Regarding the protection of the radio astronomy service (RAS), it appears necessary that compliance with the conditions for use of radio frequency spectrum by current and future Mobile Satellite Service (MSS) systems in their respective allocated bands (space-to-Earth) is monitored regularly as well as the degree of interference in the frequency band 1610.6-1613.8 MHz caused by this usage. For this reason, measurements of unwanted emissions from Iridium satellites in the radio astronomy band 1610.6-1613.8 MHz have been carried out since 2004 in order to assess the impact of the mitigation techniques implemented by Iridium in order to protect the RAS. In 2017, the most recent generation of Iridium satellites (Iridium NEXT) has been measured. To conduct these highly sensitive measurements, Leeheim station has developed specific measurement techniques and improved its equipment.

Satellite geolocation is an important component for the investigation of harmful interference cases. The Leeheim space radio monitoring station is capable of receiving signals emanating from sources of interference on Earth via an interfered satellite and via an adjacent satellite simultaneously. Leeheim station has developed and improved its capability to obtain a precise estimation of the location of the source of interference. The necessary investment was supported by payments of the SAT MoU. Firstly, in 2011 a reference transmitter campaign was performed to estimate the geolocation capabilities of the Leeheim station in European countries (France, Spain and Switzerland). Later, in 2014, the SAT MoU has funded a study to improve the satellite geolocation process. In terms of the results obtained, Leeheim station has successfully located interference sources in Europe but also further away in the Middle East.

A list of measurements carried out by the Leeheim station under supervision of the SAT MoU is available in the SAT MoU page (section related documents): https://cept.org/eco/groups/eco/sat-mou

These measurements can be divided into two categories: they are either requested by an Administration participating in the SAT MoU or by an ECC Working Group. For instance, Working Group Spectrum Engineering (WGSE) and Working Group Frequency Management (WGFM) requested measurements to provide the technical background for the development of ECC Reports and ECC Decisions and also in preparations for World Radio Conferences.

Conclusions
As space services are so strategically important and some are the most promising markets in terms of European growth, CEPT needs to continue undertaking satellite monitoring activities.

Since 2003, the SAT MoU members have funded a number of measurements benefiting CEPT as a whole in order to achieve a more efficient use of spectrum and prompt elimination of harmful interference.

In order to continue to share all these results and success, SAT MoU members would like to invite all the CEPT members to join the SAT MoU.

For more information, please contact the European Communications Office: https://cept.org/eco/

Summary

The Memorandum of Understanding on Satellite Monitoring (Sat MoU) provides the possibility for any Administration of the European Conference of Postal and Telecommunications (CEPT) to access and undertake satellite monitoring activities. It entered into force on 1 July 2003. Due to the highly specialised and costly nature of satellite monitoring facilities, it was agreed to establish a European common approach to allow access to all CEPT administrations having signed this MoU to the satellite monitoring station located in Leeheim, Germany.

The aim of the MoU is to create a common understanding and to provide cooperation among the signatories for attaining measurement results for their own purposes and also for CEPT Working Groups.

SATELLITE MEMORANDUM OF UNDERSTANDING
(SAT MoU)
(Since 1 July 2003)
Introduction

The increasing operations of satellites both in the geostationary as well as in the non-geostationary orbits result in a growing congestion of the frequency spectrum resource, which in turn has a significant associated economic impact. In order to guarantee reliable satellite services with interference-free operation, Administrations are responsible for efficient frequency management.

In that respect, satellite spectrum monitoring is essential to ensure efficient frequency use. The fully equipped space radio monitoring station in Leeheim, responds to this need. It is equipped with 4 major antennas covering the frequency range 130 MHz – 26.5 GHz (see Figure below). Additionally, an omni-directional antenna is available covering the frequency range 500 MHz to 40 GHz.

Leeheim monitoring station, Germany

The station is capable of monitoring geostationary satellites at orbital longitudes between 67° West and 83° East as well as non-geostationary satellites. It also allows the localisation of Earth stations interfering with satellites.

A detailed technical description of the facilities can be found in the Space radio monitoring station handbook available in the SAT MoU page: https://cept.org/eco/groups/eco/sat-mou

An agreement has been established on the access to space radio monitoring facilities provided in Leeheim and on the sharing of the associated costs, due to the highly specialised and costly nature of these facilities.

The agreement facilitates the following monitoring activities:

- Investigation of interference to and from satellites
- Detection of the illicit use of satellites
- Monitoring the usage of spectrum and orbital resources

As per 2020, the signatories of the agreement are: Cyprus, France, Germany, Luxembourg, The Netherlands and Switzerland.

SAT MoU measurement history

Since it entered into force in 2003, the SAT MoU has been essentially used for studies involving the Radio Navigation Satellite Service (i.e. RNSS: GALILEO, GPS and GLONASS) and the protection of the radio astronomy service (RAS).

Investigation of harmful interference cases, staff training and monitoring of the compliance of space station technical characteristics have been performed based on requests of SAT MoU members. Such campaigns are a step towards eliminating harmful interference into their satellite systems.

RNSS measurements were conducted in early 2000 in order to support CEPT in the course of preparations for various ITU-R meetings. This measurement campaign had several goals. Some measurements were conducted on navigation and location satellites to know the actual transmitted GNSS bandwidths to determine the maximum usable bandwidth for very accurate applications like geodesy or science. Unwanted emission levels of operational RNSS systems have been measured in order to achieve better protection of passive services in the course of the preparation of the World Radiocommunication Conference in 2007 (WRC-07, agenda item 1.21). The operational RNSS system spectrum measurements at 1.2 GHz as well as the first Galileo satellite spectrum measurements in the bands 1.2 GHz & 1.5 GHz have been performed to support sharing studies within the Working Group Spectrum Engineering (WGSE). The measurement of emissions from the operational RNSS system geostationary satellite in the S-band (2483.5–2500 MHz) has been carried out since this band was considered under WRC-12 agenda item 1.18 for a worldwide primary allocation to the Radio Determination Satellite Service (RDSS).

Signatories of the SAT MoU in 2020

Satellite monitoring — a need for CEPT administrations

There are only a few CEPT administrations who have notified satellites. Nevertheless, all administrations have rights and obligations relating to emissions to and from satellites. Terrestrial services may be affected by emissions from satellites and satellites may be interfered by transmissions or any other radiation emanating from an administrations territory.

In both cases satellite monitoring facilities including relevant skills and know-how are required to cope with the problem. The increasing number of satellites used for communication, navigation, earth observation, research and the distribution of broadcasting signals make interference more likely to happen at any time.

Joining the Sat MoU provides the advantage for administrations of being prepared for such instances and the benefit of shared maintenance costs, which is particularly interesting for administrations with budget restrictions, as it is obviously less expensive to share the use of a common space radio monitoring station than maintaining an own-one.