CleanWaves

Towards Spectrum Sustainability

Spectrum: A Multi-Domain item with growing focus on Media

SCIENCE

Radio interference from satellites is threatening astronomy

Just as human development tracks with more light pollution, increasing numbers of satellites are leading to more radio interference

By Christopher Gordon | Published: March 9, 2023 | Last updated on May 18, 2023

https://www.astronomy.com/science/radio-interference-from-satellites-is-threatening-astronomy/

TELECOM

Commercial

Omnispace reports interference from Starlink direct-to-device payloads

Omnispace says it is seeing interference from direct-to-device payloads on recently launched SpaceX Starlink satellites, offering an early test of new Federal Communications Commission regulations about such services.

SPACENEWS

Jeff Foust | May 17, 2024 https://spacenews.com/?s=interference

MULTI-DOMAIN

Commercial

SPACENEWS

Space-based monitoring of electronic signals is now a commercial battleground

Radio-frequency (RF) monitoring companies are broadening their capabilities beyond ship tracking

Sandra Erwin | June 3, 2024 https://spacenews.com/space-based-electronic-eavesdropping-becomes-commercial-battleground/

NAVIGATION

ITU issues warning on interference with radio navigation satellite service

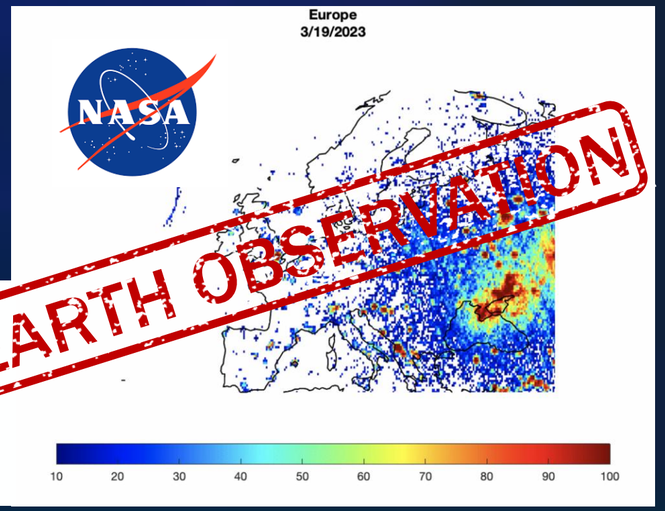
News · 23 Aug 2022

By ITU News

The blocking, jamming or serious degradation of services that rely on radio waves – known in the telecommunication world as harmful interference – can be either accidental or intentional.

https://www.itu.int/hub/2022/08/warning-harmful-interference-rnss/

EARTH OBSERVATION



RF Interference in protected band 1400–1427 MHz, crucial for Earth observation and Radio astronomy

SMAP RF Interference averaged over a four week in March 2023

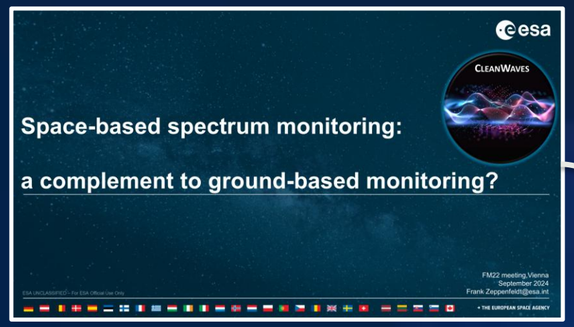
https://smap.jpl.nasa.gov/rfi/

FINANCIAL TIMES

MULTI-DOMAIN

https://www.ft.com/content/ac7702c8-238f-4656-bd26-a2ba445af971

CLEANWAVES — Use cases formulation



Regulator requirements

Industrial capabilities

Use cases

National Regulators + industries

Stakeholders Consultation Conclusions

Interference is frequent, everywhere, in all bands

Unprecedented use of spectrum requires new tools for regulators

Space adds value to ground-based services

European industry is just starting: vulnerable to competition

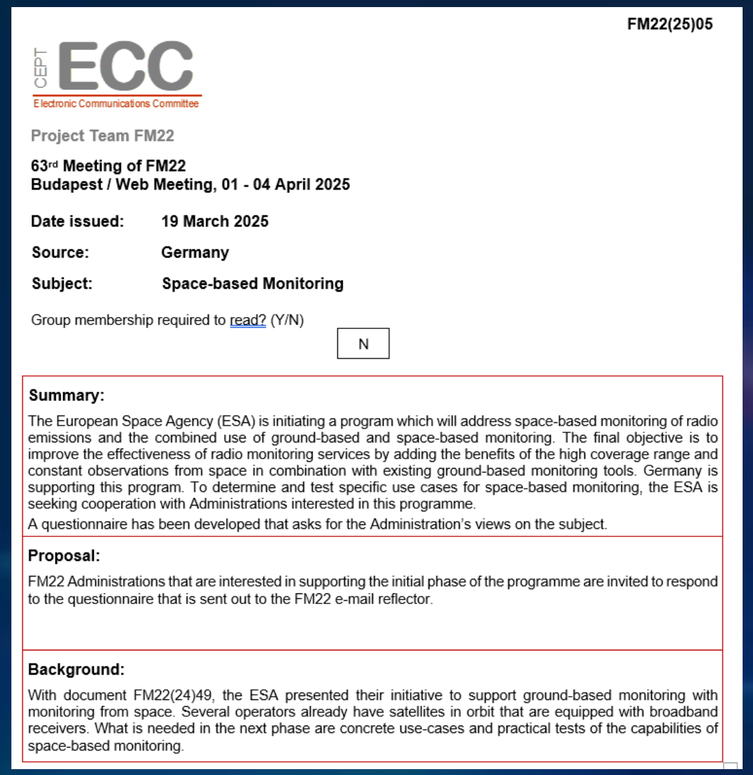
ESA and its member states are called upon to enable the ecosystem, as a trusted neutral expert

CLEANWAVES INITIATIVE

The **objectives** in the areas of *RF monitoring*, *interference detection*, *location and mitigation*, and *spectrum use optimisation* are to:

- Identify and anticipate needs, requirements, boundaries and constraints of institutional and commercial users of RF information
- Progress European industrial capabilities through ESA technology development and validation, including in-orbit demonstration activities
- Support technology developments on their path to institutional or commercial markets, including integration with existing ground-based RF services

CLEANWAVES – Relation with regulators



FM22(25)05

CEPT ECC
Electronic Communications Committee

Project Team FM22

63rd Meeting of FM22
Budapest / Web Meeting, 01 - 04 April 2025

Date issued: 19 March 2025

Source: Germany

Subject: Space-based Monitoring

Group membership required to read? (Y/N)

N

Summary:

The European Space Agency (ESA) is initiating a program which will address space-based monitoring of radio emissions and the combined use of ground-based and space-based monitoring. The final objective is to improve the effectiveness of radio monitoring services by adding the benefits of the high coverage range and constant observations from space in combination with existing ground-based monitoring tools. Germany is supporting this program. To determine and test specific use cases for space-based monitoring, the ESA is seeking cooperation with Administrations interested in this programme.

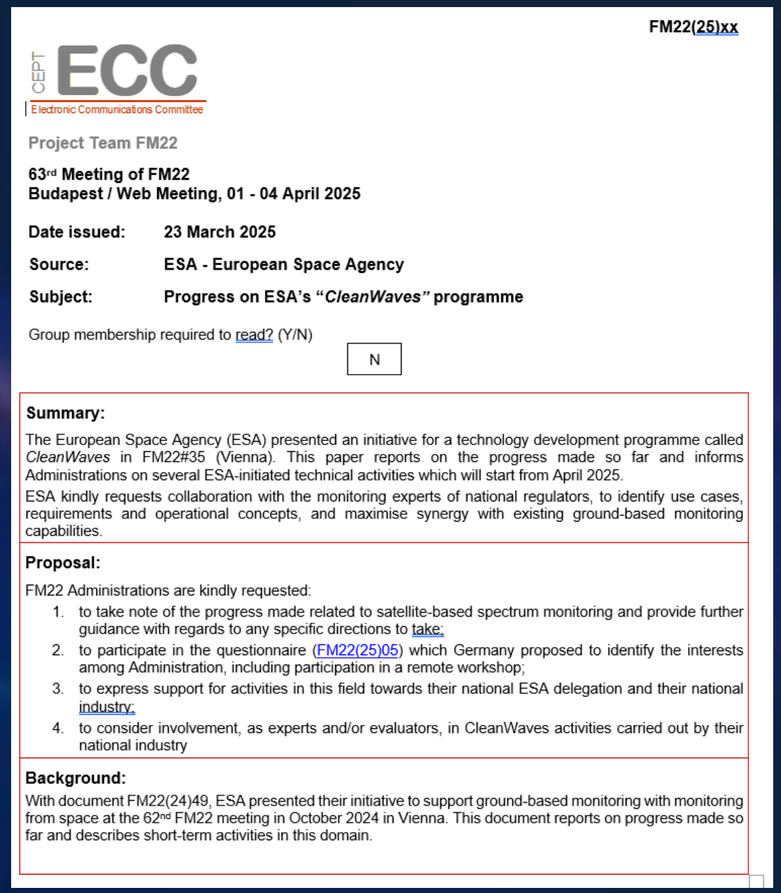
A questionnaire has been developed that asks for the Administration's views on the subject.

Proposal:

FM22 Administrations that are interested in supporting the initial phase of the programme are invited to respond to the questionnaire that is sent out to the FM22 e-mail reflector.

Background:

With document FM22(24)49, the ESA presented their initiative to support ground-based monitoring with monitoring from space. Several operators already have satellites in orbit that are equipped with broadband receivers. What is needed in the next phase are concrete use-cases and practical tests of the capabilities of space-based monitoring.



FM22(25)xx

CEPT ECC
Electronic Communications Committee

Project Team FM22

63rd Meeting of FM22
Budapest / Web Meeting, 01 - 04 April 2025

Date issued: 23 March 2025

Source: ESA - European Space Agency

Subject: Progress on ESA's "*CleanWaves*" programme

Group membership required to read? (Y/N)

N

Summary:

The European Space Agency (ESA) presented an initiative for a technology development programme called *CleanWaves* in FM22#35 (Vienna). This paper reports on the progress made so far and informs Administrations on several ESA-initiated technical activities which will start from April 2025.

ESA kindly requests collaboration with the monitoring experts of national regulators, to identify use cases, requirements and operational concepts, and maximise synergy with existing ground-based monitoring capabilities.

Proposal:

FM22 Administrations are kindly requested:

1. to take note of the progress made related to satellite-based spectrum monitoring and provide further guidance with regards to any specific directions to take;
2. to participate in the questionnaire (FM22(25)05) which Germany proposed to identify the interests among Administration, including participation in a remote workshop;
3. to express support for activities in this field towards their national ESA delegation and their national industry;
4. to consider involvement, as experts and/or evaluators, in CleanWaves activities carried out by their national industry

Background:

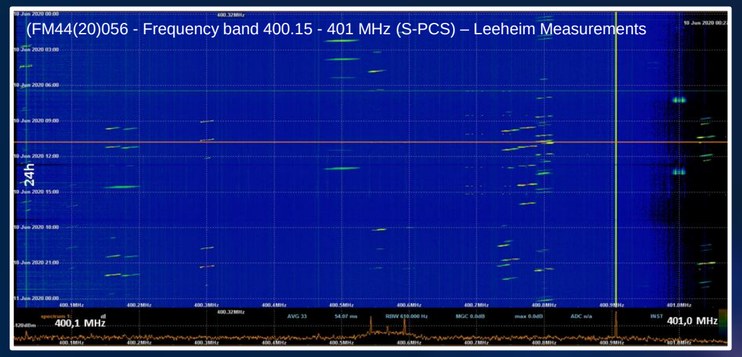
With document FM22(24)49, ESA presented their initiative to support ground-based monitoring with monitoring from space at the 62nd FM22 meeting in October 2024 in Vienna. This document reports on progress made so far and describes short-term activities in this domain.

Status

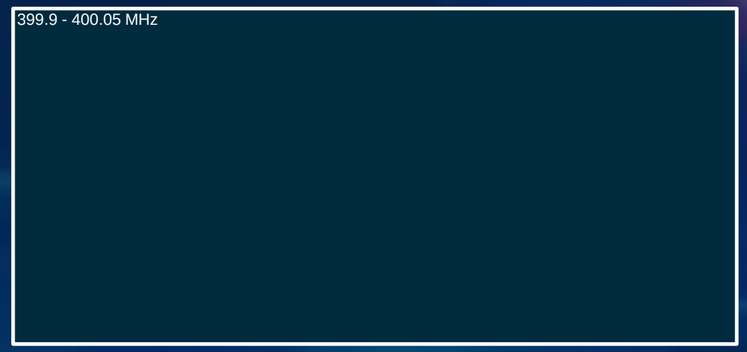
- CEPT FM22 is the group dealing with spectrum monitoring and enforcement
- Germany initiated questionnaire to understand member states interest in space-based monitoring
- Space-based monitoring shall be performed in accordance with ITU Article 17 and 18.4
- Responses coming in – summary and conclusions in September 2025

https://cept.org/documents/fm-22/88052/fm22-25-05_space-based-monitoring
https://cept.org/documents/fm-22/88148/fm22-25-12_esa-progress-on-cleanwaves-initative

Example – *Make room for new entrants*



Indication of <u>downlink</u> occupancy



<u>uplink</u> occupancy - **MISSING**

MSS systems < 1 GHz need to show co-existence with incumbent systems (see DEC (99)06)

Requirements

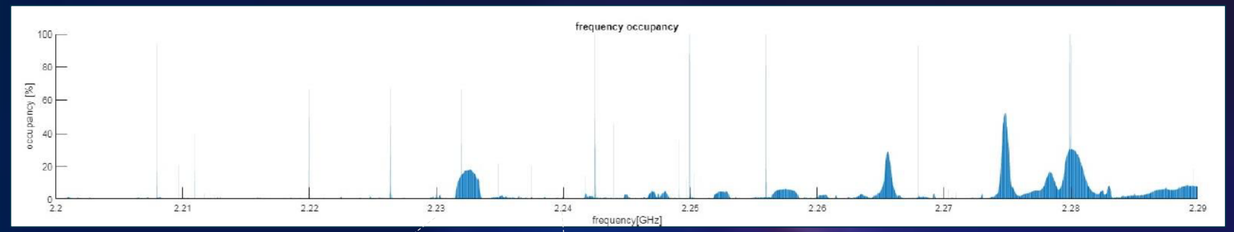
- 24 hours campaigns ?
- Continuous coverage of uplink?
- Measurements latency tolerant?
- ….

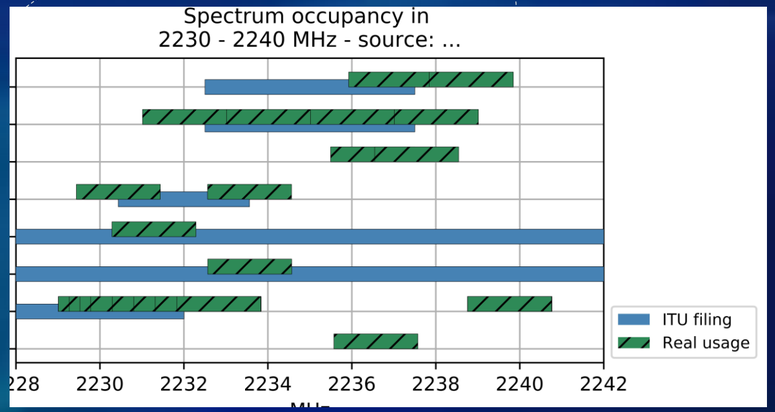
Space-based monitoring added value

- better sharing and use the spectrum more efficiently
- new space entrants having access to spectrum
- stronger position in regulatory discussions
- synergy of **simultaneous ground** and space measurements → (1 + 1 = 3)

Example – *Open up TT&C for new space*

Indication of **downlink** occupancy in 2200-2290 MHz, provided by Leeheim station *(FM44(24)006 Spectrum Occupancy Indication 2200-2290 MHz)*





?

No information on uplink usage

Insight in actual usage of space operations bands for telemetry and telecommanding - **MISSING**

Requirements

- Targeted monitoring to see spectrum occupancy
- Compliance to e.g. ECC
- ….

Space-based monitoring added value:

- provide facts to ITU
- stronger position in regulatory discussions
- …
-

Use Cases from Different Domains

CLEANWAVES

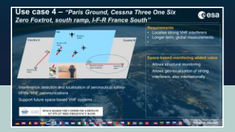
Mobility
- Aviation
- Maritime
- Land

Safety & Security
- Critical Infrastructure
- Civil Security systems

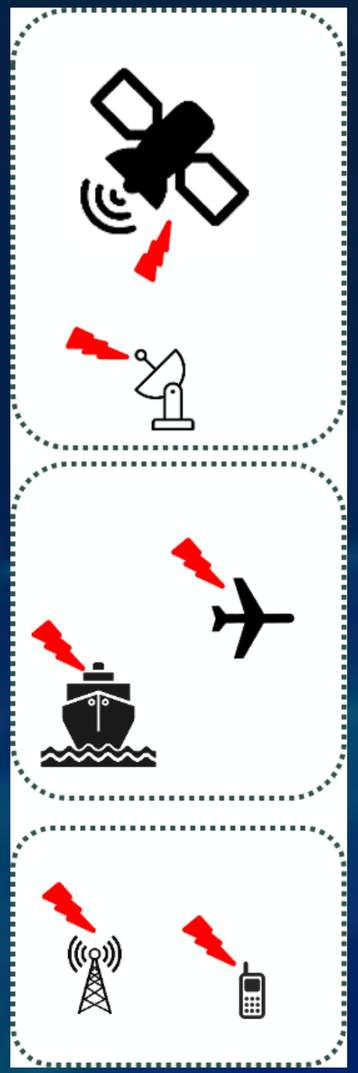
Terrestrial connectivity
- 2G to 6G
- IoT
- WiFi

Regulatory
- Frequency inventory
- Regulatory Support

Space missions
- SatCom
- NAV EO SCI
- TM/TC



Added value of space vs ground capabilities



Many RFI scenarios are addressed with ground-based monitoring

Space-based monitoring could possibly be used to enhance ground-based monitoring:

- can add a **global** dimension
- can be **long term** and **continuous**
- serve **remote** regions
- can look **“up”** and **“down”** at the same time
- can be **synchronised** with ground-based monitoring

→ **leading in the end to more effective use of spectrum**

Further investigation needed:

- market studies,
- demos,
- test,
- validation, with users

CLEANWAVES - Advancing Spectrum-related Capabilities

Upcoming tenders*:

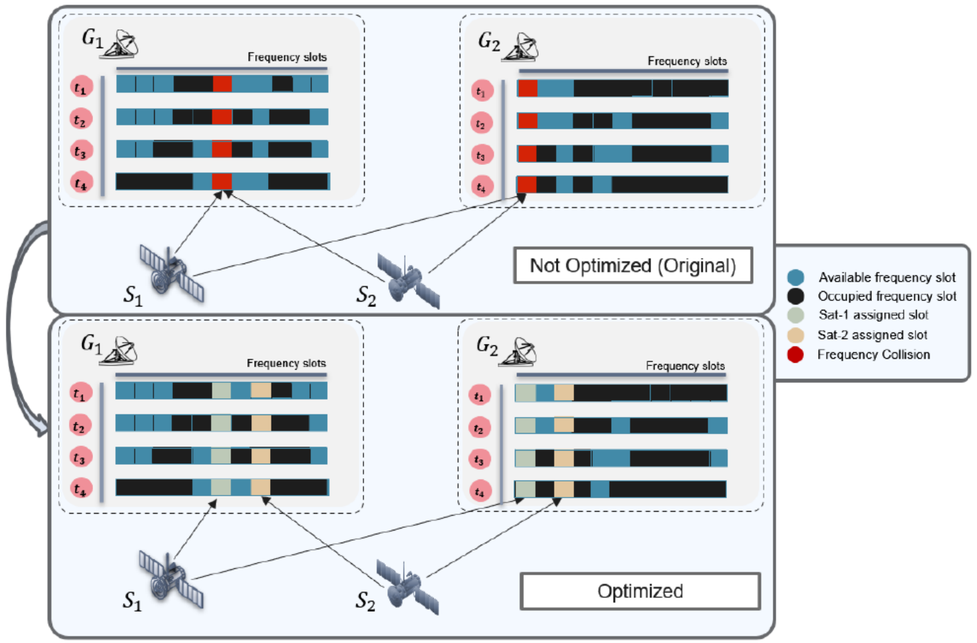
☑ Space-based RF interference geolocation	Using satellites which are currently already in-orbit, **to enhance current geolocation capabilities**.
☑ Space-ground capabilities integration	Demonstrate the **synergy between ground-based and space-based** monitoring and geolocation.
☑ Spectrum sharing and use optimisation	Demonstrate several use cases in which the combination of ground- and space-based measurements **leads to more efficient spectrum usage**.

**All developments shall conform with national and international regulations (ITU, CEPT, national regulations)*

Spectrum Sharing Makerspaces

ESA Spectrum Sharing Makerspace

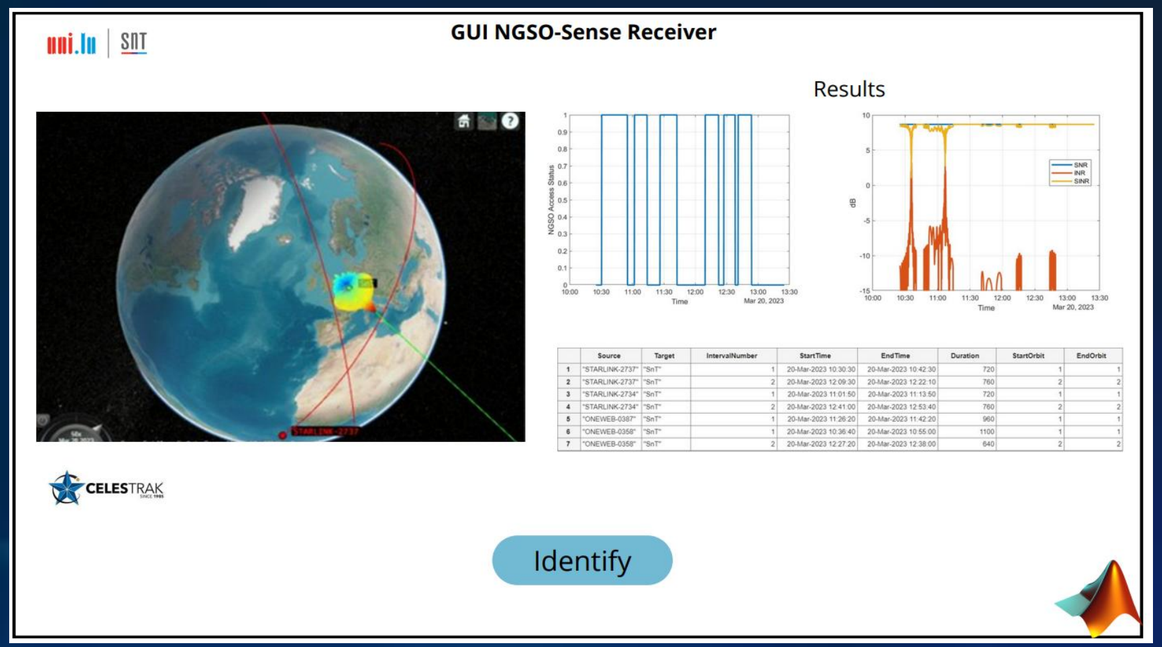
Pohybujete se v oblasti technologií radiového spektra a chcete podpořit vývoj jak v oblasti technologie, businessu nebo obojího zároveň? Vyberte si některou z vypsaných subaktivit, přihlaste se do ESA SSM, získejte až 50 tisíc euro, technický a businessový mentoring a započněte svou spolupráci s Evropskou kosmickou agenturou!

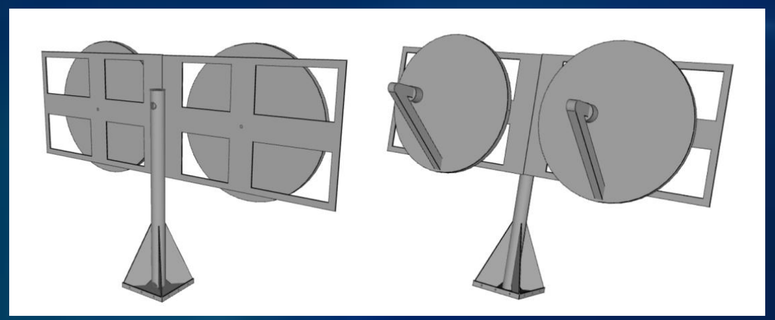


Libre Space Foundation

SPECTRUM SHARING
MAKERSPACE

NGSO/NSGO/GSO co-existence measurements

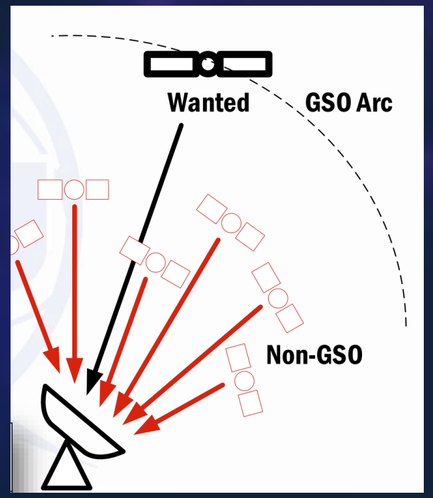




UNIVERSITÉ DU LUXEMBOURG

SES

"WRC-23 invites ITU-R to conduct technical studies on the epfd limits in Article 22, including the epfd limits referred to in No. 22.5K, in order to ensure the continued protection of GSO FSS and BSS networks, and to inform WRC-27 of the results of the studies, without any regulatory consequences. This work should not be submitted under agenda item 9.1."]



The co-existence of non-geostationary (NGSO) constellations and geostationary (GSO) satellites

Explore new ways to co-exist – work starting soon

Future models for space-based monitoring?

SatMoU

Administration

Harmful interference

SIRRS

International Monitoring System

MoU’s

Or other models? Exercise needed…tests…pilots…demonstrations…

ESA interests

- Use cases in which space-based means can add value to **regulators** → see also CEPT FM22 questionnaire and **workshop**

- Participation of **industry** in upcoming demonstrations of space-based monitoring, in synergy with ground-based monitoring – **preferably supported by regulators**

- Discuss on possible **operational models** for future use of **space-based** means and their **synergy** with **ground-based** means