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

- Radio Frequency Spectrum
- Radio-navigation satellite
- Radiodetermination satellite
- Meteorological satellite
- Mobile satellite
- Fixed satellite
- Standard frequency & time signal satellite
- Space research
- Earth observation
- Inter-satellite
- Telemetry, tracking, command
- Broadcasting satellite (TV)
- Broadcasting satellite (sound)
International Telecommunication Union

Manages global allocation of radio frequency spectrum & satellite orbits

Source: www.itu.int
RECORDED in MASTER REGISTER
1'638 Satellite Networks/Systems
72% GSO & 28% Non-GSO
75 Administrations

Source: SRS Database of Aug 2018
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

<table>
<thead>
<tr>
<th>Year of Receipt</th>
<th>Cumulative No. of Adm.</th>
<th>Country(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 2007</td>
<td>12</td>
<td>USA, RUS, CHN, F/D/NG/GS, IND, J</td>
</tr>
<tr>
<td>2009</td>
<td>14</td>
<td>LUX, NIG</td>
</tr>
<tr>
<td>2012</td>
<td>15</td>
<td>B</td>
</tr>
<tr>
<td>2013</td>
<td>19</td>
<td>ALG, ARS/ARB, PAK, PNG</td>
</tr>
<tr>
<td>2015</td>
<td>22</td>
<td>D, S, TUR</td>
</tr>
<tr>
<td>2017</td>
<td>25</td>
<td>F, HOL, NCG</td>
</tr>
<tr>
<td>2018</td>
<td>26</td>
<td>KOR</td>
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## Frequency Allocation

Table of Frequency Allocation in Article 5 of Radio Regulations

<table>
<thead>
<tr>
<th>L5/E5a/E5b/B2/L3</th>
<th>L2</th>
<th>L2</th>
<th>E6/B3/L6(LEX)</th>
<th>1164</th>
<th>1215</th>
<th>1240</th>
<th>1260</th>
<th>1300</th>
<th>1350 MHz</th>
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</table>

<table>
<thead>
<tr>
<th>L1/E1/B1</th>
<th>S</th>
<th>C</th>
<th>1559</th>
<th>1610</th>
<th>1626.5</th>
<th>2483.5</th>
<th>2500</th>
<th>5000</th>
<th>5010</th>
<th>5030 MHz</th>
</tr>
</thead>
</table>

- **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

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>ARNS</th>
<th>RLS, RNS, ARNS</th>
<th>ARNS</th>
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</thead>
<tbody>
<tr>
<td>1164</td>
<td>ARNS</td>
<td>FS, MS, EESS, SRS, Amateur</td>
<td>ARNS</td>
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<tr>
<td>1215</td>
<td>RNSS</td>
<td>RLS, RNS, ARNS</td>
<td>RLS</td>
</tr>
<tr>
<td>1240</td>
<td>RNSS</td>
<td>RLS, RNS, ARNS</td>
<td>RLS</td>
</tr>
<tr>
<td>1260</td>
<td>RNSS</td>
<td>RLS, RNS, ARNS</td>
<td>RLS</td>
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<tr>
<td>1300</td>
<td>RNSS</td>
<td>RLS, RNS, ARNS</td>
<td>RLS</td>
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<tr>
<td>1350</td>
<td>RNSS</td>
<td>RLS, RNS, ARNS</td>
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</table>

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>ARNS</th>
<th>RLS, RNS, ARNS</th>
<th>ARNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1559</td>
<td>ARNS</td>
<td>ARNS, RA, MSS, AMS(R)S</td>
<td>ARNS</td>
</tr>
<tr>
<td>1610</td>
<td>RNSS</td>
<td>RLS, FS, MS, MSS</td>
<td>RNSS</td>
</tr>
<tr>
<td>1626.5</td>
<td>RDSS</td>
<td>RLS, FS, MS, MSS</td>
<td>RDSS</td>
</tr>
<tr>
<td>2483.5</td>
<td>RDSS</td>
<td>RLS, FS, MS, MSS</td>
<td>RDSS</td>
</tr>
<tr>
<td>2500</td>
<td>RDSS</td>
<td>RLS, FS, MS, MSS</td>
<td>RDSS</td>
</tr>
<tr>
<td>5000</td>
<td>RA</td>
<td>ARNS, AMS(R)S</td>
<td>ARNS</td>
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<tr>
<td>5010</td>
<td>RNSS</td>
<td>ARNS, AMS(R)S</td>
<td>ARNS</td>
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<tr>
<td>5030</td>
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<td>ARNS, AMS(R)S</td>
<td>ARNS</td>
</tr>
<tr>
<td>5150</td>
<td>RNSS</td>
<td>ARNS, AMS(R)S</td>
<td>ARNS</td>
</tr>
</tbody>
</table>

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
CONVENTION RADIOTELEGRAPHIQUE INTERNATIONALE

CONCLUE ENTRE

L’ALLEMAGNE, LES ÉTATS-UNIS D’AMÉRIQUE, L’ARGENTINE,
L’AUTRICHE, LA BULGARIE, LA BRESIL, LA
CHILI, LE DANEMARK, L’ESPAGNE, LA FRANCE,
LA GRANDE-BRETAGNE, LA GRECE, L’ITALIE, LE JAPON,
LE MEXIQUE, MONACO, LA NORVEGE, LES PAYS-BAS, LA PERSE,
LE PORTUGAL, LA ROUMANIE, LA RUSSIE, LA SUEDE, LA
TURQUIE ET L’URUGUAY.

1906

INTERNATIONAL RADIOTELEGRAPH CONVENTION

1st Radio Regulations

Source: http://search.itu.int/history/HistoryDigitalCollectionDocLibrary/4.37.57.en.100.pdf
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

Source: Articles 5 & 13 of ITU Constitution; Free download: www.itu.int/pub/R-REG-RR-2016
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

Margin +0.39 dB below RES609 limit of -121.5 dB(W/(m²•MHz))

Source: www.itu.int/ITU-R/go/space-resolution609/en
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
www.itu.int/en/ITU-R/study-groups

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
28 Oct-22 Nov 2019
www.itu.int/en/ITU-R/conferences/wrc/2019

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)

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)

Agenda Items for WRC-19
# 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

## 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

## Scientific Services

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

## 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

Bringing into use

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

WRC-19

Agenda Item 7 Issue A

1. BIU with **one satellite**
   + Maintained for \( \leq 90 \) 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

- **WRC-19**
  - World Radiocommunication Conference 2019
  - Sharm el Sheikh, Egypt

- **Workshop**
  - 2nd ITU Inter-regional Workshop on WRC-19 Preparation
    - Geneva, Switzerland
  - 5 Nov

- **CPM19-2**
  - Prepare consolidated CPM report to support work of WRC
  - Geneva, Switzerland
  - 20-22 Nov

- **Workshop**
  - 3rd ITU Inter-regional Workshop on WRC-19 Preparation
    - Geneva, Switzerland
  - 18-28 Feb

- **Workshop**
  - 2nd ITU Inter-regional Workshop on WRC-19 Preparation
    - Geneva, Switzerland
  - 4-6 Sep

- **Workshop**
  - 3rd ITU Inter-regional Workshop on WRC-19 Preparation
    - Geneva, Switzerland
  - 28 Oct – 22 Nov

- **CPM19-2**
  - Prepare consolidated CPM report to support work of WRC
    - Geneva, Switzerland
  - 4-6 Sep

- **Workshop**
  - 3rd ITU Inter-regional Workshop on WRC-19 Preparation
    - Geneva, Switzerland
  - 28 Oct – 22 Nov
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

<table>
<thead>
<tr>
<th>RNSS/RDSS</th>
<th>Other Services</th>
<th>Status of RNSS/RDSS vs Other Services</th>
<th>RNSS/RDSS Coordination Requirements &amp; Power Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1164-1215 ↓</td>
<td>ARNS</td>
<td>RNSS shall not claim protection from ARNS (5.328A)</td>
<td>9.7 &amp; from 01.01.2005: 9.12,9.12A,9.13 Max Agg EPFD −121.5 dB(W/m²/MHz) (RES609) Max PFD −129 dB(W/m²/MHz) (REC608)</td>
</tr>
<tr>
<td>1215-1300 ↓</td>
<td>RNS in 5.331 countries ARNS in CAN, USA (5.331) RLS FS,MS in 5.330 countries EESS(active) SRS(active) Amateur(2ndary) in 1240-1300 MHz</td>
<td>Lower status (RNSS shall not cause HI to or claim protection from RNS/ARNS)(5.329) RNSS shall not cause HI to RLS but can claim protection (5.329) Same status 1215-1260 MHz: Higher status (EESS &amp; SRS shall not cause HI to or claim protection from RNSS)(5.332) 1260-1300 MHz: Same status Higher status</td>
<td>9.7 &amp; from 01.01.2005: 9.12,9.12A,9.13 Not for safety service (space-space)(5.329A)</td>
</tr>
<tr>
<td>2483.5-2500 ↓</td>
<td>RLS(primary) in 5.398A countries FS,MS, MSS RLS(primary) in R2&amp;3 ISM applications RLS(2ndary) in R1 except 5.398A</td>
<td>Lower status (RDSS shall not cause HI or claim protection from RLS)(5.399) Same status Higher status (ISM must accept HI)(5.150) Higher status</td>
<td>9.7 &amp; 9.11A (5.402) Not for safety service (5.398) Before 18.02.2012: RDSS subject to 9.21 &amp; retain regulatory status (5.401)</td>
</tr>
<tr>
<td>5010-5030 ↓</td>
<td>ARNS, AMR(R)S</td>
<td>Same status</td>
<td>9.7 &amp; from 01.01.2005: 9.12,9.12A,9.13 Max Agg PFD −124.5 dB(W/m²/150kHz) &amp; RAS limits in RES741 in adjacent band (5.443B)</td>
</tr>
</tbody>
</table>

- **Yellow**: RNSS has lower status
- **Blue**: Same status
- **Green**: 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**
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]

**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

**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

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

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