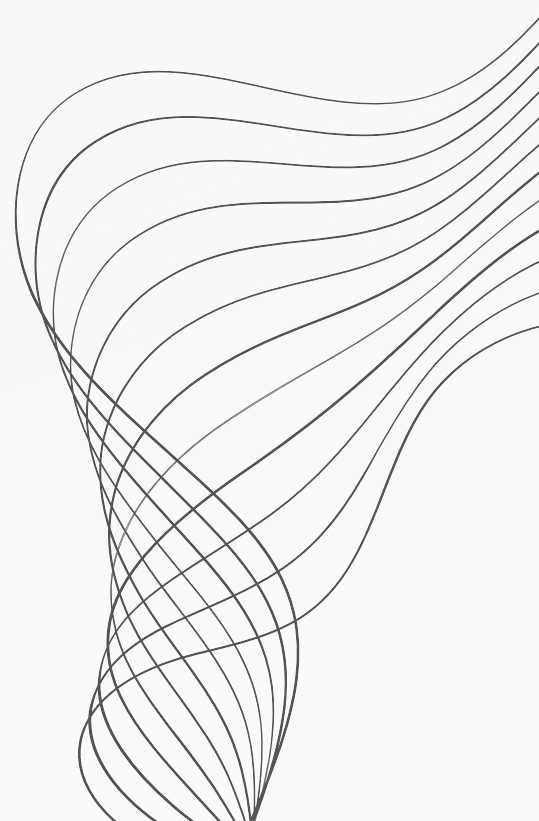


Radio Frequency Interference for receiving earth stations in Radio Navigation Satellite Service operating in L-Band

ICAO MID FM WG/6

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Introduction

- The operation of the receiving Earth stations in Radio Navigation Satellite Service (RNSS) is commonly interrupted, degraded, spoofed, or blocked due to several causes. This includes Global Navigation Satellite Systems (GNSS).
- The effects on the receiving earth stations in RNSS can be detected by several methods such as the Radio Frequency (RF) detection.
- Many Radio Frequency Interference (RFI) claims based on RF detection were inaccurate as they were based on the presence of an RF signal in the frequency bands used for RNSS (space to Earth).
- To overcome this challenge, a better understanding of RFI is critically needed.

Interference

- Interference (RR 1.166): **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.

Permissible

Acceptable

Harmful

Interference

- **Permissible Interference** (RR 1.167): 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.
- **Acceptable Interference** (RR 1.168): **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.
- **Harmful Interference** (RR 1.169): 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 (CS).

Radio Navigation Satellite Service

- Several global and regional systems.
- L-Band operation (space to Earth) on:
 - 1164-1215 MHz.
 - 1215-1300 MHz.
 - 1559-1610 MHz.
- Vulnerabilities:
 - Low received power level by receiving Earth stations.
 - **Shared spectrum with other services.**
- Resiliency: high reliability due to
 - Low modulation schemes.
 - Spread spectrum techniques

Recommendation ITU-R M.1787: Description of systems and networks in the radionavigation-satellite service (space-to-Earth and space-to-space) and technical characteristics of transmitting space stations operating in the bands 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz .

1164-1215 MHz

1 164-1 215

AERONAUTICAL RADIONAVIGATION 5.328

RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space)

5.328B

5.328A

- **RR 5.328A**: Stations in the radionavigation-satellite service in the band 1164-1215 MHz shall operate in accordance with the provisions of Resolution 609 (Rev.WRC 07) and **shall not claim protection from stations in the aeronautical radionavigation service** in the band 960-1215 MHz. **No. 5.43A does not apply**. The provisions of No. 21.18 shall apply. (WRC 07)

1215-1300 MHz

1 215-1 240	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) 5.330 5.331 5.332
1 240-1 300	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) Amateur 5.282 5.330 5.331 5.332 5.332A 5.335 5.335A

1215-1300 MHz

- **RR 5.329**: Use of the radionavigation-satellite service in the frequency band 1215-1300 MHz shall be subject to the condition that no **harmful interference** is caused to, and no protection is claimed from, the radionavigation service authorized under No. 5.331. Furthermore, the use of the radionavigation-satellite service in the frequency band 1215-1300 MHz shall be subject to the condition that no **harmful interference** is caused to the radiolocation service. No. 5.43 shall not apply in respect of the radiolocation service. Resolution 608 (Rev.WRC 19) shall apply.

1559-1610 MHz

1 559-1 610

AERONAUTICAL RADIONAVIGATION

RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space)

5.208B 5.328B 5.329A

5.341

RR 5.43 & RR 5.43A

- **RR 5.43**: If service (or station) A is subject to not causing harmful interference on service (or station) B, then **service (or station) A is cannot claim protection from service (or station) B.**
- RNSS can claim protection from RLS?
- **RR 5.43A**: If service (or station) A is subject to **not claiming protection** from service (or station) B, then service, then service (or station) A shall not cause harmful interference on service (or station) B.
- RNSS can cause harmful interference on ARNS?

RFI Detection

- Since the previously discussed frequency bands are shared with other primary services, the presence of RF Signals in the bands used by RNSS (space to Earth) **cannot specify whether the interference is permissible or harmful.**
- ITU-R Recommendations explaining the protection criteria for receiving earth stations in RNSS are:

Frequency band (MHz)	ITU-R Recommendation
1164-1215	M.1905
1215-1300	M. 1902
1559-1610	M.1903

Conclusions

- Other primary services are sharing several frequency bands with RNSS.
- RNSS operated with other services on these bands without any problems.
- Several ITU-R recommendations clarify the protection criteria for RNSS.
- The presence of an RF signal is not sufficient to claim harmful interference on the receiving Earth stations in RNSS.

Recommendations

- Improve the awareness of RFI classifications for regulators (spectrum monitoring) and the operators of RFI detection systems.
- RNSS/GNSS RFI detection systems need to be compliant with ITU-R recommendations to decrease false alarm rate.



Thank you