

ITU's Role in GNSS

Hon Fai Ng

Space Services Department
Radiocommunication Bureau (BR)
ng@itu.int



3000+ DELEGATES

193 COUNTRIES

4 WEEKS

TRILLION USD INDUSTRY



WRC

World Radiocommunication Conference



Satellite Services

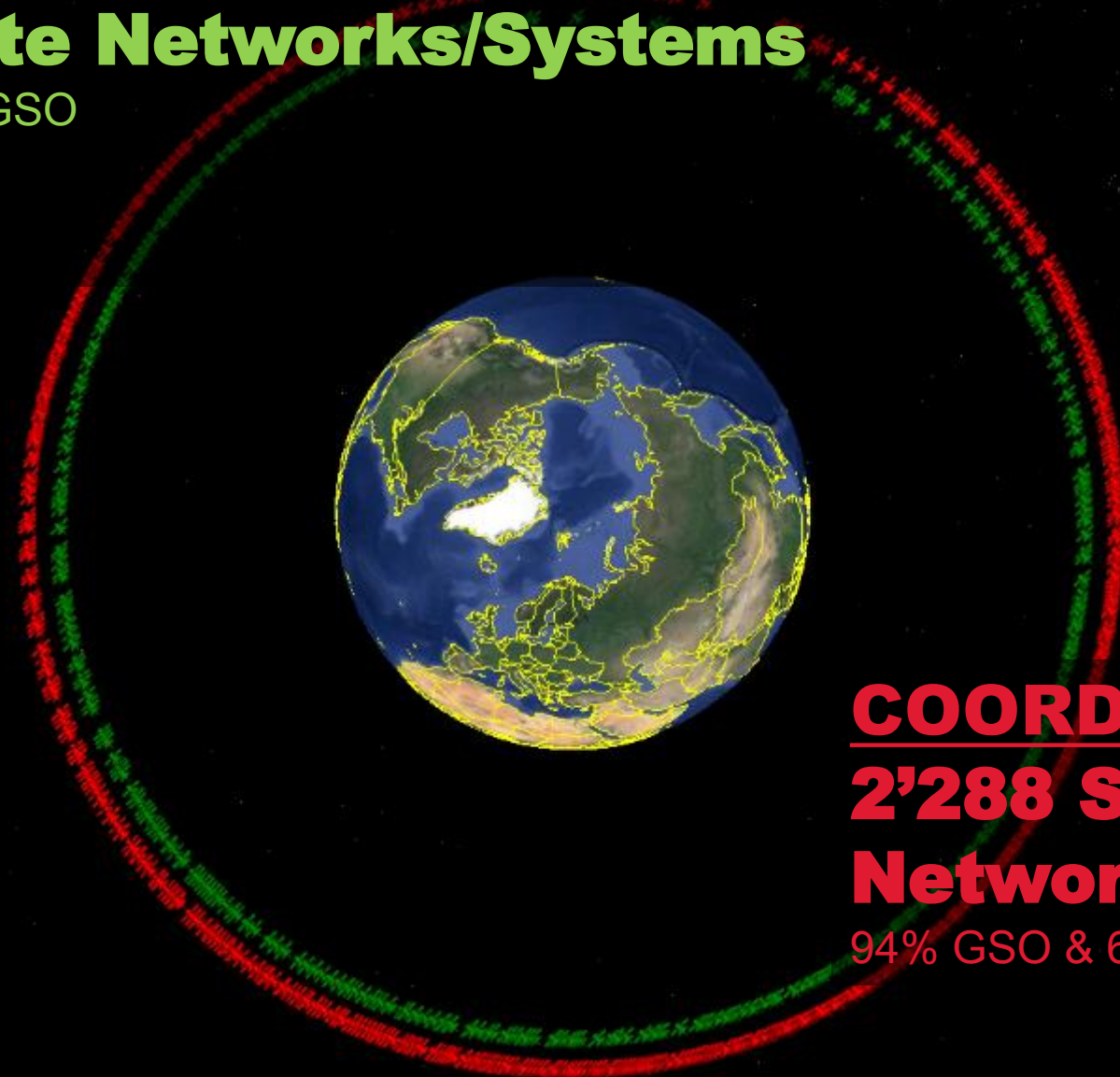


International Telecommunication Union



RECORDED in MASTER REGISTER **1'638 Satellite Networks/Systems**

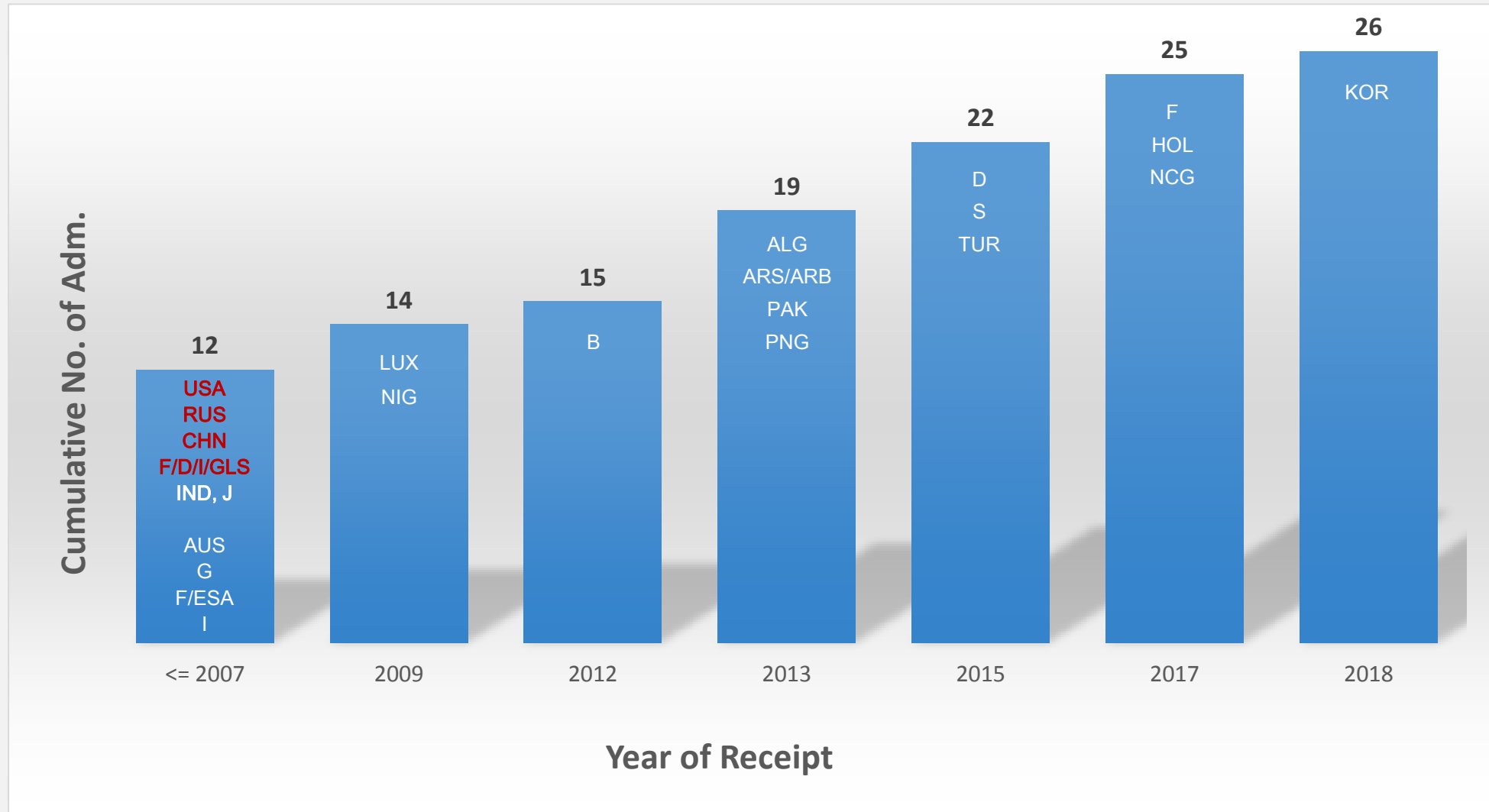
72% GSO & 28% Non-GSO
75 Administrations



COORDINATION
**2'288 Satellite
Networks/Systems**
94% GSO & 6% Non-GSO

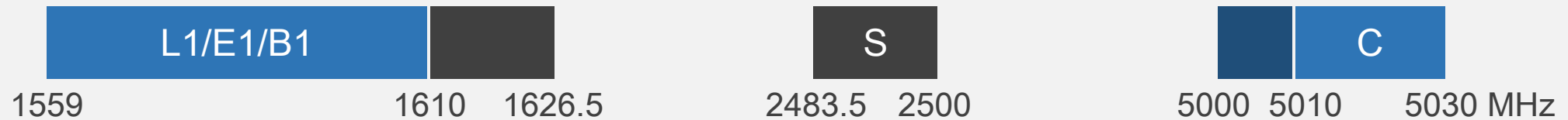
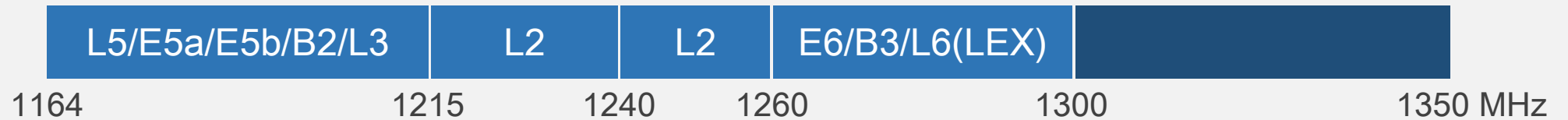
Administrations with satellite filings




RNSS/RDSS in frequency bands 1164 - 1350, 1559 - 1626.5, 2483.5-2500, 5000-5030 MHz; Source: SRS Database of Aug 2018



Frequency Allocation

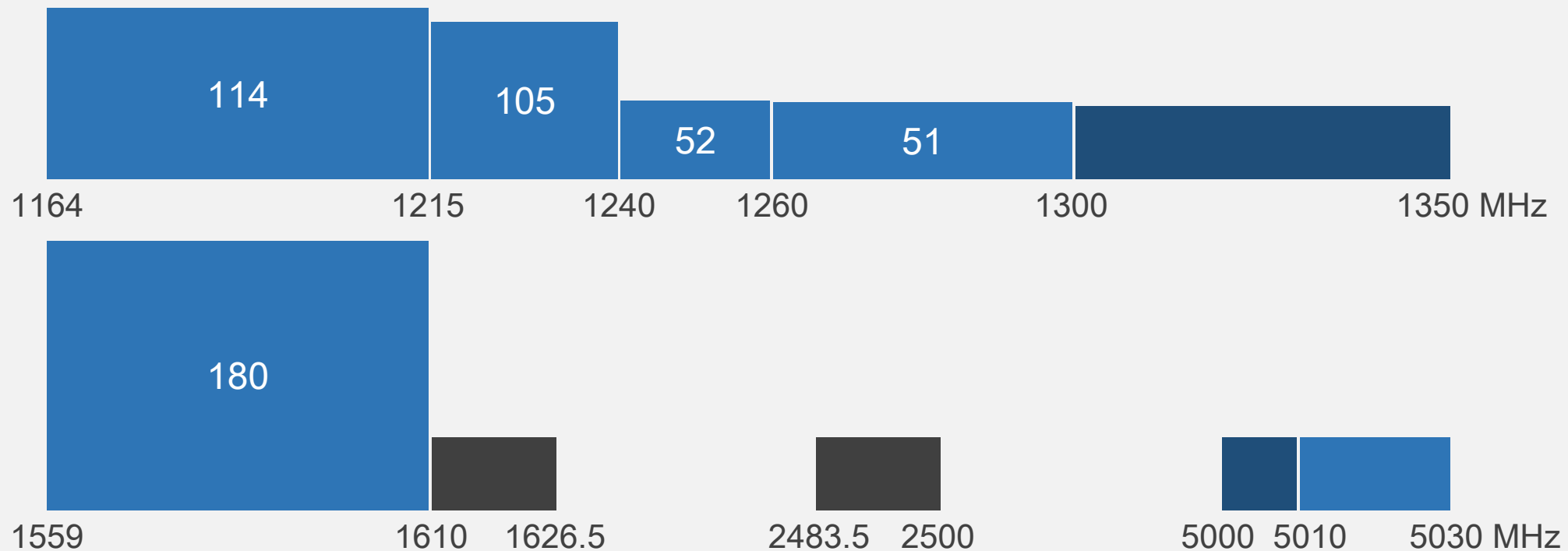
Table of Frequency Allocation in Article 5 of Radio Regulations



-  Radionavigation-Satellite Service (RNSS)
-  Radionavigation-Satellite Service (Uplink)
-  Radiodetermination-Satellite Service (RDSS)

No. of Satellite Networks

Satellite networks in coordination or notification or recorded in Master Register. Source: SRS Database of Aug 2018

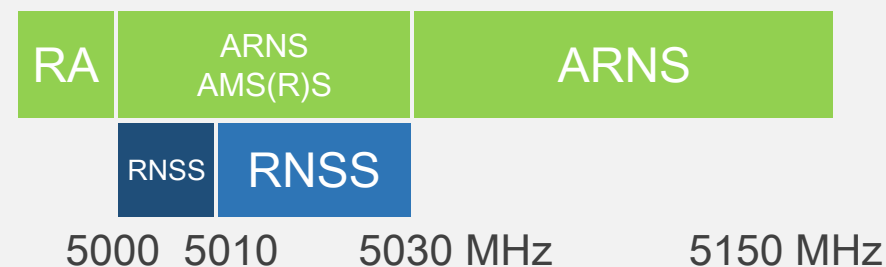
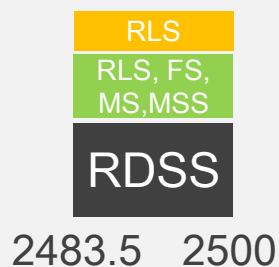
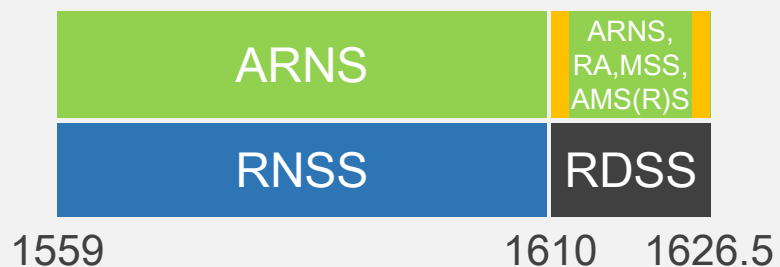
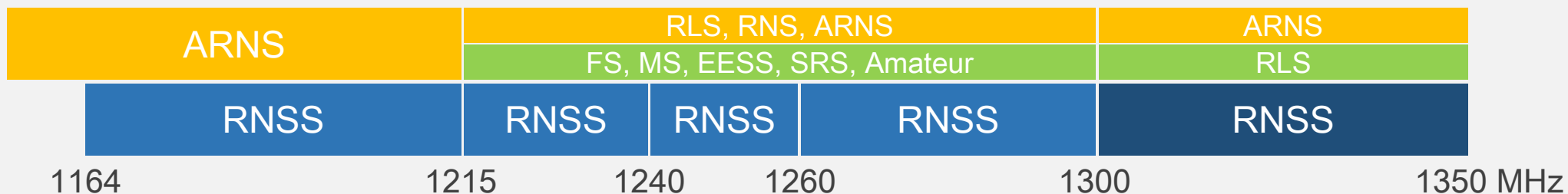


- Radionavigation-Satellite Service (RNSS)
- Radionavigation-Satellite Service (Uplink)
- Radiodetermination-Satellite Service (RDSS)

Frequency Sharing

Table of Frequency Allocation in Article 5 of Radio Regulations

960



AMS(R)S Aeronautical Mobile-Satellite (Route) Service
 ARNS Aeronautical Radionavigation Service
 EESS Earth-Exploration Satellite Service
 FS Fixed Service
 MS Mobile Service

MSS Mobile-Satellite Service
 RLS Radiolocation Service
 RNS Radionavigation Service
 RA Radioastronomy Service
 SRS Space Research Service

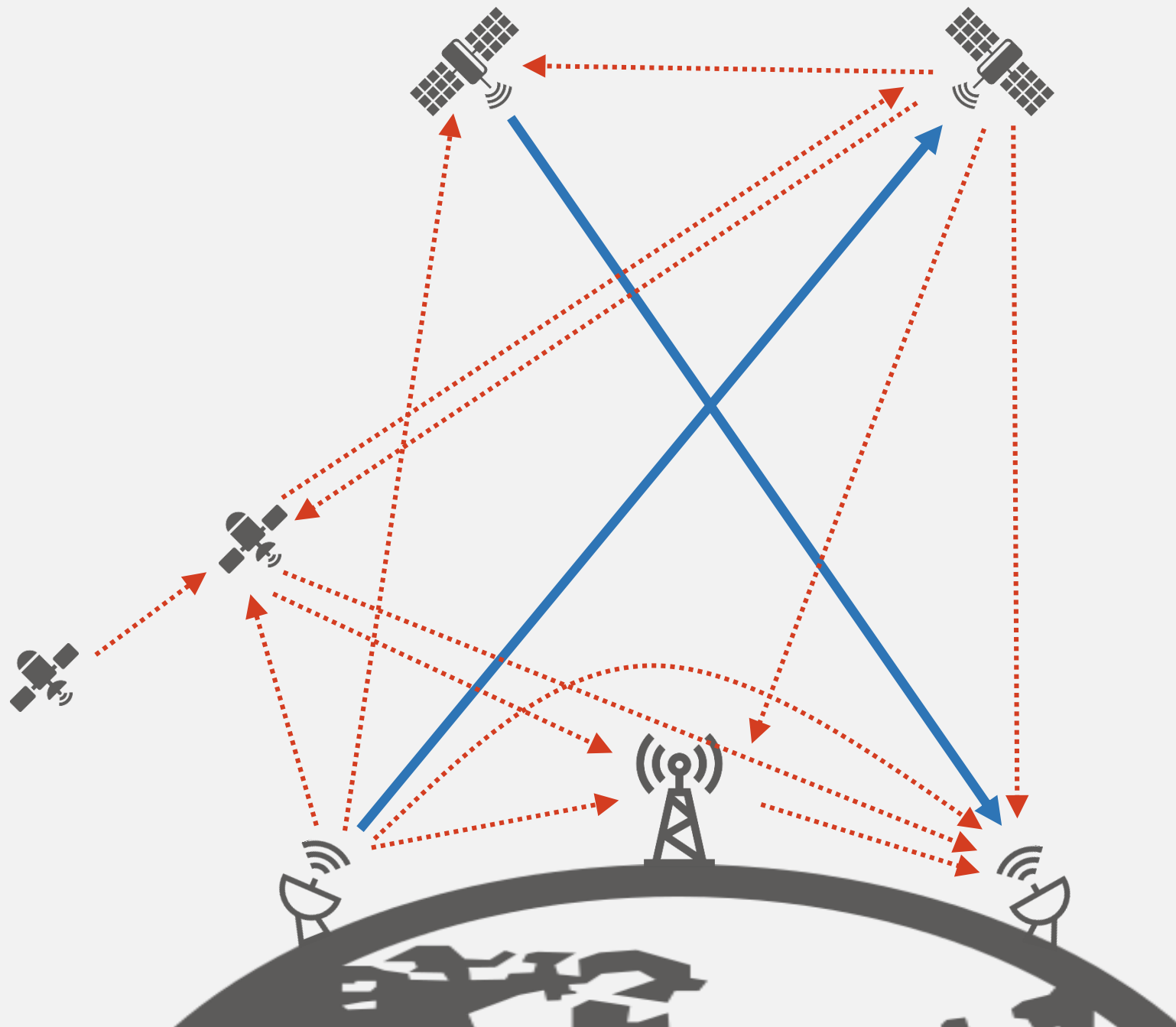
PROGRESS

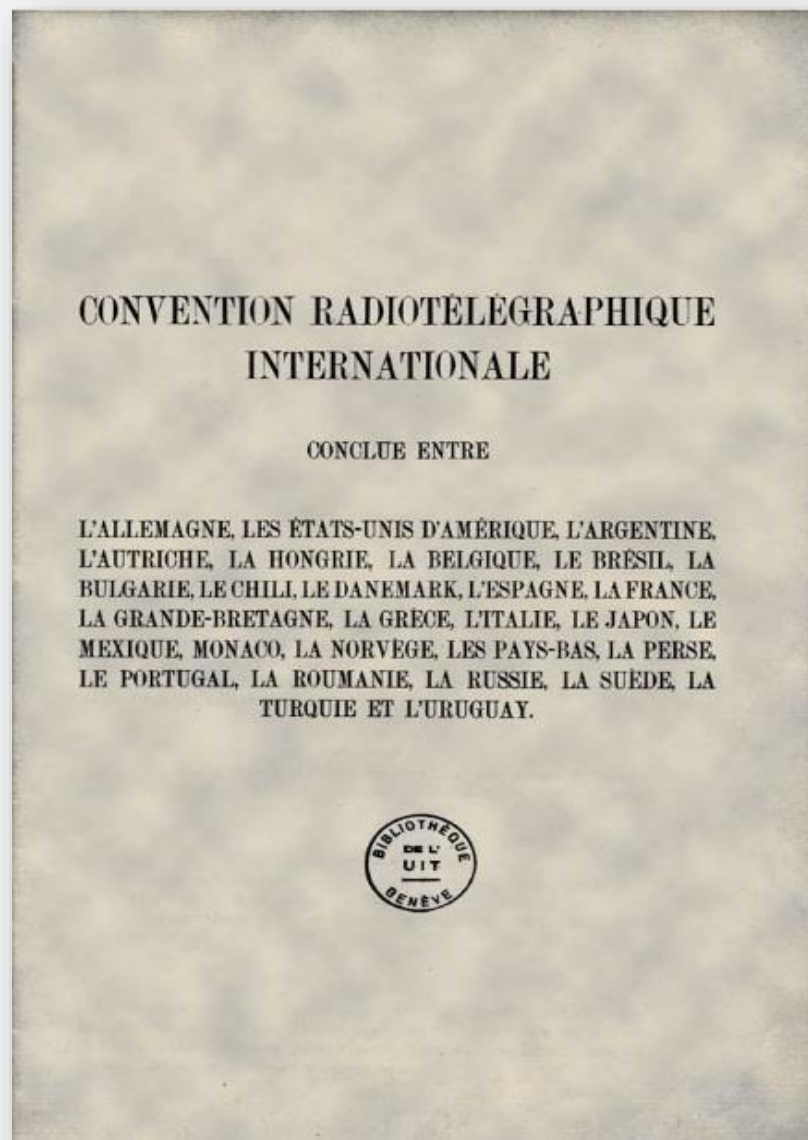
Encourage growth, new technologies & applications
Ensure efficient and economical use of resources

VS

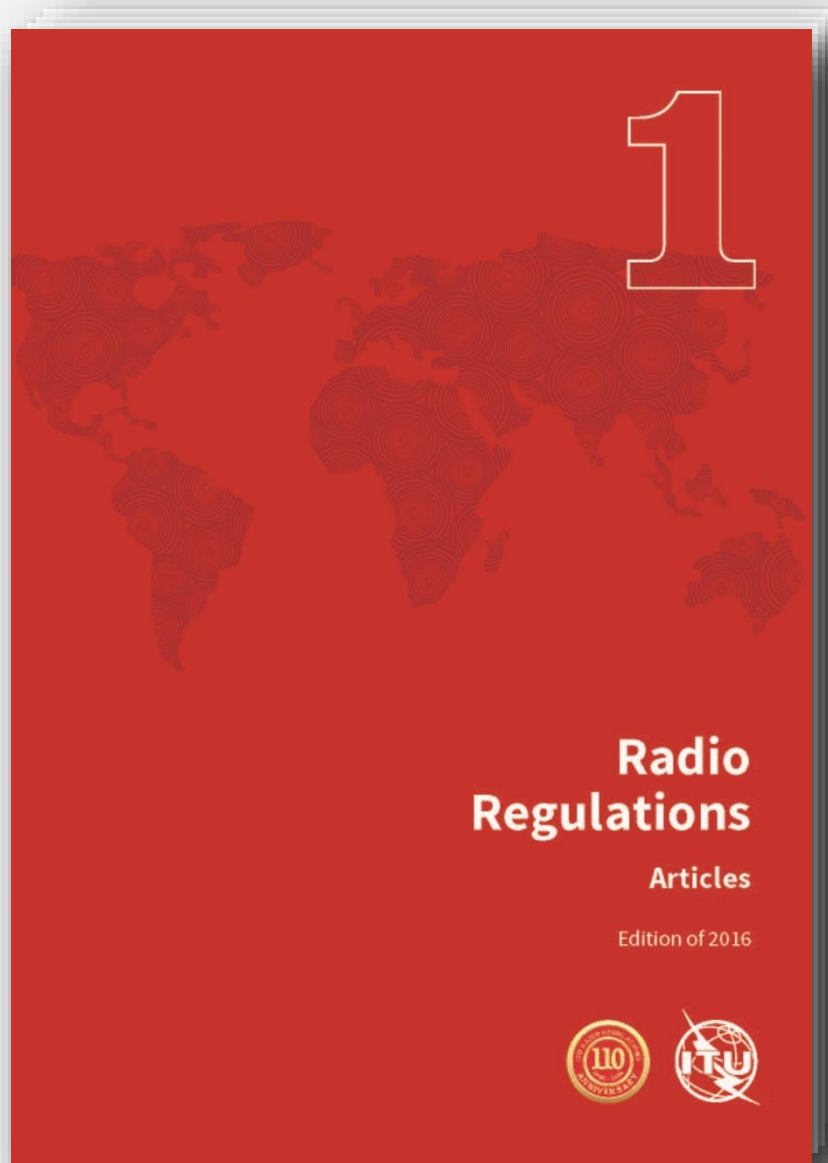
STABILITY

Safeguard investments
Ensure rational and equitable use of resources
Protect existing systems / services from interference





1906 INTERNATIONAL RADIOTELEGRAPH CONVENTION 1st Radio Regulations



2015

PROGRESS & STABILITY

Regularly revised by WRC only
Regulates use of radiocommunication
Protect against harmful interference
Agree (mostly) by consensus

TREATY

Binding on all Member States

Prevent Interference



Allocation

Frequency separation of stations of different services (Article 5)



Regulatory Protection

“Not to cause harmful interference or claim protection” e.g. No. 5.332



Power Limits

Aggregate EPFD limits e.g. RES609
PFD limits e.g. REC608, Art.21



Coordination

Identifies affected Administrations, coordinate to ensure interference-free operations e.g. 9.7, 9.12, 9.12A, 9.13



License

Issued by government (Article 18)

Prevent Interference



Allocation

Frequency separation of stations of different services (Article 5)



Regulatory Protection

“Not to cause harmful interference or claim protection” e.g. No. 5.332



Power Limits

Aggregate EPFD limits e.g. RES609
PFD limits e.g. REC608, Art.21



Coordination

Identifies affected Administrations, coordinate to ensure interference-free operations e.g. 9.7, 9.12, 9.12A, 9.13

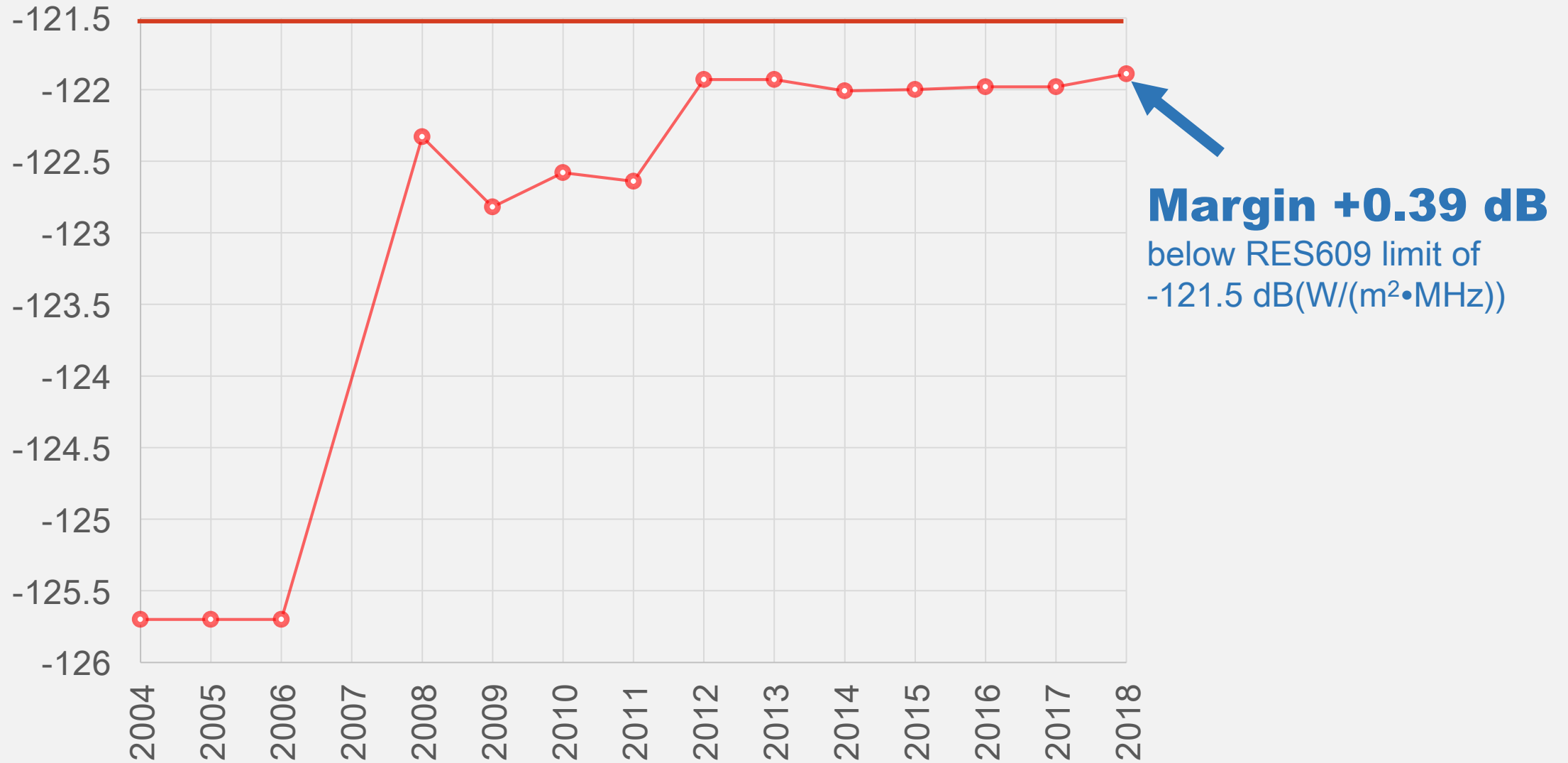


License

Issued by government (Article 18)

Max aggregate EPFD

To protect ARNS from RNSS in 1164-1215 MHz



Resolve Interference



Available Instruments

- Resolve directly between Administrations or Operators (Nos. 15.25 & 15.26)
- Report to BR for info or request for assistance & RRB to formulate recommendations (Nos. 15.41, 13.2 & CV/Art.10)
- Settlement of disputes through Negotiation, Diplomatic Channels and Bi / Multi Lateral Treaties (CS/Art.56)
- Arbitration (CV/Art.41)



Reporting to ITU/BR

- Web-interface <https://www.itu.int/ITU-R/space/sirrs>
- Report to BR for info or request for assistance
- Exchange info with other Adms/Operators
- Reach up to 193 Member States
- Cooperation Agreement for monitoring with D, PAK, BLR, VTN, CHN, KOR, [OMN, B]

WRC-15

ITU-R Study Groups

CPM19-2

Conference Preparatory Meeting

WRC-19

28 Oct-22 Nov 2019

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

www.itu.int/en/ITU-R/study-groups/rcpm

www.itu.int/en/ITU-R/conferences/wrc/2019



Agenda Items for WRC-19

WP7A: Time signals & freq standard emissions
28-31 May 2019

www.itu.int/en/ITU-R/study-groups/rsg7/rwp7a

- Current & potential future reference time scales (WD-PDN Report)

WP7C: Remote sensing systems
29 May-4 June 2019

www.itu.int/en/ITU-R/study-groups/rsg7/rwp7c

- Interference from spaceborne synthetic aperture radar sensors in EESS (active) to RNSS (PDN Report & Rec)



1: Spectrum Management



3: Radiowave Propagation



4: Satellite Services



5: Terrestrial Services



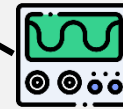
6: Broadcasting Service



7: Science Services



CPM Report



WP1C: Spectrum monitoring
28 May-5 June 2019

www.itu.int/en/ITU-R/study-groups/rsg1/rwp1c

- Assessment of electromagnetic environment in GNSS bands (PDN Report)
- Reporting harmful interference in support of Appendix 10 (WD-PDN Recommendation)



WP4C: Efficient orbit/spectrum utilization for MSS & RDSS(RNSS)
19-25 June 2019

www.itu.int/en/ITU-R/study-groups/rsg4/rwp4c

- Characteristics & protection criteria for Rx ES in RNSS (DR Rec M.1901,2,3,4,5)
- RNSS Apps (DN Report)
- Protection of RNSS from IMT spurious emissions (PDN Report)
- RNSS receiver characteristics from pulsed sources (PND Report)



WRC-19 Agenda Items



Mobile communications, etc.

Amateur at 54 MHz: 1.1
IMT: 1.13 (5G), Sharing with satellites: 9.1.1
(MSS 2 GHz), 9.1.2 (BSS 1,4 GHz), 9.1.8 (IoT)
HAPS: 1.14
FS 300 GHz: 1.15
RLAN 5 GHz: 1.16, 9.1.5



Scientific Services

400 MHz bands: 1.2
460 MHz band: 1.3
TTC for small satellites: 1.7



Transports

GMDSS: 1.8
AIS and VDES : 1.9
GADSS: 1.10
Trains: 1.11 ITS: 1.12
WPT: 9.1.6
Sub-orbital flights: 9.1.4



Satellites

ESIM 30/20 GHz: 1.5
NGSO issues: 1.6 (Q/V), 9.1.3 (C)
FSS 51.4-52.4 GHz : 9.1.9
Regulatory issues: 1.4, 7, 9.1.7



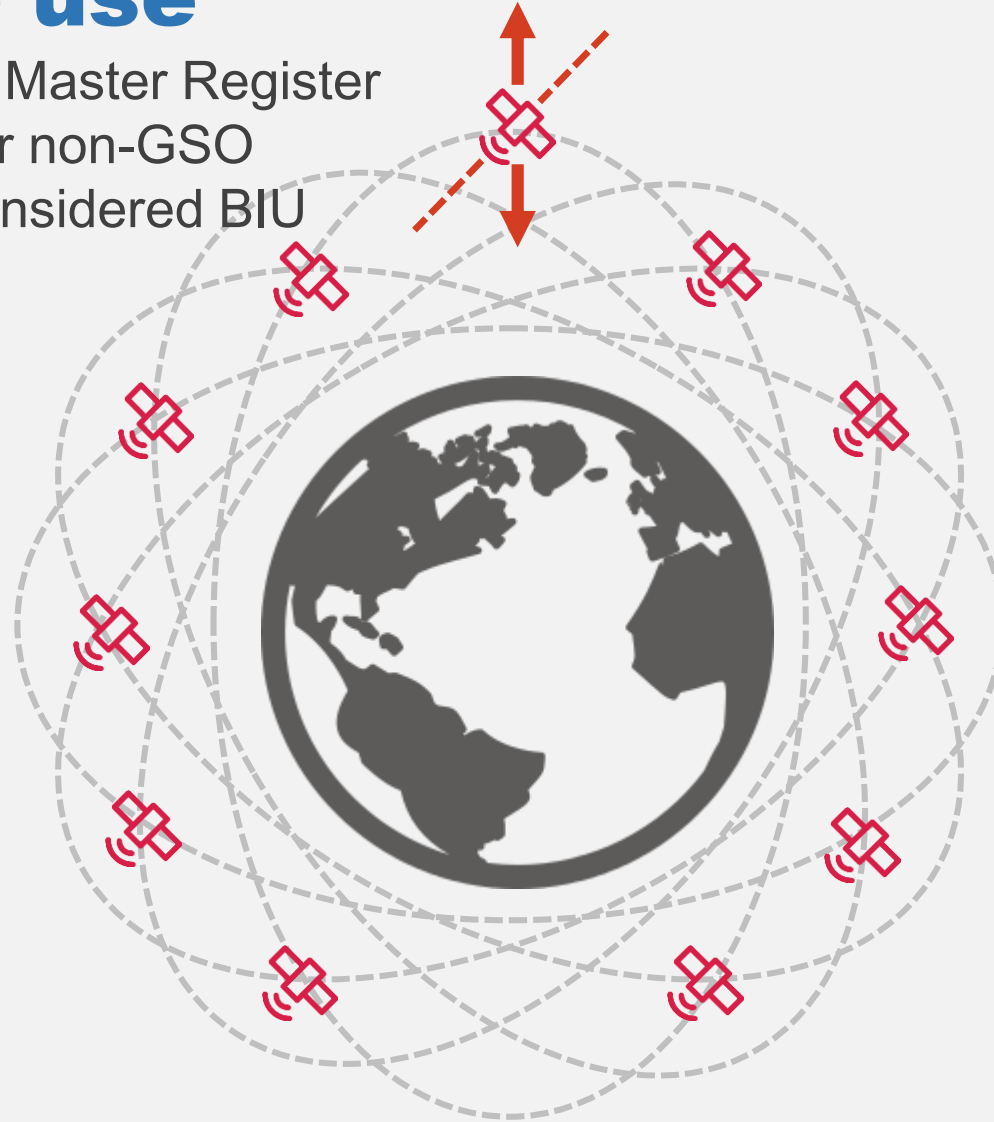
General

Recommendations: 2
Resolutions: 4
National footnotes: 8
Director's report: 9.2
Resolution 80: 9.3
WRC-23 agenda: 10

Draft CPM Report www.itu.int/md/R15-CPM19.02-C-0001/en

Bringing into use

- Must BIU to remain in Master Register
- No formal definition for non-GSO
- Entire constellation considered BIU with **one satellite**¹

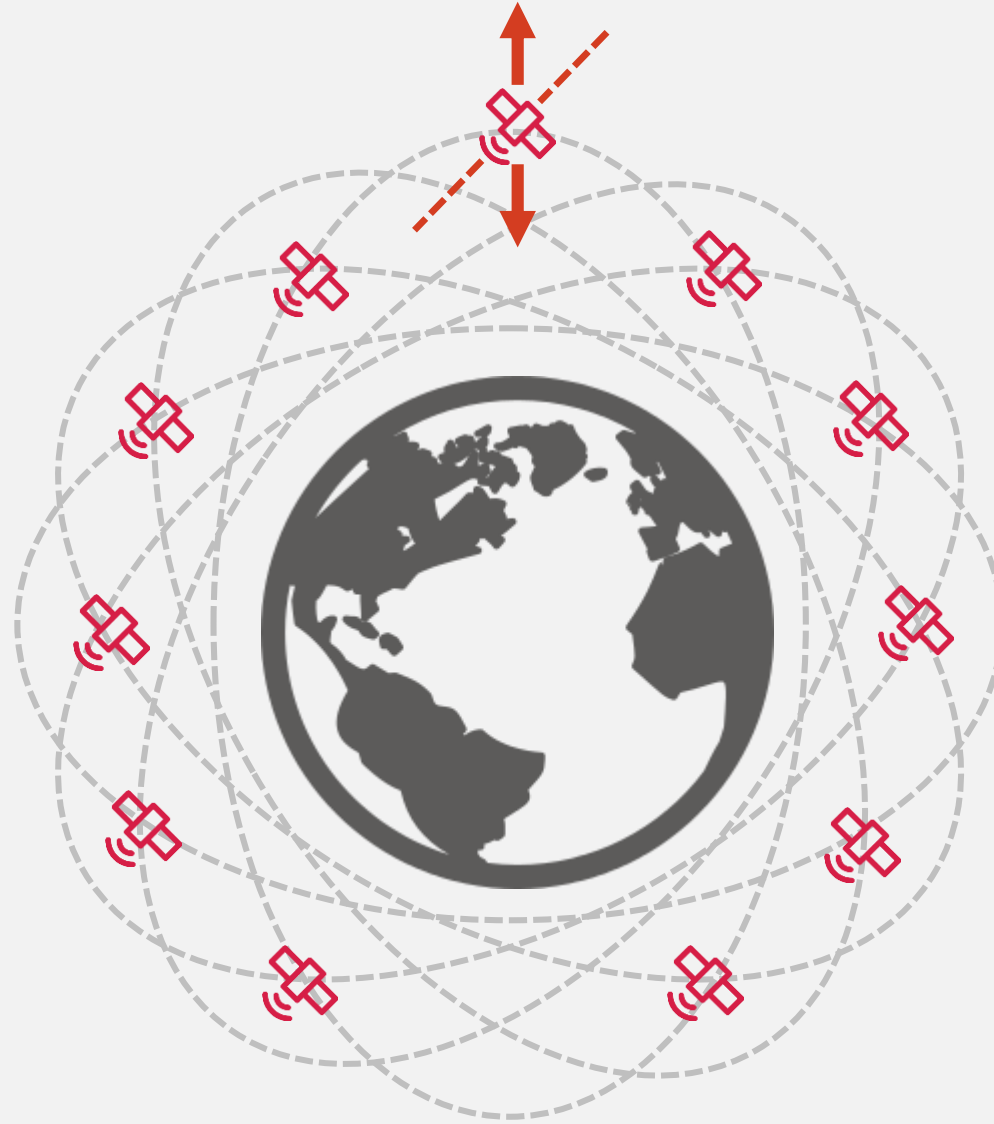


WRC-19

Agenda Item 7 Issue A

1. BIU with **one satellite**¹
 - + Maintained for ≤ 90 days or no fixed period
 - + Deployed satellite to be within certain orbital tolerance (e.g. inclination, apogee, perigee, arg of perigee)
2. Milestone based approach in certain bands & services

¹ For FSS & MSS, one satellite at notified orbital plane and capable of receiving / transmitting in the frequency assignment (RoP11.44)

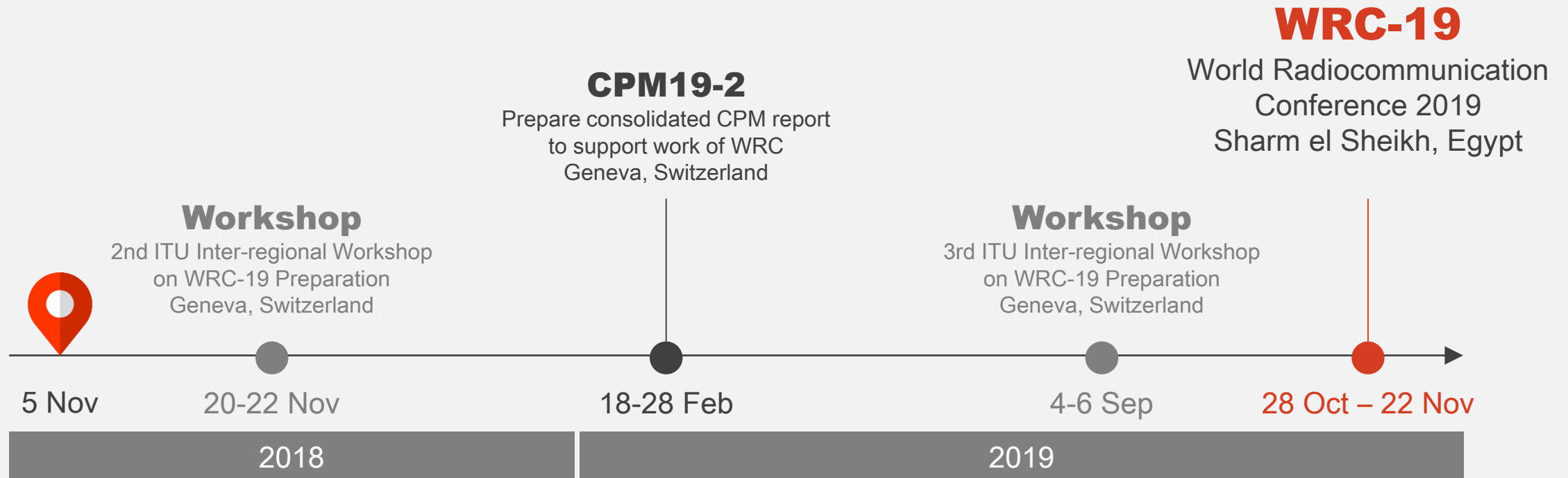


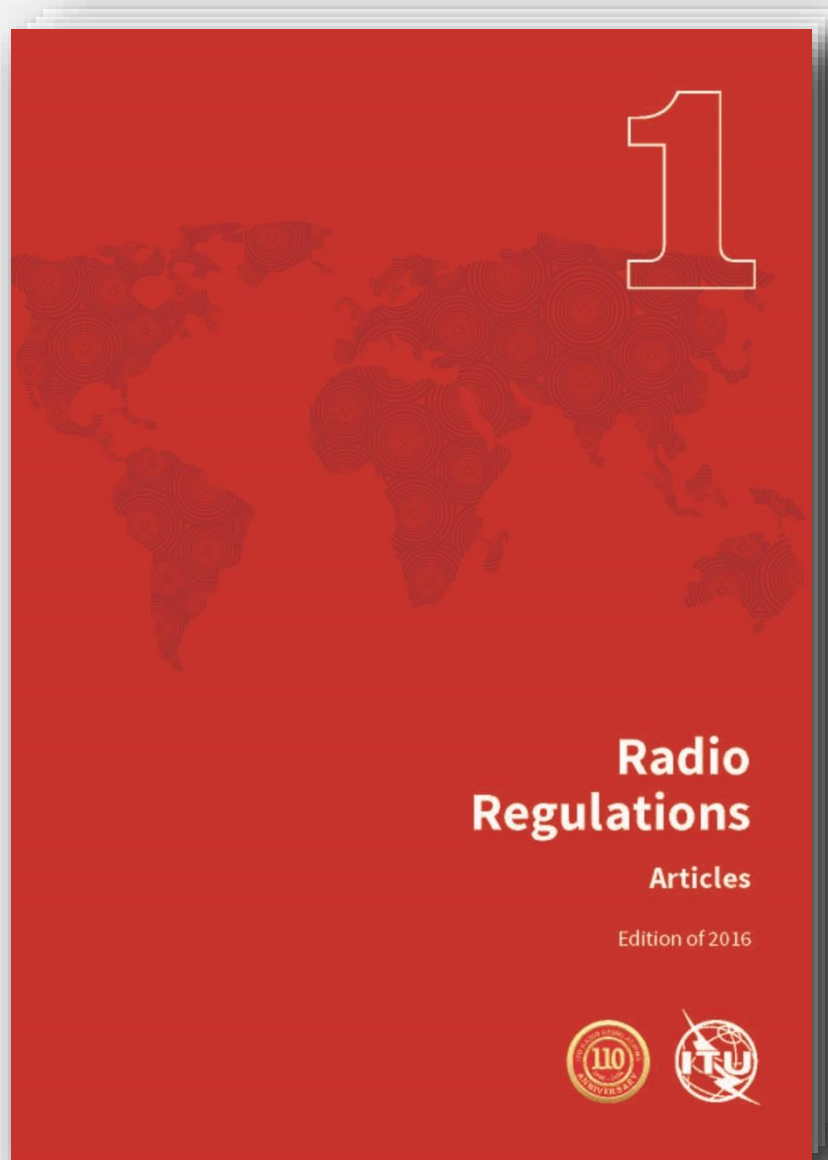
Cost Recovery Revision

- Triggered by large non-GSO FSS systems
- Filings could be more expensive for large non-GSO systems
- Currently under review by ITU Council

Important Dates

Source: <https://www.itu.int/en/events/Pages/Calendar-Events.aspx>





ITU

Provides a regulatory framework for interference-free operation

RADIO REGULATIONS

Stipulates measures to prevent & resolve interference

WRC-19

Presents an opportunity for Member States to revise and improve RR

International Telecommunication Union



www.itu.int

Quick Reference - RNSS/RDSS Allocations in Article 5 of RR

RNSS/RDSS	Other Services	Status of RNSS/RDSS vs Other Services	RNSS/RDSS Coordination Requirements & Power Limits
1164-1215↓	ARNS	RNSS shall not claim protection from ARNS (5.328A)	9.7 & from 01.01.2005: 9.12,9.12A,9.13 Max Agg EPFD -121.5 dB(W/m ² /MHz) (RES609) Max PFD -129 dB(W/m ² /MHz) (REC608)
1215-1300↓	RNS in 5.331 countries ARNS in CAN, USA (5.331)	Lower status (RNSS shall not cause HI to or claim protection from RNS/ARNS)(5.329)	9.7 & from 01.01.2005: 9.12,9.12A,9.13 Not for safety service (space-space)(5.329A)
	RLS	RNSS shall not cause HI to RLS but can claim protection (5.329)	
	FS,MS in 5.330 countries	Same status	
	EESS(active) SRS(active)	1215-1260 MHz: Higher status (EESS & SRS shall not cause HI to or claim protection from RNSS)(5.332) 1260-1300 MHz: Same status	
	Amateur(2ndary) in 1240-1300 MHz	Higher status	
1559-1610↓	ARNS	Same status	9.7 & from 01.01.2005: 9.12,9.12A,9.13 Not for safety service (space-space)(5.329A)
2483.5-2500↓	RLS(primary) in 5.398A countries	Lower status (RDSS shall not cause HI or claim protection from RLS)(5.399)	9.7 & 9.11A (5.402) Not for safety service (5.398) Before 18.02.2012: RDSS subject to 9.21 & retain regulatory status (5.401)
	FS,MS, MSS RLS(primary) in R2&3	Same status	
	ISM applications	Higher status (ISM must accept HI)(5.150)	
	RLS(2ndary) in R1 except 5.398A	Higher status	
5010-5030↓	ARNS, AMR(R)S	Same status	9.7 & from 01.01.2005: 9.12,9.12A,9.13 Max Agg PFD -124.5 dB(W/m ² /150kHz) & RAS limits in RES741 in adjacent band (5.443B)

RNSS has lower status
 Same status
 RNSS has higher status

Guidance on ITU-R Recommendations

RNSS systems/networks operating in 1 & 5GHz: **Rec. ITU-R M.1901-1**

(Note: 1GHz = 1164-1215, 1215-1300, 1559-1610 MHz & 5GHz = 5000-5010/5010-5030 MHz)

Inter-system Interference

Coordination methodology for 1 & 5GHz:
Rec. ITU-R M.1831-1

Interference evaluation method / RNSS Protection

Pulsed interference 1GHz:

Rec. ITU-R M.2030 & Rep. ITU-R M.2220

Cont. interf. 1 & 5GHz: Rec. ITU-R M.1318-1

Spurious emission 1GHz from IMT: **PDNReport
ITU-R M. [IMT-RNSS]**

RNSS Receivers or Earth Stations

Characteristics & protection criteria for
interference analysis

1164-1215 MHz: **Rec. ITU-R M.1905**

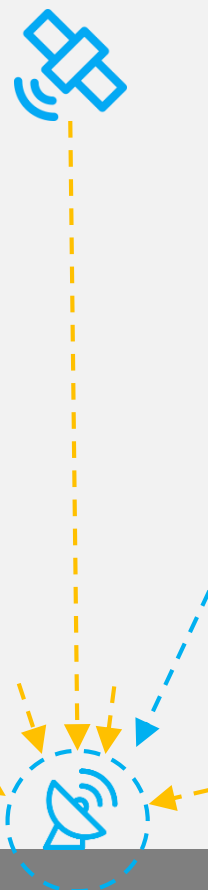
1215-1300 MHz: **Rec. ITU-R M.1902**

1559-1610 MHz: **Rec. ITU-R M.1903**

5010-5030 MHz: Rec. ITU-R M.2031-1

1GHz: **PDNReport ITU-R M. [RNSS_Rcv_Char]**

Transmitting RNSS Space Station Description & technical
characteristics of GLONASS, GPS, GALILEO, COMPASS, QZSS, IRNSS,
etc. in 1GHz: Rec. ITU-R M.1787-3 & 5GHz: Rec. ITU-R M.2031-1
RNSS Applications in 1GHz: **PDNReport ITU-R M.[RNSS_Apps]**



Protection of ARNS

from all RNSS in 1164-
1215 MHz - Assessing
Max EPFD: Rec. ITU-R
M.1642-2 and protection
criteria: Rec. ITU-R
M.1639-1



DME/TACAN



RNSS vs RA

Interference calculation NGSO RNSS vs RA: Rec. ITU-R M.1583-1



Receiving RNSS Space Station

Characteristics & protection
criteria for interference analysis
1GHz (Space-to-space): **Rec.
ITU-R M.1904**
5GHz (Earth-to-space): Rec.
ITU-R M.1906-1

RNSS vs ARNS/RLS

Computation of separation distance in
1300-1350 MHz: Rec. ITU-R M.1584
Coordination distance in 5000-5010
MHz: Rec. ITU-R M.1582



Source:

www.itu.int/rec/R-REC-M/en

www.itu.int/md/R15-WP4C-C-0417/, www.itu.int/md/R15-WP4C-C-0343/,

www.itu.int/md/R15-WP4C-C-0261/, www.itu.int/md/R15-WP4C-C-0192/