ITU Symposium and Workshop on small satellite regulation and communication systems
Santiago, Chile, 7-9 November 2016

Services and frequency bands for small satellites

Attila MATAS
matas@itu.int @AttilaMatas

Head, Space Publication and Registration Division (SPR)
ITU Radiocommunication Bureau

Is there a need for small satellite regulatory relaxation ?

- Small satellite community is interested in *relaxation* of the RR and *easy deployment* of their non-GSO satellites
- **RES 757** (WRC-12) to consider *whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation* of nano- and pico satellites…
- **WRC-15 – decision SUP RES-757 – NO need for any special regulatory procedures** *to facilitate the deployment and operation of nano- and pico satellites*

WRC-15 Decision

Committed to Connecting the World

International Telecommunication Union

Resolution 659 (WRC-15)

Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions

- *resolves to invite* ***WRC-19***

➢ *to consider the results of ITU-R studies and take necessary action, as appropriate, provided that the results of the studies referred to in invites ITU-R below are complete and agreed by ITU-R study groups,*

➢ *invites ITU-R*

to study the spectrum requirements for telemetry, tracking and command in the space operation service for the growing number of non-GSO satellites with short duration missions, taking into account RR ART **1** No. **1.23** *(space operation service definition)*

Small satellite characteristics?
ITU-R Question 254/7

Characteristics and spectrum requirements of satellite systems using nano and pico satellites

- The ITU-R WP7B finished study Question 254/7

- Report ITU-R **SA.2312** Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites
- Report ITU-R **SA.2348** Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites

For more info see **ITU-R WP7B** studies:

http://www.itu.int/en/ITU-R/study-groups/

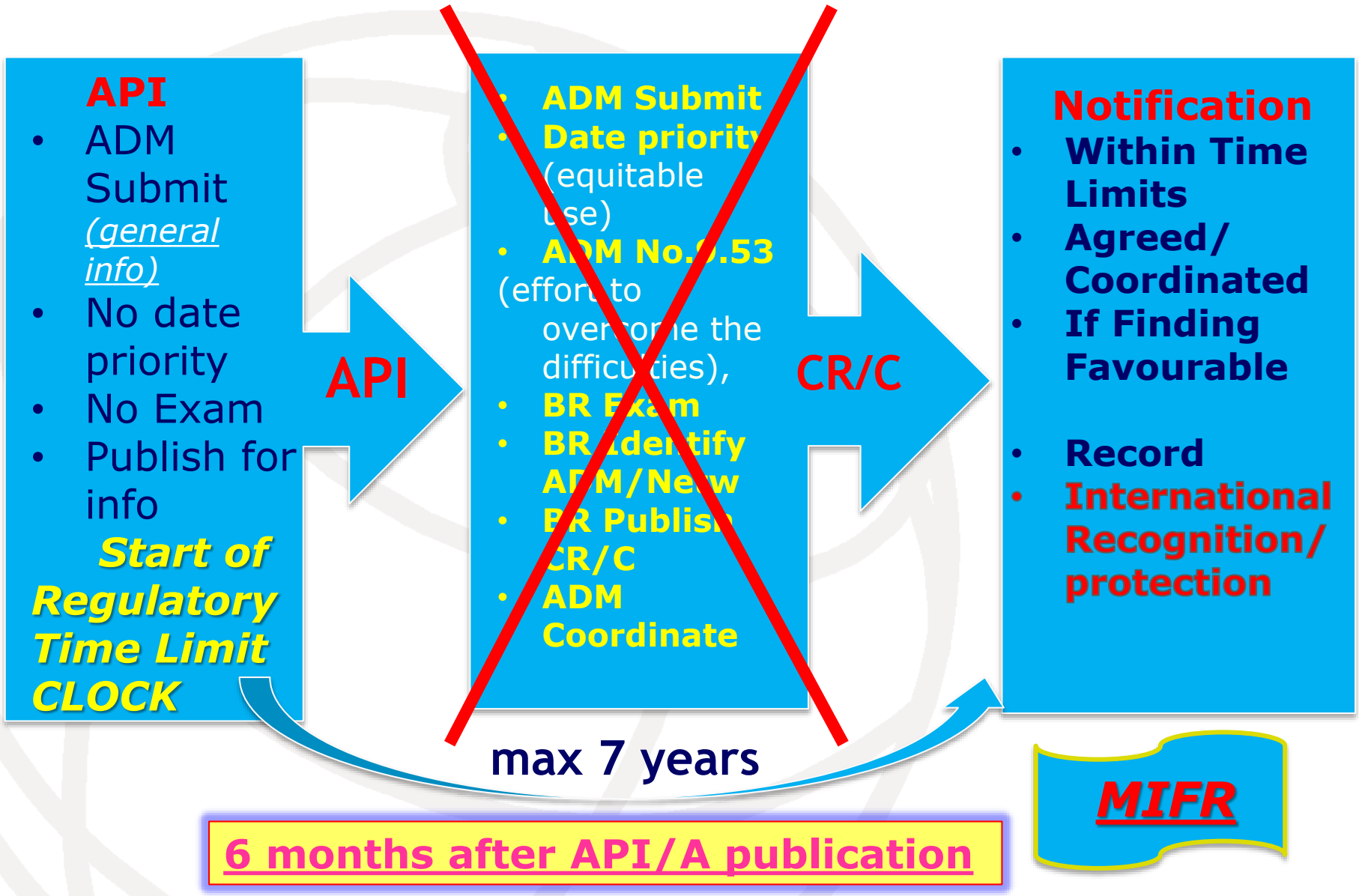
Small satellite regulatory limits 1

- *A **clear MAJORITY** of the non-GSO small satellite operates in the frequency bands not falling under formal Article 9 Coordination procedure*
- *Shortest regulatory limit for non-GSO not subject to coordination from **API** up to **Notification is no more as 9 months***

Much less cost recovery fee:

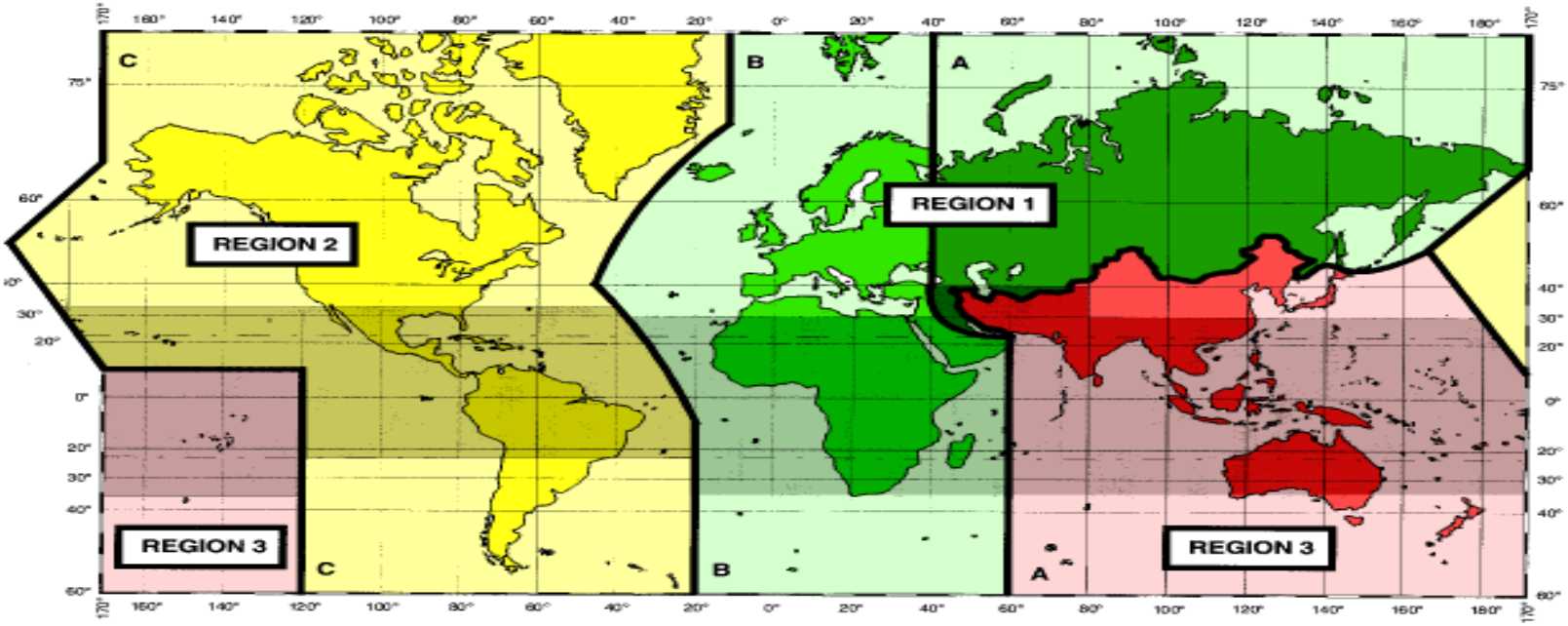
- *C required (A+C+N)= **91.387 CHF***
- ***not** subject to C (A+N) = **7.600 CHF***

Small satellite regulatory limits 2



ART 5 frequency allocations - 1

- No. **5.2** - For the allocation of frequencies the world has been divided into three "radiocommunication" Regions



➢ *Exclusive allocations*, which are favoured in cases that involve *broad international use of equipment*

➢ *Shared frequency allocations*, which are applied to maximize the use of the available spectrum when *two or more radiocommunication services can effectively utilize the same frequency band*

ART 5 frequency allocations - 2

- A *shared* frequency band can be allocated to more than one ***services*** (*PRIMARY* or secondary)
- No. **5.28 -** Stations of a *secondary* ***service***:
  - **5.29 -** *shall not cause harmful interference to* stations of PRIMARY ***service…***
  - **5.30 –** *can not claim protection from* harmful interference from stations of a PRIMARY ***service***…
  - **5.31 -** *can claim protection*, however, from harmful interference from stations of the same or other secondary ***service***(s) to which frequencies may be assigned later
- A *footnote* to a frequency band or service *may include a restriction* on the *service* or services concerned
  - to operate in a particular country(ies) or service area
  - to apply formal Article **9** coordination
  - not causing harmful interference to another service
  - not claiming protection from another service

ART 5 frequency allocations – 3

Amateur-satellite service - EA

144–146 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
144-146	AMATEUR AMATEUR-SATELLITE 5.216	

5.216 *Additional allocation:* in China, the band 144-146 MHz is also allocated to the aeronautical mobile (OR) service on a secondary basis.

430–440 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
430-432 AMATEUR RADIOLOCATION 5.271 5.272 5.273 5.274 5.275 5.276 5.277	**430-432** RADIOLOCATION Amateur 5.271 5.276 5.277 5.278 5.279	
432-438 AMATEUR RADIOLOCATION Earth exploration-satellite (active) 5.279A 5.138 5.271 5.272 5.276 5.277 5.280 5.281 5.282	**432-438** RADIOLOCATION Amateur Earth exploration-satellite (active) 5.279A 5.271 5.276 5.277 5.278 5.279 5.281 5.282	
438-440 AMATEUR RADIOLOCATION 5.271 5.273 5.274 5.275 5.276 5.277 5.283	**438-440** RADIOLOCATION Amateur 5.271 5.276 5.277 5.278 5.279	

5.282 In the bands 435-438 MHz, 1260-1 270 MHz, 2 400-2 450 MHz, 3 400-3 410 MHz (in Regions 2 and 3 only) and 5 650-5 670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No. **5.43**). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. **25.11**. The use of the bands 1 260-1 270 MHz and 5 650-5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.

ART 5 frequency allocations – 4

Usage of 902 – 928 MHz frequency bands by amateur-satellite service

890-1 300 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
890-942 FIXED MOBILE except aeronautical mobile 5.317A BROADCASTING 5.322 Radiolocation	**890-902** FIXED MOBILE except aeronautical mobile 5.317A Radiolocation 5.318 5.325	**890-942** FIXED MOBILE 5.317A BROADCASTING Radiolocation
	902-928 FIXED Amateur Mobile except aeronautical mobile 5.325A Radiolocation 5.150 5.325 5.326	

- **Amateur service (terrestrial)** in the band 902-928 MHz is a *secondary service in R2 only and there is* ***NO amateur-satellite allocation****!*

No. **5.150** The following bands:…902-928 MHz in Region 2 (centre frequency 915 MHz)…. are also designated for ISM applications…

ART 5 frequency allocations – 5

Usage of 2 300 – 2 450 MHz frequency bands by amateur-satellite service

2 170-2 520 MHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
2 300-2 450 FIXED MOBILE 5.384A Amateur Radiolocatio 5.150 5.282 5.395	**2 300-2 450** FIXED MOBILE 5.384A RADIOLOCATION Amateur 5.150 5.282 5.393 5.394 5.396	

- **Amateur-satellite service** in the band 2300 - 2450 MHz is a ***secondary service shared also with ISM***

No. 5.150 The following bands:..2400-2500 MHz… are also designated for ISM applications... operation is subject to the provisions of No. **15.13**

No. 15.13 *§ 9 Administrations shall take all practicable and necessary steps to ensure that* ***radiation*** *from equipment used for ISM applications* ***is minimal*****…..**

Most frequent services used by small satellites

- Situation with **EA** service is quite clear but what about allocations/bands for other services ?

- Here is the list of *most frequent small satellite services*

For the complete List see - ***Table 3 of the PREFACE***	
Symbol	**Space Station - Class of Station**
ED	Space telecommand space station
EH	Space research space station
EK	Space tracking space station
EM	Space station in the meteorological-satellite service
ER	Space telemetering space station
ES	Station in the inter-satellite service
ET	Space station in the space operation service
EU	Space station in the land mobile-satellite service
EW	Space station in the earth exploration-satellite service

Most frequent question from small satellite operators

- ***WHAT FREQUENCY BAND to USE for my satellite?***
- ***I don't want to use bands where ART 9 apply!***

❖ ***Solution is here:***

✓ *Please read carefully* ***footnotes in the FAT*** *calling for application of provisions of* ***ART 9***

✓ **See Rules of Procedure** (RoP) - **TABLE 9.11A-1**

Applicability of the provisions of Nos. **9.11A-9.15** to stations of space services

Typical Frequency allocations for *SMALL SATELLITES -1*

Frequency band	Service	Symb	Type of alloc
401-403 MHz	EESS (E-S)	EW	PRIMARY
401-402 MHz	SOS (S-E)	ET	PRIMARY
449.75-450.25 MHz	sos (E-S) srs (E-S)	ET EH	No.5.286-Only subject to No.9.21 (other No.4.4)
1 215-1 300 MHz	ESSS (active), SRS	Ex, EH	Nos. 5.330-5.335A protecting RNSS and RL
1 427 – 1 429 MHz	SOS (E-S)	ET	PRIMARY
2 025 – 2 110 MHz	EESS (E-S, S-S) SOS (S-E, S-S) SRS (E-S, S-S)	EW ET EH	PRIMARY
2 200 – 2 290 MHz	EESS(S-E, S-S) SOS(S-E, S-S) SRS (S-E, S-S)	EW ET EH	PRIMARY
2 290-2 300 MHz	SRS (S-E) (deep space)	EH	PRIMARY

- For more details and the conditions for the usage of these bands, please refer to **Article 5** of the RR

Typical Frequency allocations for *SMALL SATELLITES -2*

Frequency band	Service	Symb	Type of alloc
8 025 – 8 400 MHz	EESS (S-E)	EW	PRIMARY
8 400 – 8 500 MHz	FX, MOB SRS (S-E)	EH	PRIMARY
8 550 – 8 650 MHz	(EESS), (SRS) (active)	Ex, EH	PRIMARY
9 300 – 9 800 MHz	(EESS), (SRS) (active)	Ex, EH	PRIMARY
9 800 – 9 900 MHz	(eess) (active) (srs) (active)	Ex EH	secondary
10.6 – 10.7 GHz	(EESS), (SRS) (passive)	Ex, EH	PRIMARY
13.25 – 13.75 GHz	(EESS), (SRS) (active)	Ex, EH	PRIMARY
22.21 – 22.5 GHz	(EESS), (SRS) (passive)	Ex, EH	PRIMARY
22.55 - 23.15 GHz	(ISS), (SRS) (E-S)	ES, EH	PRIMARY (No.5.338A)
23.6 – 24 GHz	(EESS), (SRS) (passive)	Ex, EH	PRIMARY

- For more details and the conditions for the usage of these bands, please refer to Article 5 of the RR

Free on-line ITU-R documents

- **ITU Radio Regulations @ 2016:**

  http://www.itu.int/pub/R-REG-RR/

- **ITU Rules of Procedure**

  http://www.itu.int/pub/R-REG-ROP/en

- **ITU-R Recommendations:**

  http://www.itu.int/publ/R-REC/en

- **Preface (Space services)**

  http://www.itu.int/ITU-R/go/space-preface/en

- ***Space service web page:***

  http://www.itu.int/ITU-R/go/space/en

Services and frequency bands for small satellites

Attila MATAS
ITU BR
matas@itu.int

Questions ?

International Telecommunication Union

Committed to connecting the world