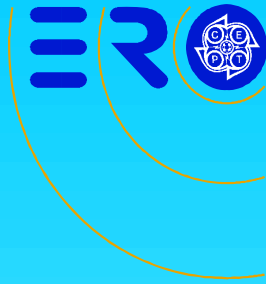




Satellite Monitoring MoU in the framework of CEPT compatibility studies

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Outline



- General on the MoU
- MoU Objectives
- Leeheim Station
- Leeheim Station's Tasks
- MoU use from a CEPT perspective

General



- Satellite monitoring is expensive
- Administrations have to slim down
- A number of countries need to be able to monitor satellites
- The ECC or its working groups need satellite monitoring

The MoU



- In 2003, an MoU has been signed by 6 countries:
 - Germany
 - France
 - UK
 - Switzerland
 - The Netherlands
 - Spain



Main objectives of the MoU

- To create a common understanding and provide a cooperation among the signatories for getting measurement results (Leeheim Station) for their own purpose.
- Establish a procedure based on a non-profit making funding and a common management of satellite monitoring activities within the CEPT.

The management committee



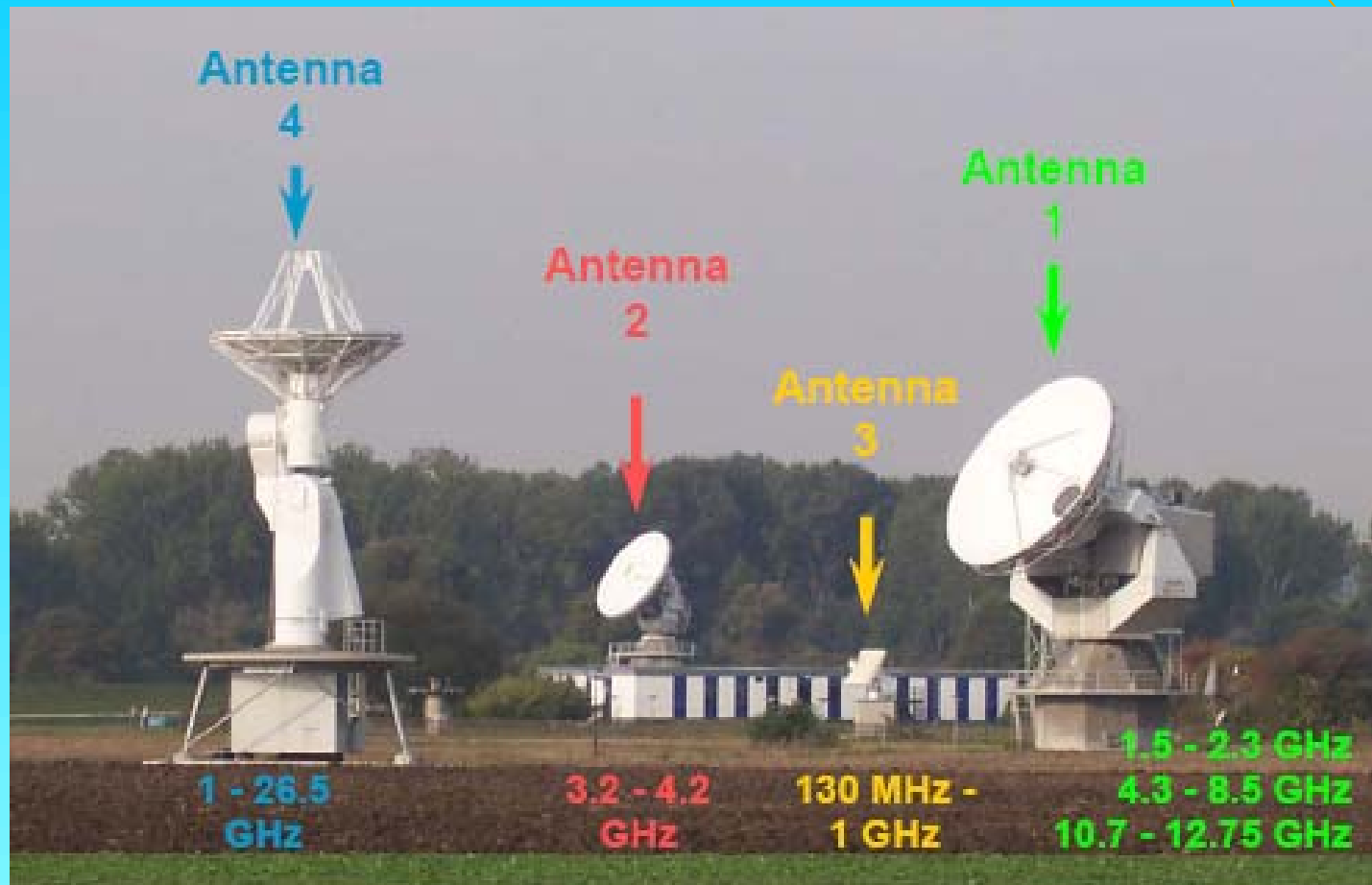
- Prioritises measurements
- Set station fee and hourly rates
- Set administrative fee
- Evaluate reports and proposals

Costs



- Annual Contribution
 - Administrative Fee
 - European Monitoring Fund
 - Station Fee
- Measurements – Hourly rates
 - Personnel
 - Equipments

Leeheim Station



Source: Space Radio Monitoring Leeheim – Station handbook –October 2007
The frequency range of the Station extends from 130 MHz - 26.5 GHz without any gap.

System Characteristics



- Antenna 1 → 12 m Cassegrain-Beam-Waveguide-Antenna is a broadband antenna (1.0 - 13 GHz).
 - Adjustable rotary reflector and a slide mounted feed
 - allow switching between the frequency bands.
 - Optimized at 1.5 - 1.8 GHz, 2.1 - 2.3 GHz, 4.3 – 8.5 GHz and 10.7 - 12.75 GHz
 - Accurate monopulse and computer controlled position tracking capability.



Source: RegTP, 7th ISRM 2004

System Characteristics



- Antenna 3 → Square of 2.4x2.4 m, composed of 3 sectors of dipole arrays of different size covering in total the frequency band from 130 - 1000 MHz.

System Characteristics



- Antenna 4 → 7 m Prime-Focus-Antenna is a multi band antenna covering the range from 1 - 26.5 GHz.
- Computer controlled antenna tracking of the Antennas 1, 3 and 4 allows to follow geostationary or non-geostationary satellites.



Source: RegTP, 7th ISRM 2004

System Characteristics

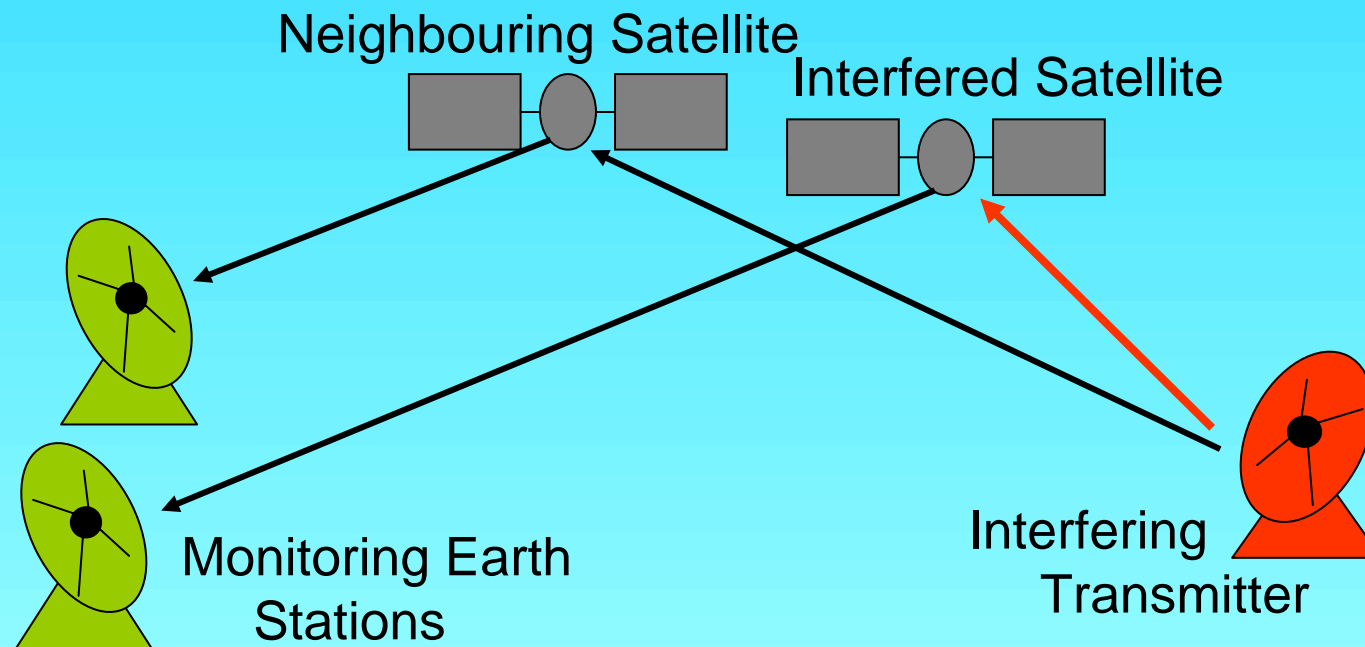


- Antenna 2 → Cassegrain-Antenna with a narrow band feed in the frequency range 3.2 – 4.2 GHz with a diameter of 8.5 m.
- Antenna 5 → 3 m Prime-Focus-Antenna with a broadband logarithmic periodic feed 1 - 26.5 GHz
- Omnidirectional Antennas → to observe simultaneously all emissions from the sky in a certain frequency band, e.g. of a multi-satellite system. The frequency range is 100 - 2500 MHz.

Transmitter Location System (TLS)



- Designed to identify the location of radio transmitters on Earth.
- Triangulation using the wanted transmitter and two satellites (time and frequency measurements).



Measurement Parameters



- The station can measure or determine emission characteristics such as:
 - Frequency
 - Doppler frequency shift
 - Spectrum and bandwidth
 - Class of emission and type of modulation
 - Polarization
 - Power flux density in the reference bandwidth
 - Total power flux density
 - EIRP
- In case of TV emissions:
 - Sound sub carrier frequencies
 - Coding
 - Program sources etc.

Leeheim Station's Task



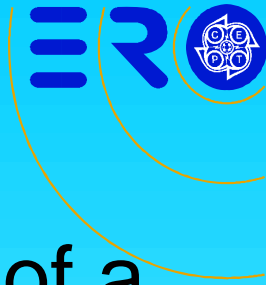
- Spectrum Occupancy Monitoring
- Position Measurements
- Interference Measurements
- Pre-Launch Monitoring

Spectrum Occupancy Monitoring



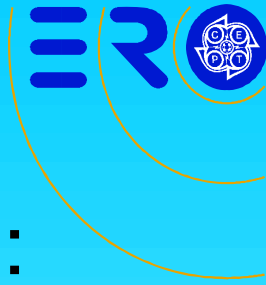
- Observe the radio frequency spectrum (e.g. Identify “paper” satellites, unknown satellites, and for co-ordination with other authorities)
- Results stored in a database and complemented with spectrum prints for each monitored emission.
- These measurements applicable for the geostationary and the non-geostationary orbit.

Position Measurements



- Where the inclination or ellipticity of a satellite orbit may cause interference to a neighbouring satellite
- The trace of the occupied position has to be measured.
- This is done with monopulse-tracking over a 24 hour period.
- The trace of the occupied position is given in geographical coordinates or in a celestial grid

Interference Measurements



- Source of interference is in space:
 - Either from a known satellite (non-compliant signals)
 - or an unknown satellite is the source (triangulation needed).
- Source of interference is on Earth:
 - it appears in the downlink of a satellite, transmitter location measurements are required.

Pre-Launch Monitoring



- During the pre-phase of the launch of a satellite the frequencies used for telemetry, telecommand and tracking are monitored with respect to the planned orbit.
- The measurement results facilitate a safer launch and a safer positioning of the satellite.

Customers of Leeheim



- Units or individuals responsible for
 - frequency management
 - spectrum engineering
 - etc...
- who are under German jurisdiction, or, authorities who are members of the CEPT SatMoU, or, other authorities or operators on a contractual basis

An example of the use of Leeheim Station



- Monitoring Glonass Emissions at 1.6 GHz

Monitoring Glonass Emissions

- CEPT requested the monitoring of GLONASS at 1.6 GHz satellites in order to assess the pfd levels radiated in the radioastronomy band by the new and old generation of GLONASS satellites, in the framework of WRC-07 AI 1.21.
- Leeheim produced a report

GLONASS Spectral measurement



OLD GLONASS satellite
Snapshot of the spectrum analyser

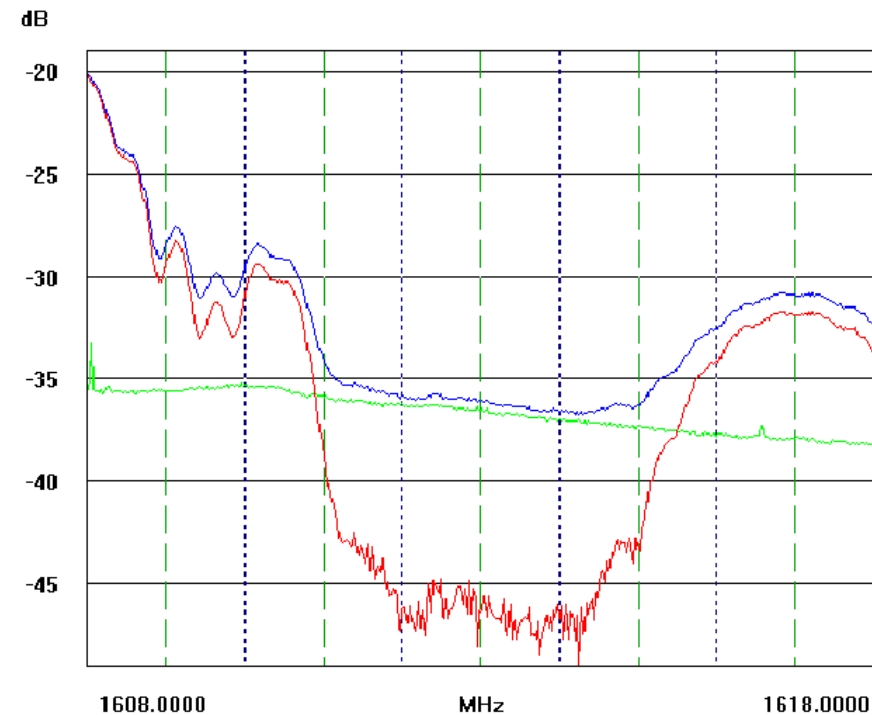
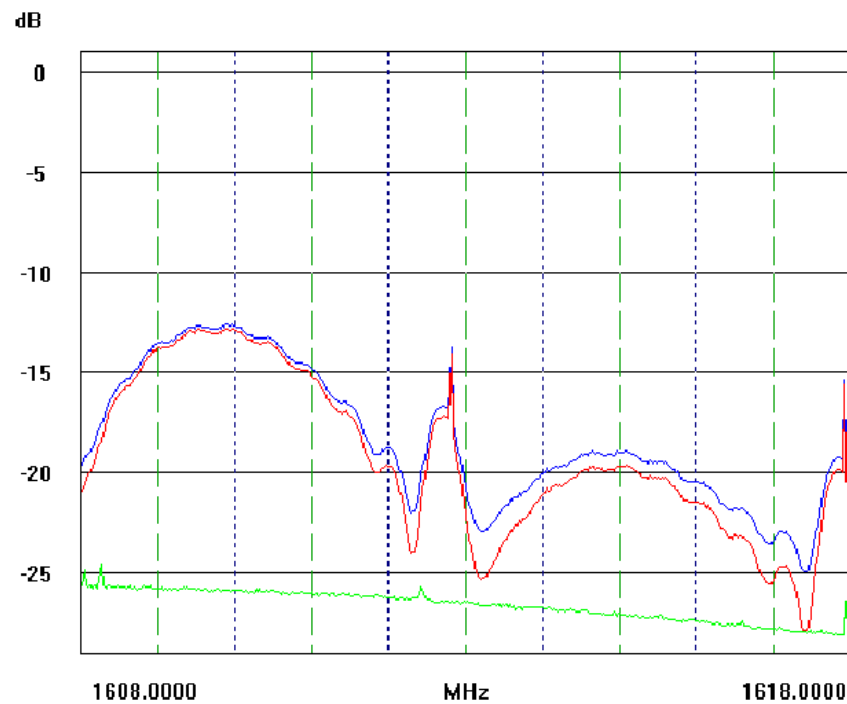
NEW GLONASS satellite
Snapshot of the spectrum analyser

Task: COSMOS 2402 (GLONASS 794) RA band

Task: COSMOS 2411 (GLONASS 712) RA band

Date: 08.02.2006 10:34 UTC Azimuth: 74.6°; Elevation: 47.0°

Date: 03.02.2006 12:58 UTC Azimuth: 177.5°; Elevation: 58.3°



Source: WGSE (Doc 17SE21(06) Measurement of GLONASS unwanted emissions in the band 1610.6 -1613.8 MHz)

Glonass measurement results

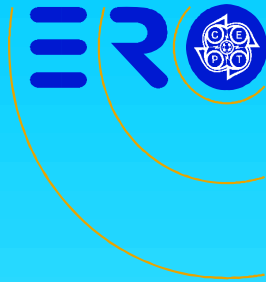
- Modulation improved between the old and new GLONASS satellites (the null spikes have disappeared)
- Filter was implemented in the band 1610-1613 MHz in order to reduce the level of unwanted emissions by up to 19 dB in the RAS band.



Its use by the CEPT

- The output of the measurement useful for the CPM Report of WRC07
- Chapter 2 on Agenda item 1.21 section 2/1.21/1.3.8 Studies of the RNSS (space-to-Earth)/RAS band pair 1 559-1 610 MHz/1 610.6-1 613.8 MHz

Links



- [Sat MoU website \(ww.ero.dk/satmou\)](http://www.ero.dk/satmou)
- [Leeheim station](#)
- [Station handbook](#)
- [MoU text](#)