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HARMFUL INTERFERENCE TO SATELLITE SYSTEMS

1 Abstract

The purpose of this paper is to provide an overview of the international regulatory framework governing satellite radiocommunications which exists to ensure the interference-free operation of satellite systems, and to present some of the actions that the International Telecommunication Union is taking, along with other initiatives it is developing to combat harmful interference to satellite systems.

The paper also describes the current situation in terms of harmful interference incidents reported to the Radiocommunication Bureau, the regulatory provisions applicable and possible limitations encountered by administrations when seeking to resolve such cases.

It ends with a few key messages in the form of guidelines to stakeholders involved in satellite services, the aim being to tackle the problem of harmful interference in such a way as to minimize its impact by implementing synergistic and continuous action and cooperation between all involved players.

2 Introduction to the Radiocommunication Sector and the international regulatory framework

The ITU Radiocommunication Sector is committed to maintaining right of access and efficient use of the orbit/spectrum resource; to contributing to ensure that the benefits of economies of scale, interoperability and roaming and global harmonization are reaped; to providing guidelines for national and regional regulations; and to maximizing operation free from harmful interference. Attainment of these strategic goals would make it possible to employ a better quality and less costly equipment in a more favourable clear and stable investment environment. This virtuous mechanism is supported by international regulations, global standards, guidelines and the assistance by the Radiocommunication Bureau.

In other words, in terms of satellite communications, interference-free operation maximizes quality of service and prevents loss of investment, customers and revenue by minimizing the amount of satellite capacity that is unusable due to the harmful interference.

The international regulatory framework is provided by a set of legal instruments that include the ITU Constitution, Convention and Radio Regulations that have the status of intergovernmental treaties and are legally binding on all Member States. They define the objectives, rights and obligations of parties. They states for example that *"The Union shall… effect allocation of bands of the radio-frequency spectrum, the allotment of radio-frequencies and the registration of radio frequency assignments and, for space services, of any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits, in order to avoid harmful interference between radio stations of different countries."*[1]

And: "All stations… must be established and operated in such a manner as not to cause harmful interference to the radio services … 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."[2]

When using the orbit/spectrum resource, Member States have the right to international recognition and protection of those frequency assignments successfully coordinated and recorded in the Master International Frequency Register (MIFR), and the obligations to license transmitting stations, to coordinate frequency assignment sharing with other administrations and more importantly to immediately take necessary actions to stop the signal from causing harmful interference.

Some of the devices of this complex regulatory mechanism designed to ensure equitable access and adequate control of interference are listed below:

– allocation of frequency bands to different services;
– power limits: in general, power flux density limits to protect terrestrial services, e.i.r.p. limits to protect space services, EPFD limits to protect GSO from non-GSO;
– coordination between administrations to ensure interference-free operating conditions;
– recording of frequency assignments in the MIFR to obtain international recognition and protection;
– monitoring to verify compliance with the Radio Regulations (RR) and resolve cases of harmful interference.

The main associated provisions of the Radio Regulations may be found in:

– Article **4**: General provisions to prevent harmful interference
– Article **5**: Table of Frequency Allocations – individual conditions in the footnotes
– Articles **7**, **8**, **9**, **11**: Coordination/notification procedures
– Articles **21** and **22**: Power limits
– Appendices **30**/**30A**/**30B**: Plans and associated procedures
– Provisions Nos. **11.42**, **13.2**, **13.6** and Articles **16** and **18** regarding obligations, cooperation, assistance, international monitoring, licensing and identification of stations;

and for the provisions more related to harmful interference in:

– Sections VI of Article **15**: Procedure in case of harmful Interference
– Section V of Article **15**: Reports of Infringements
– Section I of Article **13**: Assistance by the Bureau
– No. **7.8**, No. **8.5**, No. **11.42**, § 4.1.20/4.2.21D of AP**30**/**30A**

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1 ITU Constitution, Article 1, paragraph 11.

2 ITU Constitution, Article 45.

– Appendix **10**: Report of harmful interference, and
– Report ITU-R SM.2181 for the submission of reports of harmful interference to the Radiocommunication Bureau.

In this context, it should be noted that there is no real enforcement mechanism in the current regulations, apart from Article 56 of the ITU Constitution related to the settlement of disputes and the Optional Protocol (see paragraph 3 below).

3 Current situation

Based on the reports submitted by administrations to the Bureau, the reasons for the harmful interference affecting satellite services could be divided as follows:

– *No coordination*: cases of harmful interference caused by the operation of uncoordinated frequency assignments (very often a fait-accompli approach by operating a space station under an ITU satellite network recorded or in the process of being recorded in the MIFR without having initiated the normal and mandatory coordination process under the ITU framework);
– *Unauthorized use*: accessing transponders without the required authorization, either accidentally or deliberately (very common reasons for accidental cases include equipment failure, human error, improper commissioning, interference from proliferation of terrestrial (e.g. microwave) systems; deliberate interference are generally caused by unauthorized "borrowing" of bandwidth for test purposes (e.g. at commissioning), piracy, hostile attempts to deny service, becoming more prevalent though geopolitical motivation);
– *Unnecessary transmission*: cases of harmful interference as described in RR No. **15.1**:

  "All stations are forbidden to carry out unnecessary transmissions, or the transmission of superfluous signals, or the transmission of false or misleading signals…".

  Typically, this refers to harmful interference caused by a high-power Carrier Wave (CW), which is believed to be deliberately transmitted in some circumstances;
– *Technical or operational:* spurious emissions, excessive transmitting power, transmitting stations that are not in conformity with frequency tolerances, miss-pointing of antennas associated with earth stations, cross-polarization interference or interference due to transponder saturation, for example, and
– *Regulatory*: out-of-band operations not authorized by the Radio Regulations, or exceptionally under a non-interference/non-protection basis.

The most frequently affected services include the broadcasting-satellite service, fixed-satellite service and earth exploration-satellite service. However, with fewer occurrences, harmful interference also hits the mobile-satellite service and the radionavigation-satellite service.

Incidents related to coordination not fully completed or event not initiated between closely separated satellite networks and cases of harmful interference as described in RR No. **15.1** are concerning issues which have drawn attention of the Bureau and deserve thorough and careful considerations.

The current definition of harmful interference in the Radio Regulations similar to the one in the Annex to the ITU Constitution (CS 1003) reads as follows:

*No. **1.169** harmful interference:*

"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)."

No distinction is made between deliberate and unintentional interference and no specific level to define when from a *permissible interference* (RR **1.167**) it could be an *accepted interference* (RR **1.168**) and then considered as *harmful interference*.

Moreover, as mentioned above, there is no real enforcement mechanism in the current regulations, apart from Article 56 of the ITU Constitution related to the settlement of disputes and the Optional Protocol. Indeed, the utmost goodwill, mutual assistance and cooperation of Member States involved are the only current methodology specified in the regulations for the settlement of problems of harmful interference. Should it be deemed, however, that the current rules require modification; this could be achieved by the ITU Member States at a plenipotentiary or world radiocommunication conference.

4 ITU actions and initiatives to combat harmful interference

In addition to the preventative measures described in section 2 above, incorporated in the Radio Regulations and eventually revised at radiocommunication assemblies and/or world radiocommunication conferences every 3 or 4 years, whenever a report of harmful interference is sent to ITU Radiocommunication Bureau in accordance with the procedure set forth in Article **15** of the Radio Regulations, the Bureau is providing assistance, helping in identifying the source of interference and seeking the cooperation of the responsible administration in order to resolve the matter.

Taking the above into account, several initiatives are currently being put in place by the Bureau to reduce the impact that harmful interference to space services can produce.

A non-exhaustive list of these on-going initiatives is described below:

a) Extension and use of the international monitoring system (IMS) related to space services

The ITU Secretary-General sent out a circular letter inviting administrations to subscribe to a cooperation agreement between ITU and administrations having monitoring facilities part of the international monitoring system (IMS). This allows measurements to be performed in relation to cases of harmful interference for which an administration is seeking the assistance of ITU under Article **15**, No. **13.2** of the Radio Regulations, and in cases of reported interference arising from coordination issues (Article **11**, No. **11.41**). As a follow-up to this letter, bilateral discussions have been pursued between ITU and administrations with IMS facilities. The cooperation agreement was signed with the Administrations of Germany, Pakistan, Korea, China, Vietnam, Belarus, Brazil and is expected to be signed with the Administration of Oman very soon.

b) Promotion of exchange of experiences, cooperation, joint organization and participation in related fora

ITU has organized and participated in several informative meetings around the world on harmful interference issues, where participants from all the sectors involved in satellite communications have exchanged experiences, views and solutions. The latest event on this specific topic organized by ITU took place virtually on 16 September 2020 under the name of ITU Satellite Webinar: Interference to Satellite Systems. A complete set of documents presented at the webinar as well as full video recordings can be found at

https://www.itu.int/en/ITU-R/space/workshops/sat-webinars/Pages/default.aspx.

c) Provisions of technical and regulatory assistance to ITU members

ITU provides assistance on a regular basis through a series of seminars and workshops, but also on demand to individual or small group of ITU members focusing on a subject of concern to a specific region or country.

d) Recommendation on access procedures for fixed-satellite service occasional use, transmissions to GSO space stations in the 4/6 GHz and 11-12/13/14 GHz FSS bands (ITU-R S.2049, December 2013)

e) Recommendation on Carrier ID (ITU-R S.2062-0, September 2014)

f) New Recommendation on Detection and Resolution of radio frequency interference to Earth exploration-satellite service (passive) sensors. (ITU-R RS 2106-0, July 2017)

g) New Report on Measurement Techniques and New Technologies for Satellite Monitoring. (Report. ITU-R SM.2424-0, June 2018)

h) Development of Working Document towards a Preliminary Draft New Rec. ITU-R SM.[APP10] on reporting harmful interference in Support of Appendix 10

i) Implementation of a Satellite Interference Reporting and Resolution System (SIRRS)

This online application has been developed in response to Resolution 186 (BUSAN, 2014) and in line with Annex 2 to Decision 5 (REV. BUSAN, 2014) on modern electronic communication methods. The objective of this system, as reported to WRC-15, is to facilitate the communication between the parties concerned in case of harmful interference and to assist them in the identification of sources of interference and their prompt elimination in accordance with the provisions of Articles 15 and No. 13.2 of the Radio Regulations. The system allows to capture information in accordance with Appendix 10 of the Radio Regulations and to upload additional information in the format of Report ITU-R SM.2181, Recommendation ITU-R RS.2106-0 or any other standard format.

By using SIRRS, you will be able:

- to report a case of harmful interference affecting a radio station you are responsible for under No. 15.41 of the Radio Regulations;
- to request Assistance from ITU under No. 13.2 of the Radio Regulations;
- to exchange technical and administrative information in alphanumeric and high-quality image formats with other Administrations, Operators and Agencies;
- to be informed when a radio station under your jurisdiction is causing harmful interference to space services of other Administrations.

The SIRRS online application was made available to Administrations, Satellite Operators, Space Agencies and stakeholders for official use since 1st September 2018. Additional information may be found in the Circular Letters CR/435 (28.08.2018) and CR/428 (13.03.2018).

5 Conclusions

While recognizing that satellite systems are constantly exposed to the risk of interference, our objective is to keep such occurrences and their impact to a controlled minimum. This is achieved through a series of actions relating *inter alia* to the following:

– Compliance with the ITU Constitution and Radio Regulations

– Exchange of information and cooperation between administrations, satellite operators, service and content providers, industry, organizations and associations involved in satellite communications
– Utilization of ITU Recommendations, standards, procedures
– Participation in trainings
– Utilization of new technologies, including use of the international monitoring system
– Participation in and contribution to study groups and preparatory work at regional and world meetings for the upcoming conferences, presenting the respective needs and proposals for technical and regulatory solutions.

ITU has been playing this role and will continue to do so, by providing the required assistance to its members in order to ensure and maintain the interference-free operation of space services, a challenging strategic goal under the Radiocomunication Bureau's core responsibilities.

ITU holds the firm conviction that only the continuous synergistic implementation of these actions by all sectors involved in satellite radiocommunications can guarantee that harmful interference is kept to a minimum for the satellite community and end users.

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