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Radio Navigation Satellite Service and the ITU Radio Regulations

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ITU Mission

Committed to Connecting the World



*“To ensure **rational, equitable, efficient and economical** use of the **radio frequency spectrum** by all radiocommunication services - including those using the geostationary satellite orbit or **other satellite orbits** - and to carry out studies on radiocommunication matters”*

- United Nations Outer Space Treaty (1967)
 - *Outer space is free for exploitation and use by all states in conformity with international regulations*
 - States retain jurisdiction and control over objects they have launched into outer space
- ITU Radio Regulations (RR)
 - Part of the ITU Administrative Regulations and Instruments complementing the provisions of the *ITU Constitution* (CS) and *Convention* (CV), which govern the use of telecommunications
 - **Intergovernmental treaty – legal bindings** on all Member states
 - Principles of use of *orbit/spectrum* (CS and RR)
 - *Allocation* of frequency bands (Article 5 of the RR) and *services*
 - *Procedures* and Plans
- Are we obliged to apply the ITU Radio Regulations?
 - **Ratification of the ITU Convention (CV) implies acceptance of the ITU Radio Regulations**

ITU Radio Regulations



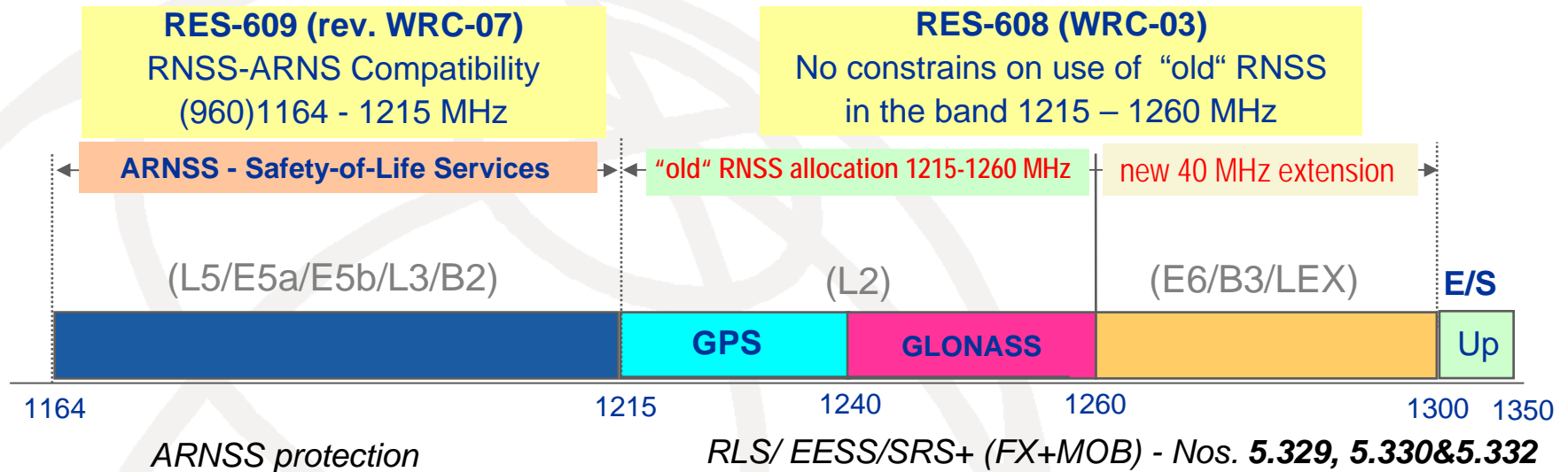
OBJECTIVES:

- to **facilitate** *equitable access to* and *rational use* of the natural resources of the *radio-frequency spectrum* and *any associated orbits*;
- to **ensure** the *availability and protection* from harmful interference of the frequencies provided for *distress and safety purposes*;
- to **assist** in the *prevention and resolution of cases of harmful interference* between the radio services of different administrations;
- to **facilitate** the *efficient and effective operation* of all *radiocommunication services*;
- to **provide** for and, where necessary **regulate new applications** of radiocommunication technology.

➤ Definitions from the ITU Radio Regulations (RR) -1

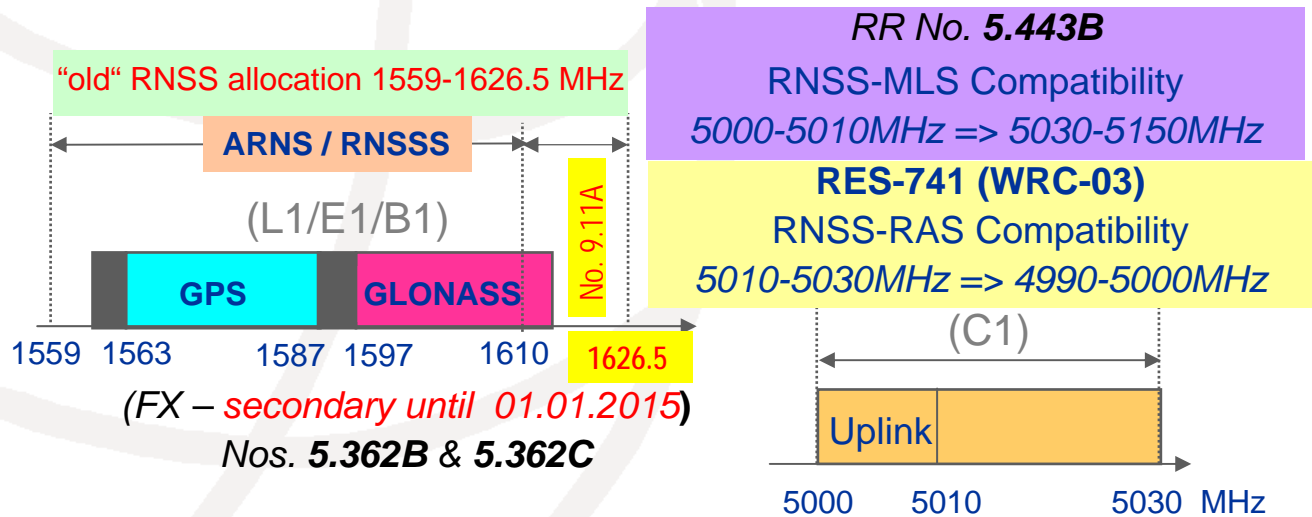
- No. **1.43** **radionavigation-satellite service (RNSS):**
A radiodetermination-satellite service used for the purpose of radionavigation
- No. **1.59** **safety service:**
Any radiocommunication service used for the safeguarding of human life and property
- No. **4.10** Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies.

RNSS regulatory situation summary



EPFD -121,5 dBW/m² in 10 MHz for all sats in view

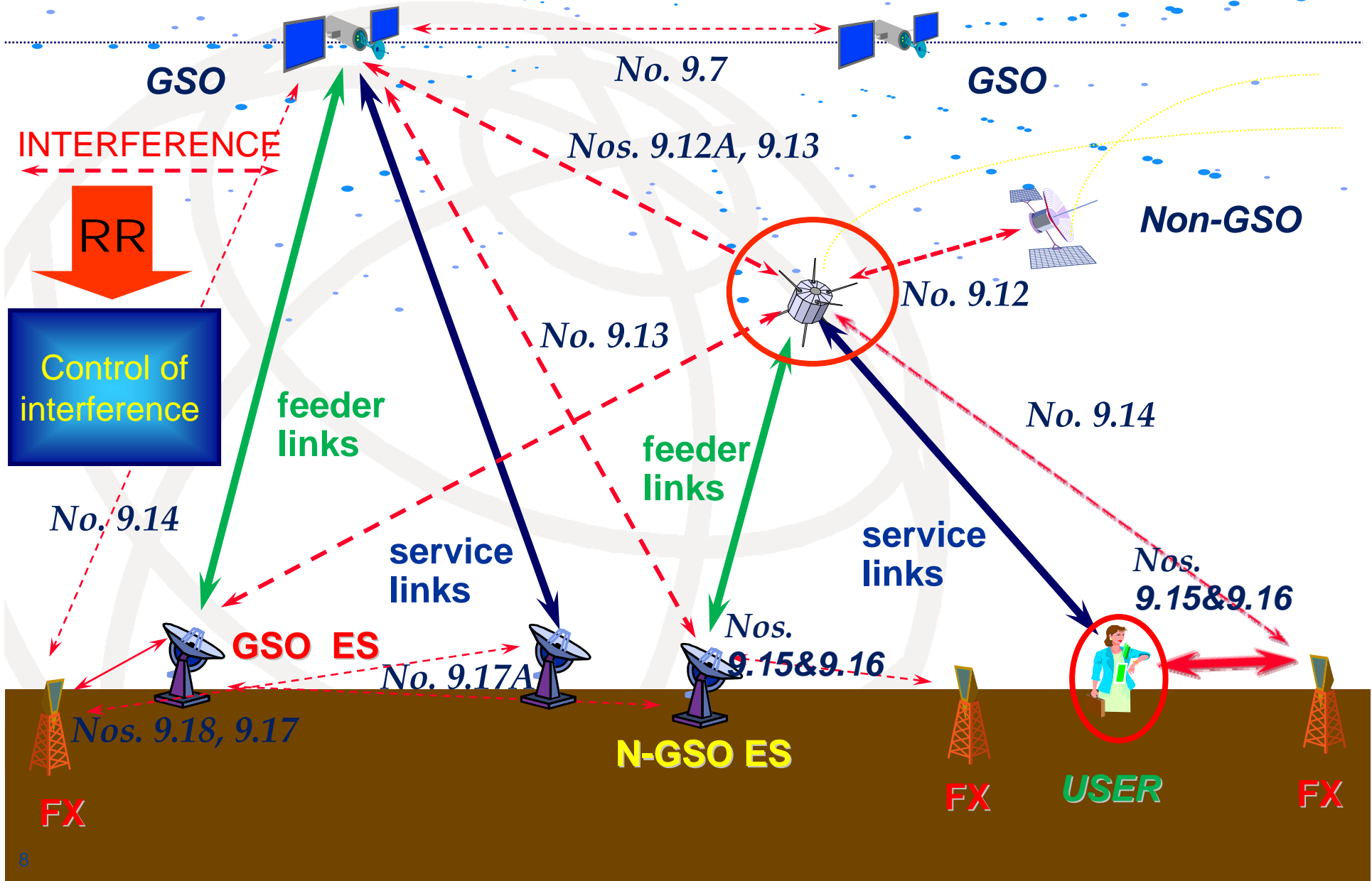
RES-610 (WRC-03)
Coordination and bilateral
resolution of technical
compatibility issues for
RNSS networks



➤ Definitions from the ITU Radio Regulations (RR) - 2

- No **1.166** *interference*: The effect of unwanted energy due to one or a combination of *emissions*, *radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.
- No **1.167** *permissible interference*: Observed or predicted *interference* which complies with quantitative *interference* and sharing criteria contained in these Regulations or in ITU-R Recommendations or in special agreements as provided for in these Regulations.
- No **1.168** *accepted interference*: *Interference* at a higher level than that defined as *permissible interference* and which has been agreed upon between two or more administrations without prejudice to other administrations.
- No **1.169** *harmful interference (HI)*: *Interference* which endangers the functioning of a radionavigation service or of other *safety services* or seriously degrades, obstructs, or repeatedly interrupts a *radiocommunication service* operating in accordance with Radio Regulations.

N-GSO interference situation



Infringement of the Constitution, Convention or Radio Regulations



- All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, etc. (No. **15.1**)
- Transmitting stations shall radiate only as much power as is necessary to ensure a satisfactory service (No. **15.2**)

Infringement of the Constitution, Convention or Radio Regulations



- Not necessarily harmful interference;
- Representations relating to infringement committed by a station shall be made to the administration of the country having jurisdiction over the station by the administrations which detect it. (No. **15.20** of the RR)
- If an administration has information of an infringement of the Constitution, the Convention or the Radio Regulations (in particular Article **45** of the Constitution and No. **15.1** of the RR) committed by a station under its jurisdiction, the administration shall ascertain the facts and take the necessary actions (No. **15.21 – REV WRC-12**)

ARTICLE 45 - Harmful Interference

CS 197

1. All stations, whatever their purpose, must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations.

CS 198

2. Each Member State undertakes to require the operating agencies which it recognizes and the other operating agencies duly authorized for this purpose to observe the provisions of No. **197** above.

CS 199

3. Further, the Member States recognize the necessity of taking all practicable steps to prevent the operation of electrical apparatus and installations of all kinds from causing harmful interference to the radio services or communications mentioned in No. **197** above.

Report of an infringement (AP9 to RR)



15.19 § 11 Infringements of the Constitution, Convention or Radio Regulations shall be reported to their respective administrations by the control organization, stations or inspectors detecting them. For this purpose they shall use forms similar to the specimen given in Appendix 9.

APPENDIX 9
Report of an irregularity or infringement

(See Article 15, Section V)

Particulars concerning the station infringing the Radio Regulations:

- 1 Name¹ if known (in BLOCK letters)
- 2 Call sign or other identification (in BLOCK letters)
- 3 Nationality, if known
- 4 Frequency used (kHz, MHz, GHz or THz)
- 5 Class of emission²
- 6 Class of station and nature of service, if known
- 7 Location^{3, 4, 5}

Particulars concerning the station, the centralizing office or inspection service reporting the irregularity or infringement:

- 8 Name (in BLOCK letters)
- 9 Call sign or other identification (in BLOCK letters)
- 10 Nationality
- 11 Location^{3, 4}

Particulars of the irregularity or infringement:

- 12 Name⁶ of the station (in BLOCK letters) in communication with the station committing the irregularity or infringement
- 13 Call sign or other identification (in BLOCK letters) of the station in communication with the station committing the irregularity or infringement

- 14 Date and time⁷
- 15 Nature of the irregularity or infringement⁸
- 16 Extracts from ship log or other information supporting the report

Particulars concerning the transmitting station interfered with⁹:

- 17 Name of the station (in BLOCK letters)
- 18 Call sign or other identification (in BLOCK letters)
- 19 Frequency assigned (kHz, MHz, GHz or THz)
- 20 Frequency measured at the time of the interference
- 21 Class of emission² and bandwidth (indicate whether measured or estimated, or indicate the necessary bandwidth notified to the Radiocommunication Bureau)
- 22 Receiving location^{3, 4} (in BLOCK letters) where the interference was experienced
- 23 Certificate:

I certify that the foregoing report represents, to the best of my knowledge, a complete and accurate account of what took place.

Signatures¹⁰ Date:

Causes of HI



- Out of band emissions;
- Non-coordination of the assignments;
- Non-observance of limits of
 - Appendix **2** to the ITU RR
(Table of transmitter frequency tolerances)
 - Appendix **3** to the ITU RR
(Tables of maximum permitted power levels for spurious or spurious domain emissions);
- Operating with different technical parameters from those recorded in the Master International Frequency Register (**MIFR**);
- Unauthorised emissions, etc.

Measures against HI (1/4)



- No. 4.3 Any new assignment or any change of frequency or other basic characteristic of an existing assignment *shall be made in such a way as to avoid causing harmful interference to assignments recorded in the MIFR* in accordance with the Table of Frequency Allocations (ART 5) and the other provisions of the RR;
- No. 4.4 Administrations *shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations (ART 5) or the other provisions of the RR*, except on the express condition that such a station shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations

Measures against HI (2/4)



Primary and secondary services (Nos. 5.23 – 5.31)

- Primary service;
- *Secondary service*
 - shall cause no harmful interference to, nor claim protection from, the primary service;
 - can claim protection from harmful interference from stations of the same or other secondary services.

Measures against HI (3/4)



Right to international recognition (No. 8.3)

- *Any frequency assignment recorded in the Master Register (MIFR) with a favourable finding* with respect to the Table of Frequency Allocations and other provisions of the RR shall have the right to international recognition;
- *This right means that other administrations shall take it into account when making their own assignments, in order to avoid harmful interference.*

Measures against HI (4/4)



Non-conforming assignment (Nos. 8.4 & 8.5)

- A frequency assignment shall be known as a non-conforming assignment when it is not in accordance with the Table of Frequency Allocations or the other provisions of the RR.
- Recorded in the MIFR for information purposes only if the administration states that it shall be operated under the conditions that:
 - it shall cause no harmful interference to, nor claim protection from, other stations operating in accordance with the Table of Frequency Allocations or the other provisions of the RR;
 - it shall eliminate harmful interference if caused to a station operating in accordance with the Table of Frequency Allocations and other provisions of the RR.

Procedure in a case of harmful interference (1/2)



- Administrations shall exercise the utmost goodwill and mutual assistance to the settlement of problems of harmful interference (No. **15.22**)
- Administrations shall cooperate in the detection and elimination of harmful interference, employing where appropriate the facilities described in Article **16** (*International monitoring*) and the procedures detailed in the Section VI of Article **15** (Procedure in a case of harmful interference) (No. **15.25**).
- Where practicable, and subject to agreement by administrations concerned, the case of harmful interference may be dealt with directly by their monitoring stations or by direct coordination between the operators (No. **15.26**).
- Full particulars relating to harmful interference shall, whenever possible, be given in the form indicated in Appendix **10** (No. **15.27**).

Report of HI (AP10 to RR)



No. **15.27** § 19 Full particulars relating to harmful interference shall, whenever possible, be given in the form indicated in Appendix 10.

APPENDIX 10 (Rev.WRC-07)

Report of harmful interference

(See Article 15, Section VI)

Particulars concerning the station causing the interference:

- a Name, call sign or other means of identification
 - b Frequency measured
 - Date:
 - Time (UTC):
 - c Class of emission¹
 - d Bandwidth (indicate whether measured or estimated)
 - e Measured field strength or power flux-density²
 - Date:
 - Time (UTC):
 - f Observed polarization
 - g Class of station and nature of service
 - h Location/position/area/bearing (QTE³) (wrc-07)
 - i Location of the facility which made the above measurements
- Particulars concerning the transmitting station interfered with:*
- j Name, call sign or other means of identification
 - k Frequency assigned

¹ The class of emission shall contain the basic characteristics listed in Appendix 1. If any characteristic cannot be determined, indicate the unknown symbol with a dash. However, if a station is not able to identify unambiguously whether the modulation is frequency or phase modulation, indicate frequency modulation (F).
² When measurements are not available, signal strengths according to the QSA scale should be provided.
³ See the most recent version of Recommendation ITU-R M.1172. (WRC-07)

- l Frequency measured
 - Date:
 - Time (UTC):
 - m Class of emission⁴
 - n Bandwidth (indicate whether measured or estimated, or indicate the necessary bandwidth notified to the Radiocommunication Bureau)
 - o Location/position/area
 - p Location of the facility which made the above measurements
- Particulars furnished by the receiving station experiencing the interference:*
- q Name of station
 - r Location/position/area
 - s Dates and times (UTC) of occurrence of harmful interference
 - t Bearings (QTE⁵) or other particulars (wrc-07)
 - u Nature of interference
 - v Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference⁶
 - Date:
 - Time (UTC):
 - w Polarization of the receiving antenna or observed polarization
 - x Action requested

NOTE – For convenience and brevity, telegraphic reports shall be in the format above, using the letters in the order listed in lieu of the explanatory titles, but only those letters for which information is provided should be used. However, sufficient information shall be provided to the administration receiving the report, so that an appropriate investigation can be conducted.

⁴ See footnote 1.
⁵ See footnote 3.
⁶ See footnote 2.

Procedure in a case of harmful interference (2/2)



- On being informed that a station over which it has jurisdiction is believed to have been the cause of harmful interference, an administration shall, as soon as possible, acknowledge receipt of that information (No. **15.35**).
- An administration receiving a communication to the effect that one of its stations is causing harmful interference to a safety service shall promptly investigate the matter and take any necessary remedial action and respond in a timely manner (No. **15.37**).
- If it is considered necessary, and particularly if the steps taken in accordance with the procedures described above have not produced satisfactory results, the administration concerned shall forward details of the case to the Bureau for its information (No. **15.41**).
- In such a case, the administration concerned may also request the assistance of the Bureau (No. **15.42**).

- No. **16.1** To assist to the extent practicable in the implementation of these Regulations, in particular to help ensure efficient and economical use of the radio-frequency spectrum and to help in the prompt elimination of harmful interference, administrations agree to continue the development of monitoring facilities and, to the extent practicable, to cooperate in the continued development of the *international monitoring system*, taking into account the relevant ITU-R Recommendations

ART 16 - International monitoring (2/2)



- No. **16.2** - The international monitoring system comprises ***only*** those monitoring stations which have been so nominated by administrations in the information sent to the ITU in accordance with Resolution ITU-R **23-1** and Recommendation ITU-R **SM.1139**.

<http://www.itu.int/rec/R-REC-SM.1139-0-199510-I/en>

- These stations may be operated by an administration or, in accordance with an authorization granted by the appropriate administration, *by a public or private enterprise*, by a common monitoring service established by two or more countries, or by an international organization.
- ***List of International Monitoring Stations (List VIII)***
<http://www.itu.int/ITU-R/index.asp?category=terrestrial&mlink=terrestrial-monitoring-listviii&lang=en>

Harmful Interference Conclusions



- What some see as interference is considered by others as useful information.
- For improving the use of the frequency spectrum, the utmost goodwill and mutual cooperation among the interested parties are necessary.
- When assigning frequencies to stations and in their operation, Members shall remain faithful to the spirit of No. **37** of the Constitution and conform strictly to the RR, in particular to the Table of Allocations, which constitutes the basis for the prevention of harmful interference.
- Apart from requests for assistance, the BR intervenes in the case of harmful interference only if the frequency affected is recorded in the **MIFR** or the harmful interference is caused to a safety service.

RNSS info 1



- **WP 4C** is responsible for studies related to all mobile-satellite services including **RNSS**
 - Studies on the RNSS are very active
 - **Sharing** and **protection criteria** have been intensively investigated for existing spectrum allocation for RNSS
 - Studies are also on-going for newly allocated bands for future enhancements and newly planned RNSS systems, addressing **frequency sharing with other services**
 - These studies contribute not only to the development of **ITU-R M Series Recommendations** but also to WRC-15 preparation
 - *Free online access to current ITU-R Recommendations* is provided to all users at:
<http://www.itu.int/publ/R-REC/en>

RNSS info 2A



- **List of most important ITU-R Recommendations related to RNSS (1)**
 - **ITU-R M.1582** - Method for determining coordination distances, in the 5 GHz band, between the international standard microwave landing system stations operating in the aeronautical radionavigation service and stations of the radionavigation-satellite service
 - **ITU-R M.1787** - *Description of systems and networks in the radionavigation-satellite service and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz*
 - **ITU-R M.1831** - *A coordination methodology for RNSS inter-system interference estimation*
 - **ITU-R M.1901** - Guidance on ITU-R Recommendations related to systems and networks in the radionavigation-satellite service operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz
 - **ITU-R M.1902** - Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 215-1 300 MHz

RNSS info 2B



- **List of most important ITU-R Recommendations related to RNSS (2)**
 - **ITU-R M.1903** - Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz
 - **ITU-R M.1904** - Characteristics, performance requirements and protection criteria for receiving stations of the radionavigation-satellite service (space-to-space) operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz
 - **ITU-R M.1905** - Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1164-1 215 MHz
 - **ITU-R M.1906** - Characteristics and protection criteria of receiving space stations and characteristics of transmitting earth stations in the radionavigation-satellite service (Earth-to-space) operating in the band 5 000-5 010 MHz



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Questions ?



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