system (dBW) in the reference bandwidth

θ_i: off-axis angle between the boresight of the transmit statio system and the direction of the geostationary-satellite system

$G_i(\theta_i)$: transmit antenna gain (as a ratio) of the station considered direction of the geostationary-satellite system receive station

d_i: distance (m) between the transmit station considered in t geostationary-satellite system receive station

φ_i: off-axis angle between the boresight of the antenna of the g the direction of the i-th transmit station considered in the no

$G_r(\varphi_i)$: receive antenna gain (as a ratio) of the geostationary-satelli i-th transmit station considered in the non-geostationary-sate

$G_{r,max}$: maximum gain (as a ratio) of the antenna of the geostationary

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

TABLE **22-1A** (WRC-03)

Limits to the epfd$_\downarrow$ radiated by non-geostationary-satellite systems in the fixed-satellite service systems in certain frequency bands [3, 4, 5, 6]

Frequency band (GHz)	epfd$_\downarrow$ (dB(W/m^2))	Percentage of time during which epfd$_\downarrow$ may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter and reference radiation pattern[7]
10.7-11.7 in all Regions; 11.7-12.2 in Region 2; 12.2-12.5 in Region 3 and 12.5-12.75 in Regions 1 and 3	−175.4	0	40	60 cm Recommendation ITU-R S.1428-1
	−174	90		
	−170.8	99		
	−165.3	99.73		
	−160.4	99.991		
	−160	99.997		
	−160	100		
	−181.9	0	40	1.2 m Recommendation ITU-R S.1428-1
	−178.4	99.5		
	−173.4	99.74		
	−173	99.857		
	−164	99.954		
	−161.6	99.984		
	−161.4	99.991		
	−160.8	99.997		
	−160.5	99.997		
	−160	99.9993		
	−160	100		

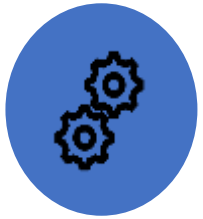
AGENDA ITEM 10 – RELAXATION OF NGSO EPFD LIMITS)

Appropriate Protection

- The Article 22 provide **adequate protection** for Ku and **Ka** band GSO networks from NGSO
- Exceeding permitted levels of **short-term NGSO** interference are a particular concern because of the **disruptive impact** of such interference on GSO services

Proven Framework

- The current regulations have enabled the **effective sharing** of Ku-band and Ka-band spectrum
- It is a **long-standing framework**, based on compromises, that is proven to function. multiple NGSO and GSO systems



Studies Underway

- WP 4A is already working on methods to **improve** the **modelling** of NGSOs & application of the current EPFD limits
- To discard the EPFD limits and start from scratch **would burden the ITU-R with extensive work**, and may not produce any benefits for GSOs or NGSOs

Threat to SKA

- Many countries have supported a new agenda item proposal to study the **protection** of the **SKA** radio telescope from **mega constellations** (NGSO)
- This new agenda item proposal was triggered by legitimate concerns regarding NGSO interference

The relaxation of Article 22 limits is unwarranted and should not be tabled as a new WRC-27 agenda

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GSOA WRC-23 Positions

Thank You