

**ITU Symposium and Workshop on small satellite
regulation and communication systems**

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***De-mystifying
Articles of the RR
related to
SMALL SATELLITES***

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Presentation outline

- ✓ Is it **OBLIGATORY** to follow the ITU RR ?
- ✓ **WHAT NEEDS TO BE NOTIFIED** to the ITU ?
- ✓ **WHEN** TO INITIATE A NOTIFICATION ?
- ✓ **HOW MUCH COST** an ITU NOTIFICATION ?
 1. **HOW** TO SUBMIT API & NOTIFICATION? *See workshop...*
 2. **HOW** TO PARTICIPATE in the ITU-R nano and pico satellite studies ? *See ITU-R WP7B presentation...*
- **WHAT SERVICE / FREQUENCY BAND to USE ?**

Control of Interference

ALLOCATION

Frequency separation of stations of different services

POWER LIMITS

PFD to protect TERR services

EIRP to protect SPACE services

EPFD to protect GSO from N-GSO

(EPFD = aggregate equivalent power flux-density)

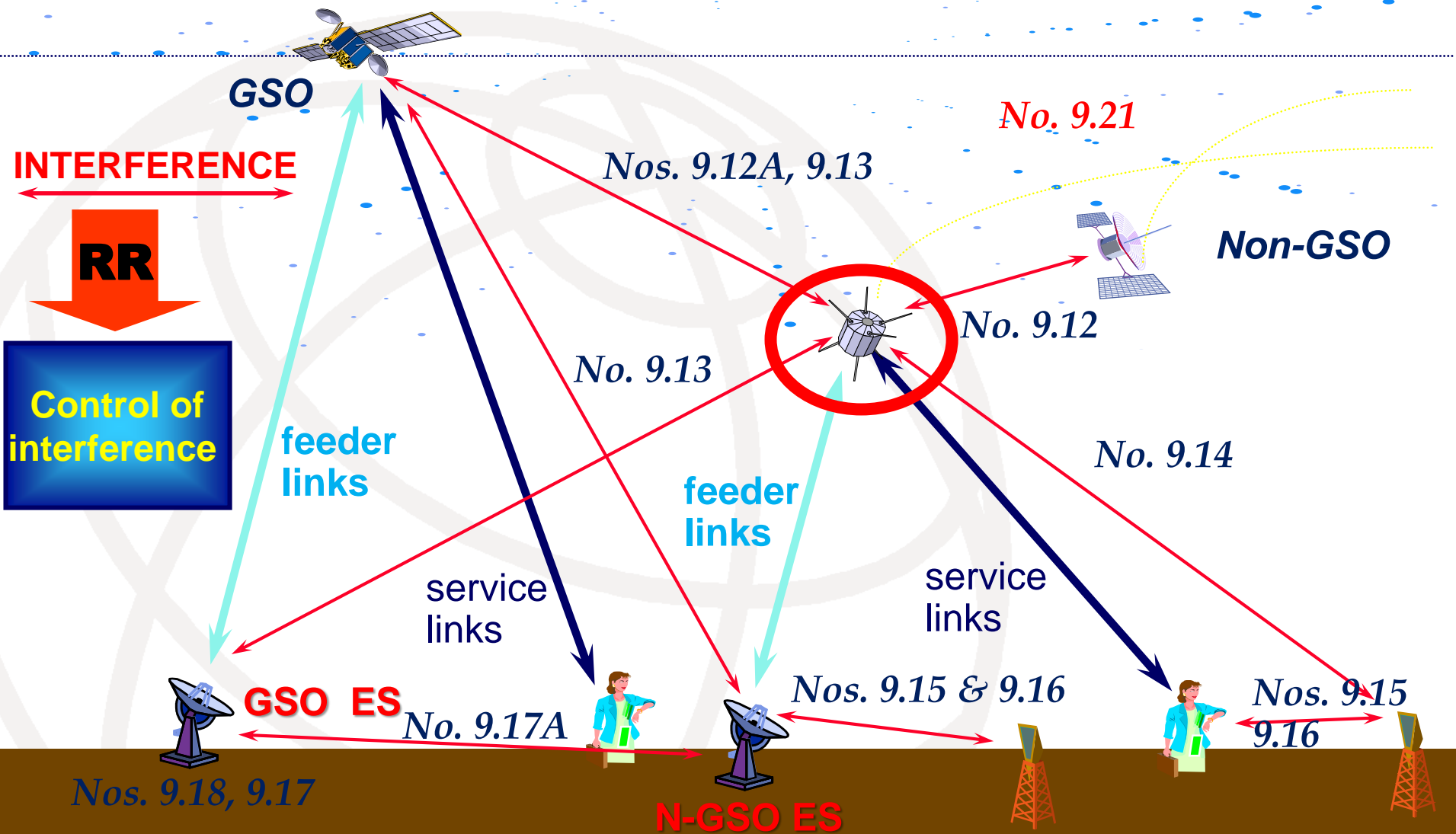
REGULATORY PROTECTION

e.g. No. 22.2: Non-GSO to protect GSO (FSS and BSS)

COORDINATION

between Administrations to ensure **interference-free** operations conditions

Non-GSO Coordination provisions



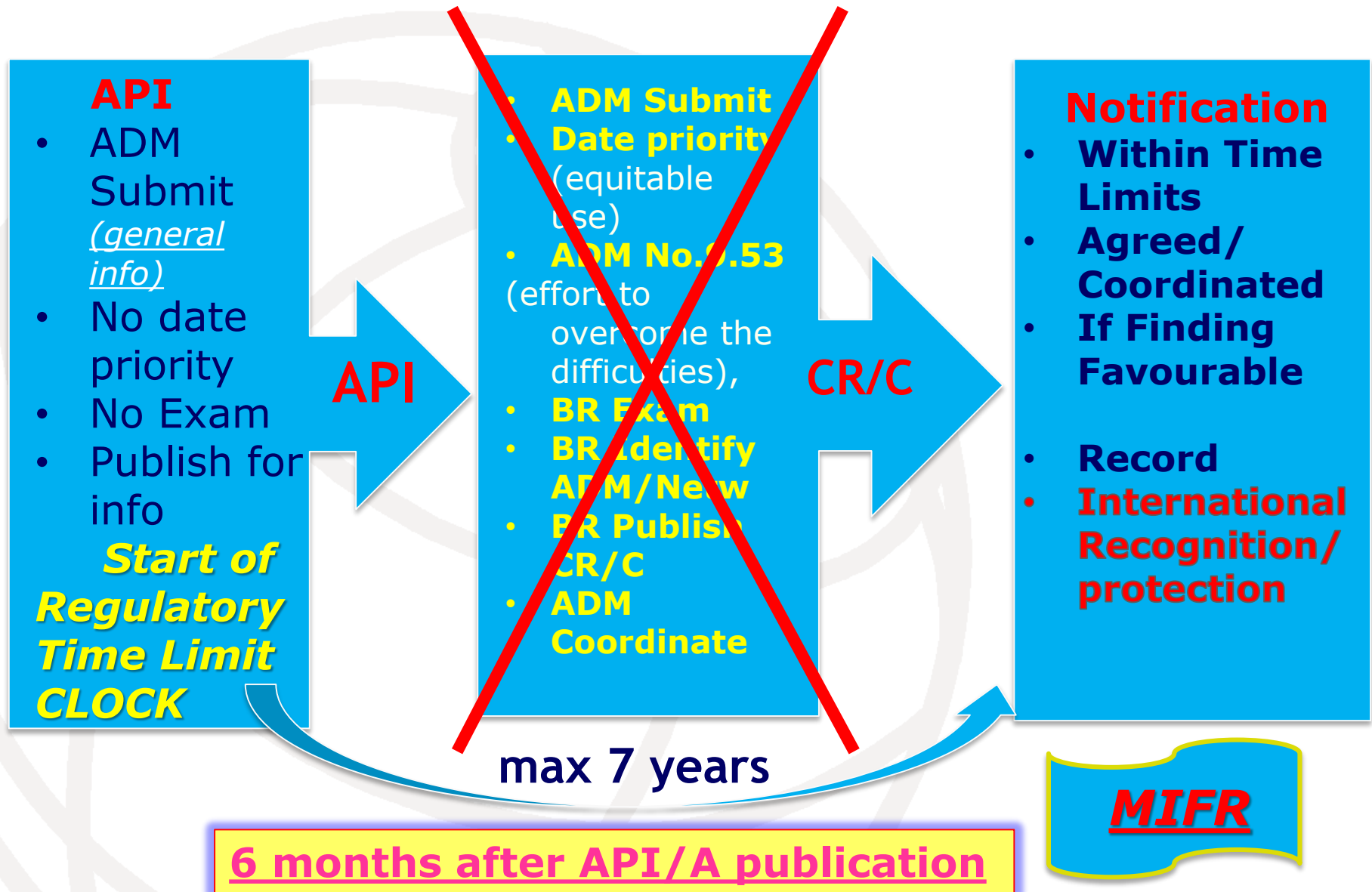
Is there a need for small satellite regulatory relaxation ?

First - see the current *applicable* regulatory rules

- Small satellite community is requesting relaxation of the RR and easy deployment of their non-GSO satellites
- **RES 757** (WRC-12) is inviting 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...
- 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 max C+N= **91.387 CHF / not subject to C = 7.600 CHF**

Is there a need for small satellite regulatory relaxation ?
First - see the current *applicable* regulatory rules



WHAT SERVICE / FREQUENCY BAND to USE ?

•Before we are going to answer this question we going *to clarify some myths and serious missing of understandings* circulating in the small satellite community !!

M1: We are going to use "a licence free band" for our sat project

A1: *There is no "licence free band" for ANY space service allocation*

M2: We are going to use "a free ISM band" for our sat project

A2: ISM band is NOT allocated to ANY space service !

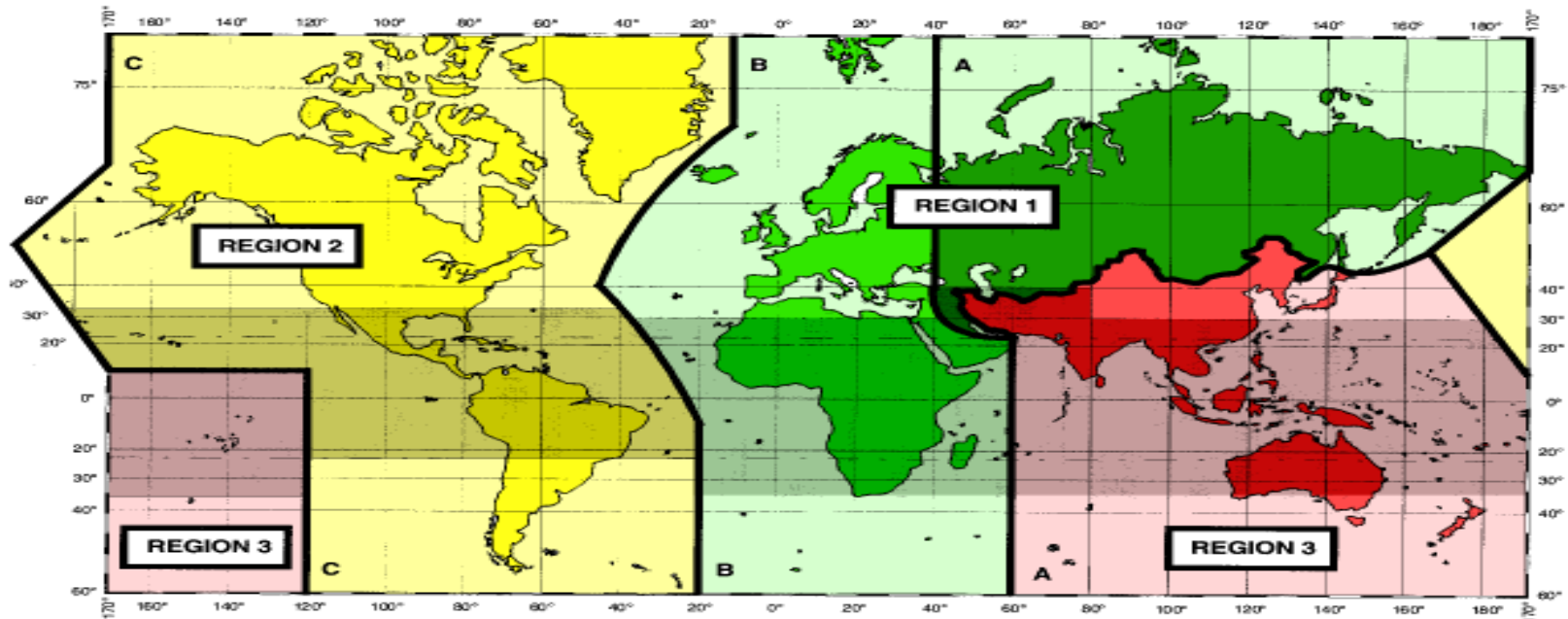
ISM ...equipment or appliances to generate and use locally radio frequency energy for industrial, scientific, medical, *domestic or similar purposes*, excluding **applications in the field of telecommunications** - usage of these bands for any satellite communication can be ONLY under Nos. **4.4** and **15.13**

WHAT SERVICE / FREQUENCY BAND to USE ?

- **M3:** We are going to use "a free ham frequency band"
- **A3:** For use of amateur-satellite bands
ART 25 and **No. 1.56 apply !**
- **M4:** We don't know our sat "orbital parameters"
therefore we can't submit our API to the Bureau!
- **A4:** ART **9** for **API** is requiring **ONLY**
submission of general characteristics (*used for
example for the link budget calculation*)
For Notification filing No. **11.28.1** may apply

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

- **HF amateur satellite allocations** - due to specific HF antenna systems and radio equipment and operation modes these bands are **ONLY for communication between ARS stations** (ART 25 and Nos. **1.56-1.57** apply)

ART 5 Frequency band [MHz]	ART 5 Allocated to service			Class of station
	Region 1	Region 2	Region 3	
14.0-14.25 18.068-18.168 21 000-21 450 24 890-24 990 28-29.7	AMATEUR AMATEUR-SATELLITE			EA

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, 1 260-1 270 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 5.325 902-928 FIXED Amateur Mobile except aeronautical mobile 5.325A Radiolocation 5.150 5.325 5.326	890-942 FIXED MOBILE 5.317A BROADCASTING Radiolocation

- **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 Radiolocation 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.....**

More ART 5 frequency allocations for EA...

Frequency band (MHz)	Service	Type of allocation
1 260–1 270	Amateur-Satellite Service (E-S)	Secondary (No.5.282)
3 400–3 410	Amateur-Satellite Service (R2&R3 only)	Secondary (No.5.282)
5 650–5 670	Amateur-Satellite Service (E-S)	Secondary (No.5.282)
5 830–5 850	Amateur-Satellite Service (S-E)	Secondary
10 450–10 500	Amateur-Satellite Service (S-E)	Secondary
24 000–24 050	Amateur-Satellite Service	PRIMARY but also No.5.150 (ISM)

Even more? **There are more Amateur-satellite service frequency bands up to 250 GHz !!** - For more details and the conditions for the usage of these bands, see Article **5** of the RR.

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	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

➤ **ITU Radio Regulations @ 2012:**

<http://www.itu.int/pub/R-REG-RR-2012>

➤ **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>

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Questions ?



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