regulatory challenges **for small satellites and new satellite constellations**

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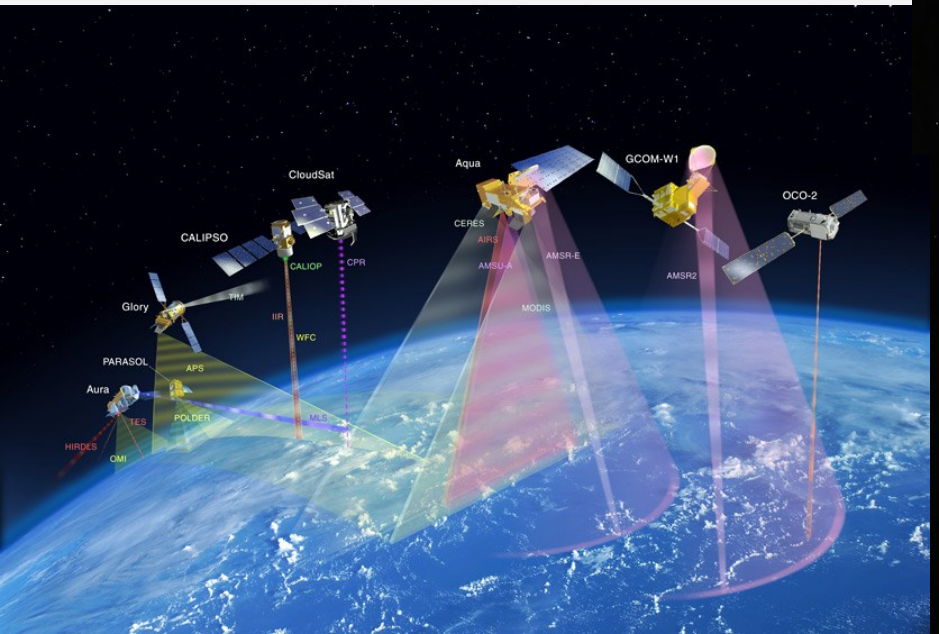
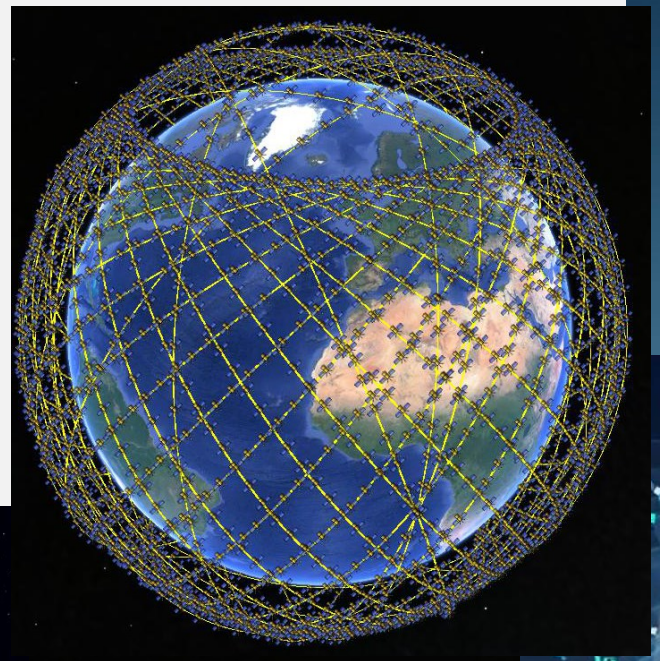
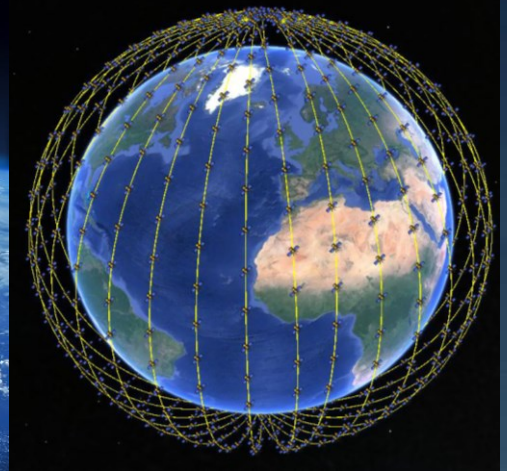
Are the cubesat/small sat and large constellations coming?

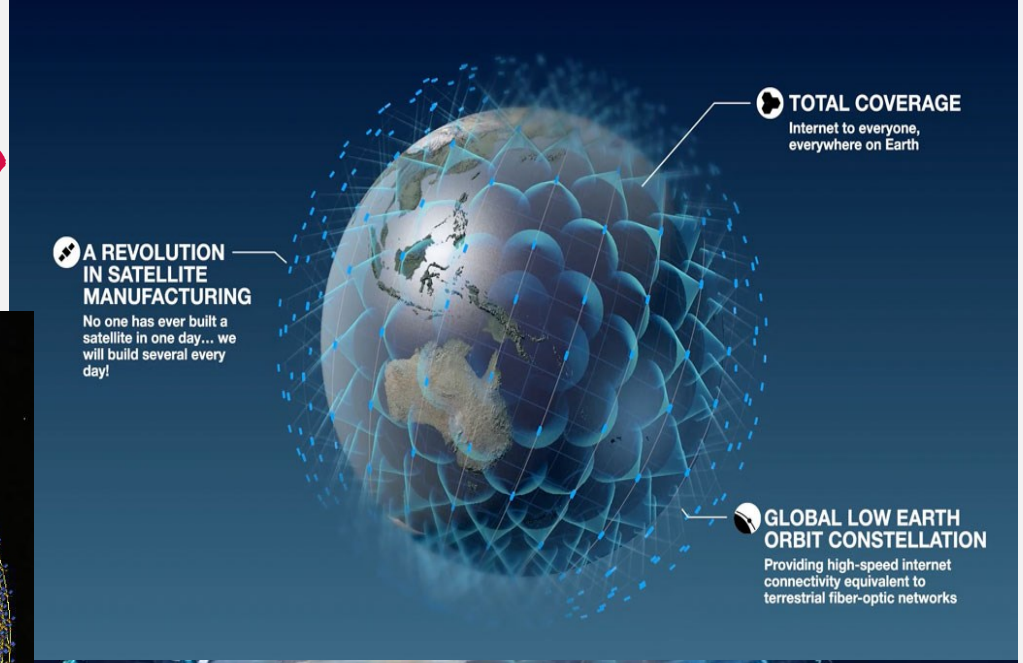
... YES

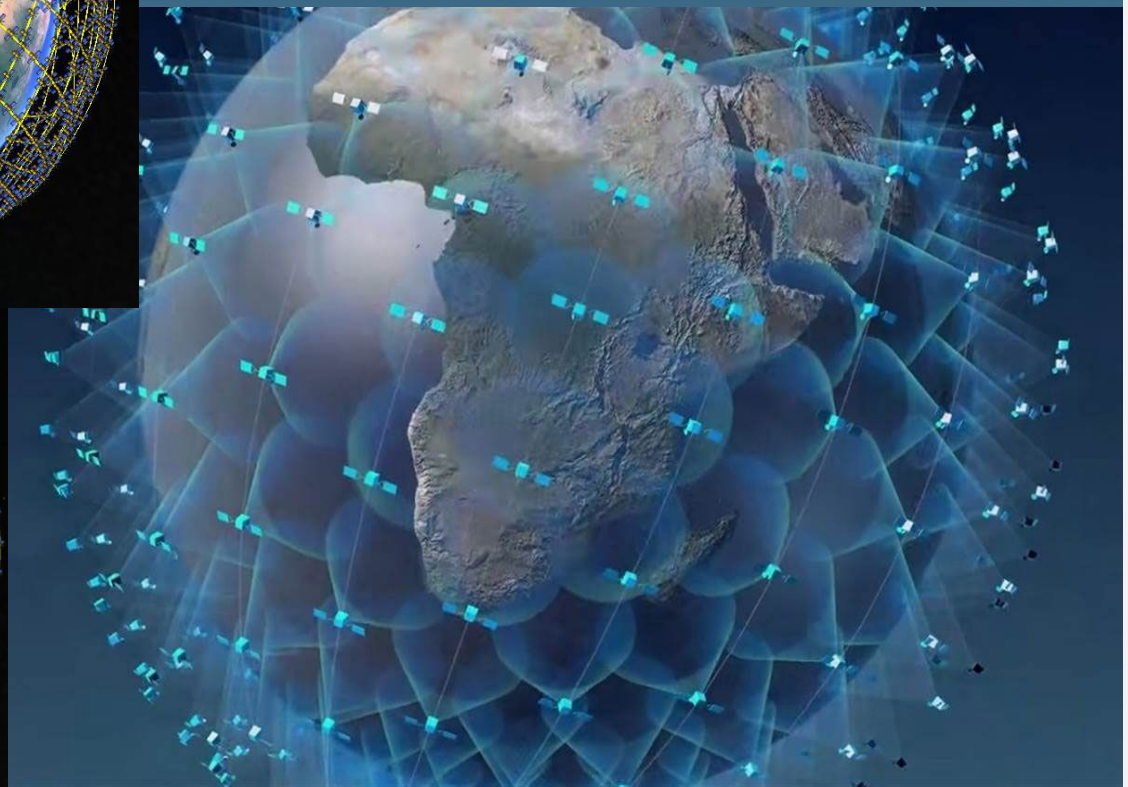
What are the issues as seen from the ITU?





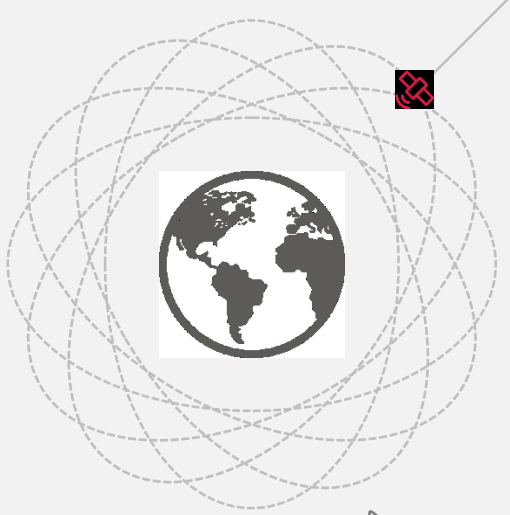






NGSO

Non-geostationary satellite systems



How to ensure protection from NGSO systems?

NGSO shall not cause unacceptable interference to and not claim protection from GSO FSS & BSS (Art. 22 No. 22.2)

No. 22.2 obligation fulfilled if comply with **EPFD** limits (Art. 22 No. 22.5I)

How to define unacceptable interference?
How to get agreement from all GSO satellite networks worldwide?

Defines level of acceptable interference
Meet EPFD limits, meet No. 22.2 requirements
GSO satellites get needed protection

… And ultimately **Coordination**;

- Coordination between non-GSO and GSO in limited frequency bands
- Coordination between non-GSO in limited frequency bands

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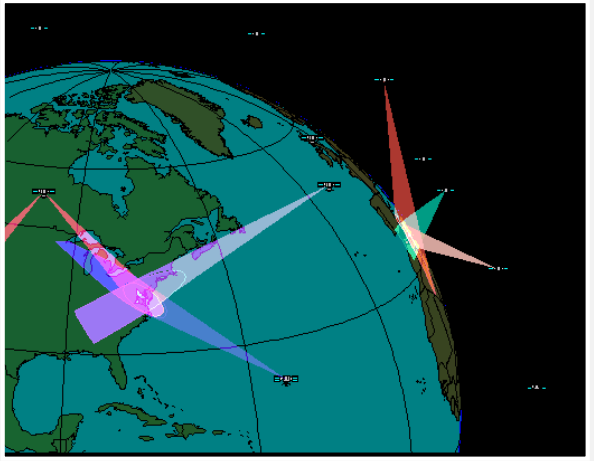
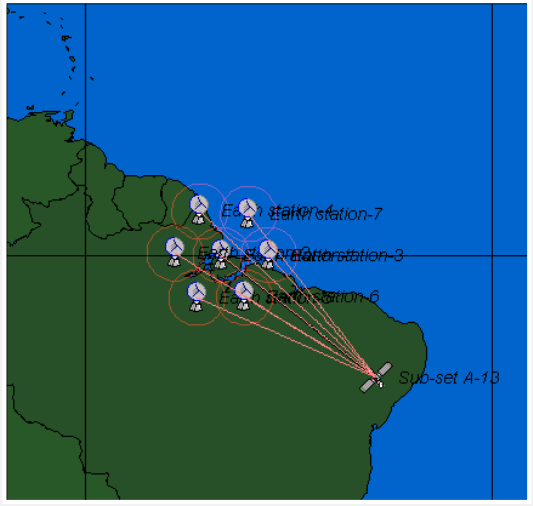


EPFD Equivalent power-flux density

Sum of power flux-densities (PFD) produced by all transmit stations within NGSO system at a GSO earth station or at GSO (Taking into account receive antenna directivity)



Source: No. 22.5C.1 of Article 22

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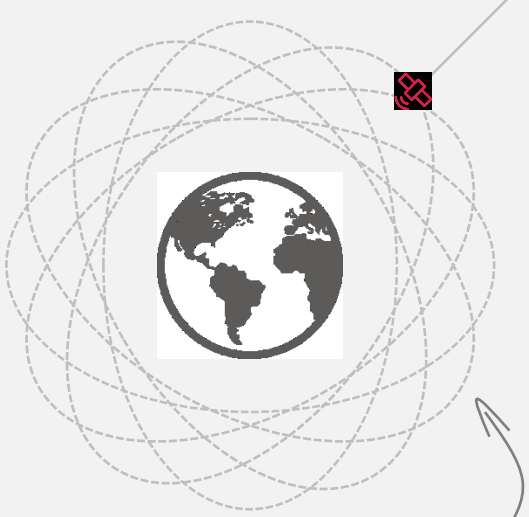
NGSO

Cubesat/Smallsat issues



There is NO regulatory definition for small satellites in the ITU RR

small satellites

- provide a means for testing emerging technologies
- offer new opportunities for new satellite operators that might not otherwise have considered or been able to afford the use of satellite technologies
- operation or demonstration in a variety of practical space based applications

- **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

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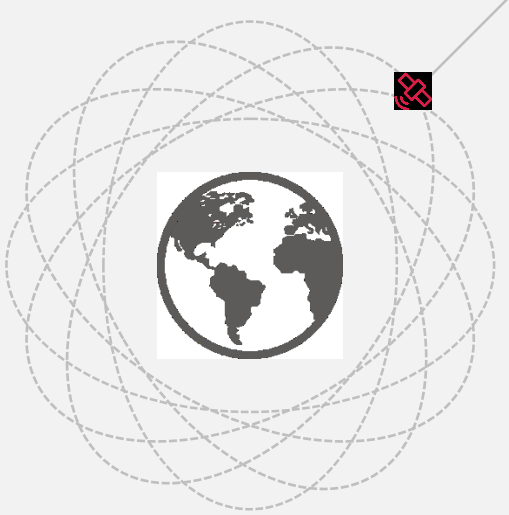

NGSO

Cubesat/Smallsat issues

There is NO regulatory definition for small satellites in the ITU RR

"Grey" operation of small satellites

- *Dream of "licence free" bands* (ISM, Amateur band…): *There is no license free band for any space service allocation;*
- *Uncertainty on the orbital characteristics* to register the system at ITU: Article 9 of the RR for API and No. 11.28.1 at notification stage provide the regulatory framework;
- *Improper and frequent usage of frequency assignments under No.4.4 of the RR* (Operation in terrestrial service bands or non allocated space service bands, Earth terminal operation on board small satellite for global data collection, …)

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What were the issues, outcome and updates following WRC-15?

5 issues

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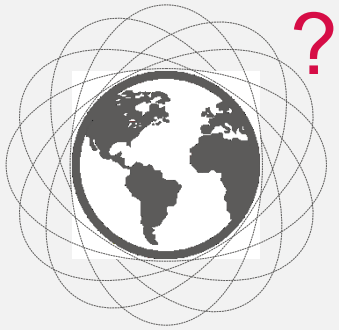
#1 small (nano- and pico) satellites

RES-757(WRC-12)

Consider whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation of small (nano- and pico) satellites…



Unknown

WRC-15

- **NO need for any special regulatory procedures** to facilitate the deployment and operation of nano- and pico satellites
- **Resolution 659 (WRC-15)**
  Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions

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#2 Constellation Flexibility

Issue

Various configuration at coordination stage

NGSO systems with

- Simultaneous operation of all orbital characteristics
- Mutually exclusive operation - Different orbital characteristics but only one set will be notified
- No clear indication of actual use

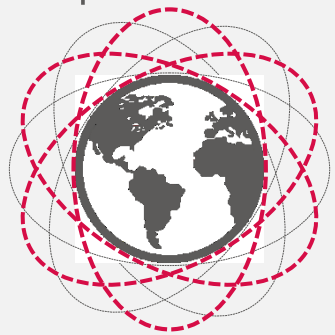
WRC-15

ROP to be drafted to limit flexibility to simultaneous or mutually exclusive operation at coordination stage and finally one configuration at notification

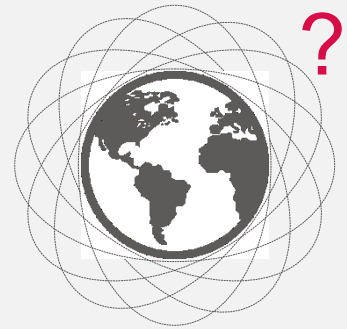
Rules of Procedures

Limit receivability to simultaneous or mutually exclusive operations

Simultaneous operation



Mutually exclusive



Unknown

Source: Doc. CMR15/4(Add.2), Doc CMR15/505 8th Plenary Minutes , RRB-73

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#3 NGSO vs NGSO Coordination

Issue

Identified based on frequency overlap (No. 9.12)
No methodology to assess compatibility
How much changes allowed without losing priority date?

WRC-15

Adms may mutually agree multilateral coordination meetings
NGSO coordination can be further studied in ITU-R
Any modifications to procedures, can be submitted under WRC-19 AI7

Source: Doc. CMR15/4(Add.2), RoP No. 9.6, Article 9, Doc CMR15/505 8th Plenary Minutes

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#4 EPFD Validation Software

Update

BR actions:

To request EPFD masks (**March/April 2017**)

Review findings with respect to EPFD limits (**June 2017 onwards**)

Reestablish coordination requirements under No. 9.7A/B (NGSO FSS vs GSO E/S) (**June 2017 onwards**)

WRC-15

Res 85 (WRC-03) continues to be applied when software cannot adequately model certain NGSO

Source: Doc. CMR15/4(Add.1,2), Res85, Rec ITU-R S.1503-2, Doc CMR15/505 8th Plenary Minutes

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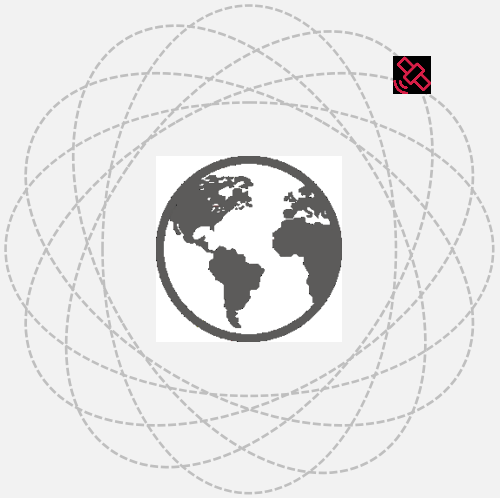
#5 Bringing into Use

Issue

Lack of clear provision, current practice:

- At least one NGSO satellite at one orbital plane
- Capable to transmit or receive filed frequency assignments,
- 90 days of operation

Possible spectrum warehousing / "fictitious frequency assignments"



WRC-15

ITU-R invited to examine provisions requiring additional milestones beyond normal notification and BIU procedure

Consider implications on NGSO systems BIU after WRC-15

Rules of Procedures

Current practice

Source: Doc. CMR15/4(Add.2), Doc CMR15/504 7th Plenary Minutes, CR/389 of 29.01.2016, RRB 73

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What are the NGSO issues at WRC-19?

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#1 Agenda Item 1.7 (TT&C non-GSO, short duration mission)

to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15)

#2 Agenda Item 1.6 (NGSO in V-bands)

Regulatory framework for NGSO FSS in 37.5-39.5 GHz (s-E), 39.5-42.5 GHz (s-E), 47.2-50.2 GHz (E-s), 50.4-51.4 GHz (E-s) Res 159 (WRC-15)

Broadband terrestrial to compete with broadband satellite for spectrum

No regulatory provisions for sharing NGSO vs GSO

No ITU-R defined protection requirements for GSO

WP4A responsible group:

- Ensure protection of GSO FSS, MSS, BSS, EESS (passive), RA
- Develop EPFD to protect GSO

www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-19-studies.aspx

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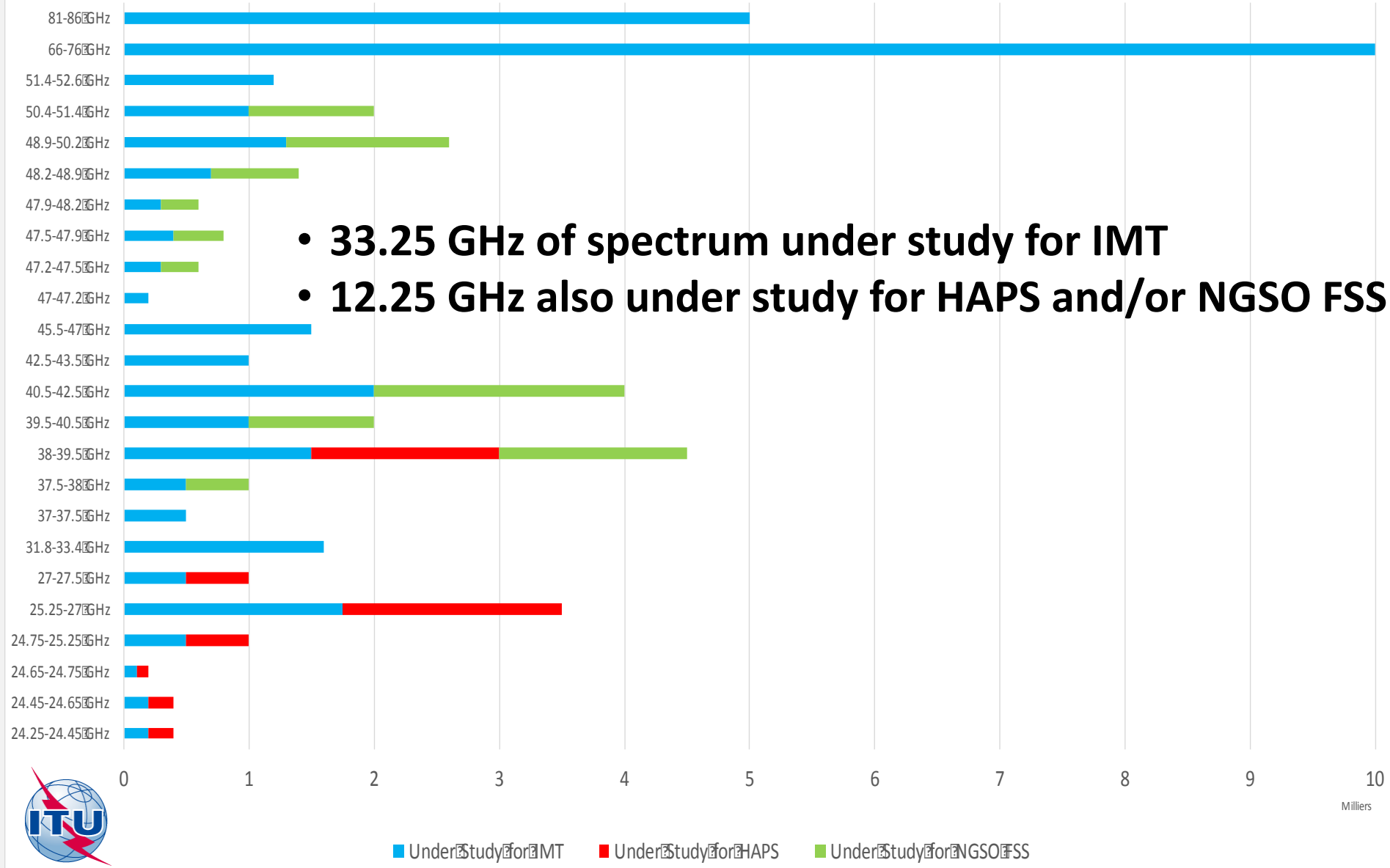
Spectrum (GHz) under study for IMT identification by WRC-19



- **33.25 GHz of spectrum under study for IMT**
- **12.25 GHz also under study for HAPS and/or NGSO FSS**

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#3 Agenda Item 9.1.3 (NGSO in C-Band)

Study provisions for NGSO in C-Band (circular orbit) Res 157 (WRC-15)

WP4A responsible group:

- Ensure protection of existing NGSO HEO, AP30B, Fixed, Mobile
- Ensure protection of GSO from unacceptable interference

#4 Agenda Item 7 Issue A (BIU of NGSO)

BIU of frequency assignments for NGSO systems subject to coordination

www.itu.int/en/ITU-R/study-groups/rcpm/Pages/wrc-19-studies.aspx

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Free on-line ITU-R help & documents

- ***Space service web page:*** http://www.itu.int/ITU-R/go/space/en
- **Small Satellite** *support*:

http://www.itu.int/en/ITU-R/space/Pages/SupportAmateur.aspx

- **ITU RR @ 2016 -** http://www.itu.int/pub/R-REG-RR/
- **WRC-15** - https://www.itu.int/en/ITU-R/conferences/wrc/2015/
- **WRC-19** - http://www.itu.int/en/ITU-R/conferences/wrc/2019/Pages/default.aspx
- **ITU-R Recommendations:** http://www.itu.int/publ/R-REC/
- **ITU-R Reports:** https://www.itu.int/pub/R-REP/

- **SNL** ONLINE *(basic reference info concerning space stations)* *https://www.itu.int/ITU-R/go/space/snl/en*

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