
9th Interference Detection and Mitigation Workshop
UN Vienna International Center (Virtual)
Vienna, Austria - 24 August 2021

International Committee on
Global Navigation Satellite Systems

9th ICG Workshop on GNSS Spectrum Protection and Interference Detection and Mitigation

AGENDA

Tuesday, 24 August, 2021 Times: UTC
Location: United Nations Vienna International Center and online

1200 Introductions

Opening Remarks (Chair)

ICAO Agenda Item 30: *Urgent Need to Address Harmful Interference to GNSS*

IMO Maritime Safety Committee, Agenda Item 22: *Interference with the United States' Global Positioning System (GPS) and other Global Navigation Satellite Systems (GNSS)*

U.S. Coast Guard Paper to IMO: *GNSS Interference from Shipboard LED Lighting*

1215 Briefings

Incorporating Resilience into IDM: *Mr. Ernest Wong, Technical Manager, Science and Technology Directorate U.S. Department of Homeland Security*

Implementation and Definition of Interference Protection Standards at Space Segment for the European Space Agency: *Mr. Francisco Amarillo Fernandez, European Space Agency*

Environment-aware GNSS Position Estimation Process Realisation in Software-Defined Radio (SDR): *Professor Dr. Renato Filjar, University of Rijeka, Croatia (et al Team)*

Air-Ground coordinated RFI detection system in airport: *Mr. ZHEN Weimin, China Research Institute of Radiowave Propagation*

1345 Break

1400 Interference Detection and Geo-Location Capabilities

Development of the European GNSS Interference Detection Network: *Mr. Joaquin REYES GONZALEZ, European Union Agency for Space Programmes (EUSPA)*

Characterization of ADS-B Performance under GNSS Interference: *Professor Dr. Todd Walter, Director, GNSS Laboratory, Aeronautics and Astronautics Department, Stanford University*

Madrid Airport and TMA GNSS RFI Monitoring System (DYLEMA-Madrid): *Mr. José Luis Madrid Cobos, Satellite Navigation Department, Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA)*

Interference scenario in S-band: NavIC experience: *Dr. Pravin Patidar, Space Applications Centre, Indian Space Research Organisation*

Fourteen Maritime Organizations Protest Jamming and Spoofing

U.S. Coast Guard has filed protest on their behalf with the International Maritime Organization (IMO).


Aviation Groups to
ICAO –
“Urgent Need
To Address
GNSS Interference”

JOINT IMO/ITU EXPERTS GROUP ON MARITIME RADIOCOMMUNICATION MATTERS

Agenda Item #7: Consideration of the electromagnetic interference (EMI) effects of light emitting diode (LED) lighting systems and other sources of EMI on board vessels.

- RTCM SC137 is intended to apply only to shipboard electrical and electronic equipment installed within about 15 meters of VHF antennas, including LED luminaires such as navigation lights as well as other devices installed near antennas capable of causing interference.

DHS SCIENCE AND TECHNOLOGY

Incorporating Resilience into IDM

United Nations International Committee on GNSS – 9th Interference Detection and Mitigation Workshop

Homeland Security

Science and Technology

August 24, 2021

Ernest Wong

Technical Manager
Technology Centers Division
Science and Technology Directorate

Key Takeaways

- **Emerging Paradigm**: Multi-PNT Ecosystems & Increasing Frequency of Interference
  - Traditional approach of detecting and locating interference will not be sufficient
  - Need to be resilient and able to live with and operate through disruptions

- **Two Aspects to Achieving Resilience**:
  - System Resilience (Hardware Aspect)
    - PNT systems designed with resilient system architectures
    - PNT systems incorporate cybersecurity principles for holistic approach to threats
  - Operational Resilience (End-User Aspect)
    - Operators plan for and know how to respond to PNT disruptions
    - Operators understand and minimize PNT dependencies in downstream systems
    - Operators able to withstand, operate through, and recover from PNT disruptions

GNSS Interference Monitoring from Space

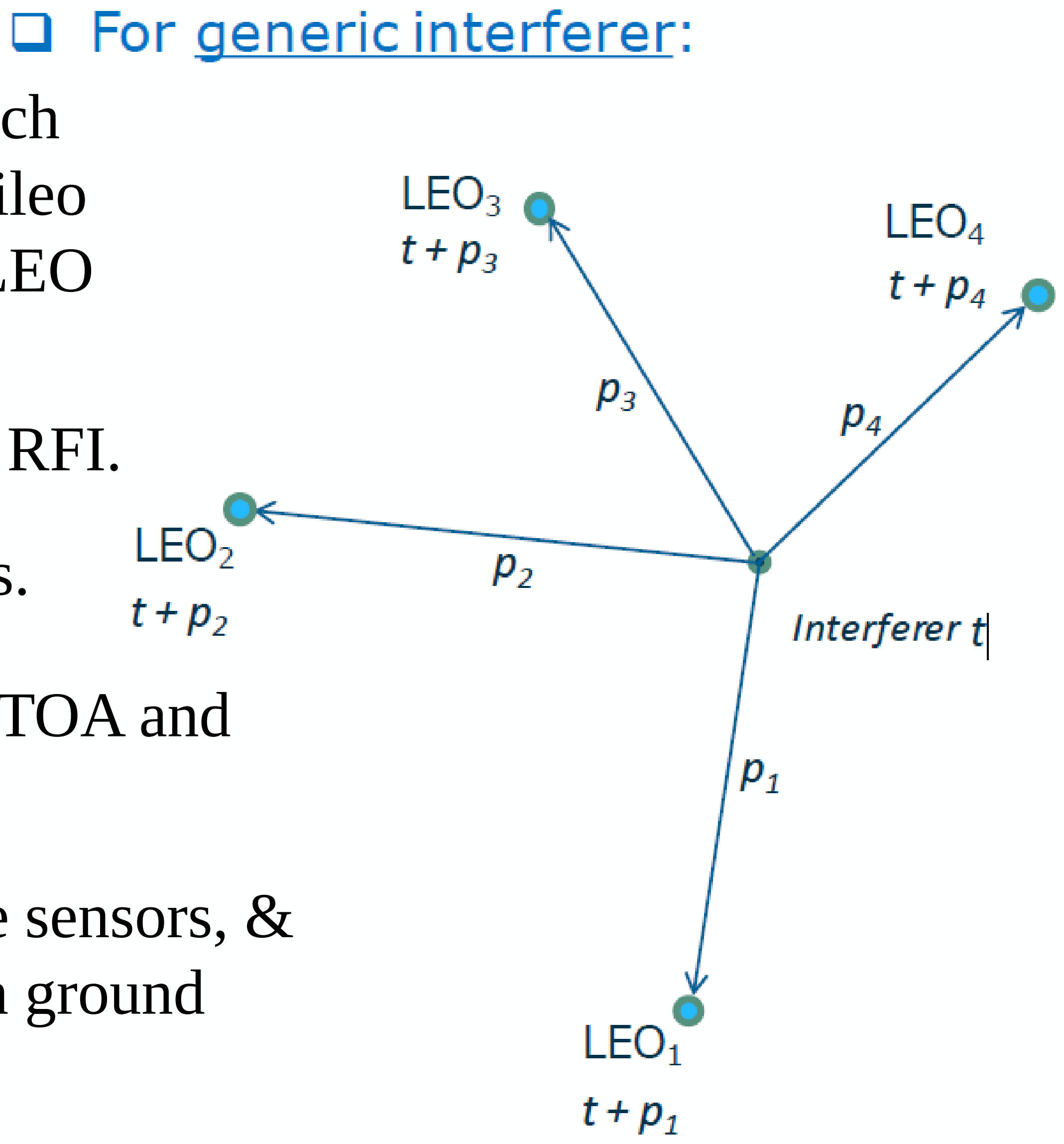
Francisco Amarillo Fernandez

ESA ESTEC

23/08/2021

RFI-LEOM Project. Conclusions.

- RFI-LEOM is a running exploratory study, which designs a spectrum monitoring-system, for Galileo OS signals, based on space-borne monitors at LEO orbit.
- Targets the detection of generic and predefined RFI.
- Provides worldwide coverage, including oceans.
- Provides RFI localization by means of TDOA, TOA and DOA techniques
- Based on architecture in which the satellites are sensors, & the actual detection and localization is based on ground processing.
- Minimum performance targets have been identified.



University of Rijeka, Croatia:

Environment-aware
GNSS Position Estimation Process Realisation
in Software-Defined Radio (SDR).

Renato Filjar
Faculty of Engineering, University of Rijeka, Rijeka, Croatia, and
Krapina University of Applied Sciences, Krapina, Croatia

GNSS ionospheric effects mitigation using the statistical learning-based method embedded in the position estimation process (R Filjar, Croatia)

- State-of-the-art
- Positioning environment conditions as the cause of GNSS positioning performance degradation at various scales of intensity, occurrence, and duration . traditionally mitigated with costly augmentation infrastructures, and global and generalized correction models
- Traditional approach assumes equivalence between GNSS receiver and GNSS positioning process
- GNSS operators cannot control the positioning environment, but requested to provide guarantees of PNT service quality
- Software-defined radio deployment renders GNSS positioning process transparent, in computationally capable technology environment

- Environment-adaptive GNSS positioning process is proposed
- GNSS positioning process rendered distributed, and considered independent from GNSS receiver architecture, with GNSS position estimation associated to GNSS application
- Immediate real-time positioning environment conditions awareness achieved through *sensor information fusion* (third-party data, or direct measurements at the positioning spot)
- Statistical learning on GNSS positioning environment conditions data.
- Detection, identification, modelling, correction, learning from direct experience . adaptiveness to the actual environmental conditions
- Position estimation process associated to GNSS application, not GNSS receiver . fitting the process design with GNSS application needs, this revealing GNSS operators from GNSS augmentations, corrections, and PNT guarantees provision

Air ground coordinated RFI detection system in airport

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Zhen Weimin, Chen li，Jin Ruimin Yang Huiyun
China Research Institute of Radiowave Propagation

2021-8-24

- RFI in 1G-3GHz detection and positioning.
- Signal analysis, recognition and direction finding of Multi GNSS multi frequencies (BDS: B1、B2、B3; GPS L1、L2、L5; and GalileoE1、GLONASS G1)
- Airborne device measures the direction of the RFI at one point, the drone flies to another points, and measure the direction again. The RFI source can be localized with the direction finding results of two or more points.
- Can not be singly used for movable RFI source identification.
- Can be used for RFI detection in large regions and is not restricted by terrain and complex environment.
- The ground and airborne direction finding devices measure the RFI at the same time and the source is identified with cross positioning.
- Advantage: fast localization, localization of movable RFI

Development of the European GNSS Interference Protection Network: EGIPRON

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Joaquín REYES GONZALEZ

European Union Agency for Space Programme (*EUSPA*)

24 August 2021

EUSPA European Union Agency for the Space Programme

EGIPRON Mission and objectives

- Analysis of the national interference reporting regulatory environment
- Design and implement a platform to collect heterogeneous interference-related data from contributors and share events to relevant end users.
- Promptly notify competent authorities in EU Member States of GNSS interference.
- Ensure the protection of sensitive information.

GIDAS, GNSS Interference Detection & Analysis System

- Enables a continuous 24/7 monitoring of the GNSS frequency bands.
- Classify and localize intentional interference by means of jamming and spoofing.
- GIDAS targets safety critical applications with either high-demands regarding interference monitoring

GIMAD, GNSS Interference Monitoring And Detection System

- Portable station designed to efficiently detect and support the location of threats that can endanger satellite-navigation based critical activities.
- To monitor permanently the GNSS environment in geographical areas where critical activities take place.
- Inform users about the nature of the threat, allowing government to initiate the necessary remedial actions.

Characterization of ADS-B Performance under GNSS Interference

Todd Walter, Zixi Liu, & Sherman Lo

Stanford University
August 2021

Summary

- U.S. airspace is sampled by > 45,000 flights every day
  - > 200,000 globally
- These aircraft sample the GNSS RF environment and broadcast information that may be used to detect the presence of interference
- ADS-B was not designed for RFI detection, so care must be taken to properly distinguish RFI events from other issues
  - Active proposals to include more direct information (e.g., C/N0)
- Work is being done by many different organization to parse this data and identify effective means of detection and localization
  - Expect ADS-B to be increasingly used for RFI detection & localization

Spanish Ministry of Transport, Mobility and Urban Agenda (MITMA):

Madrid Airport and TMA GNSS RFI Monitoring System (DYLEMA-Madrid)

DYLEMA-Madrid

Madrid Airport and TMA GNSS RFI Monitoring System

ENAIRE

José Luis Madrid Cobos
GNSS RFI Monitoring Technical Manager
ENAIRE - Air Navigation Service Provider
Ministry of Transport, Mobility and Urban Agenda - Spain

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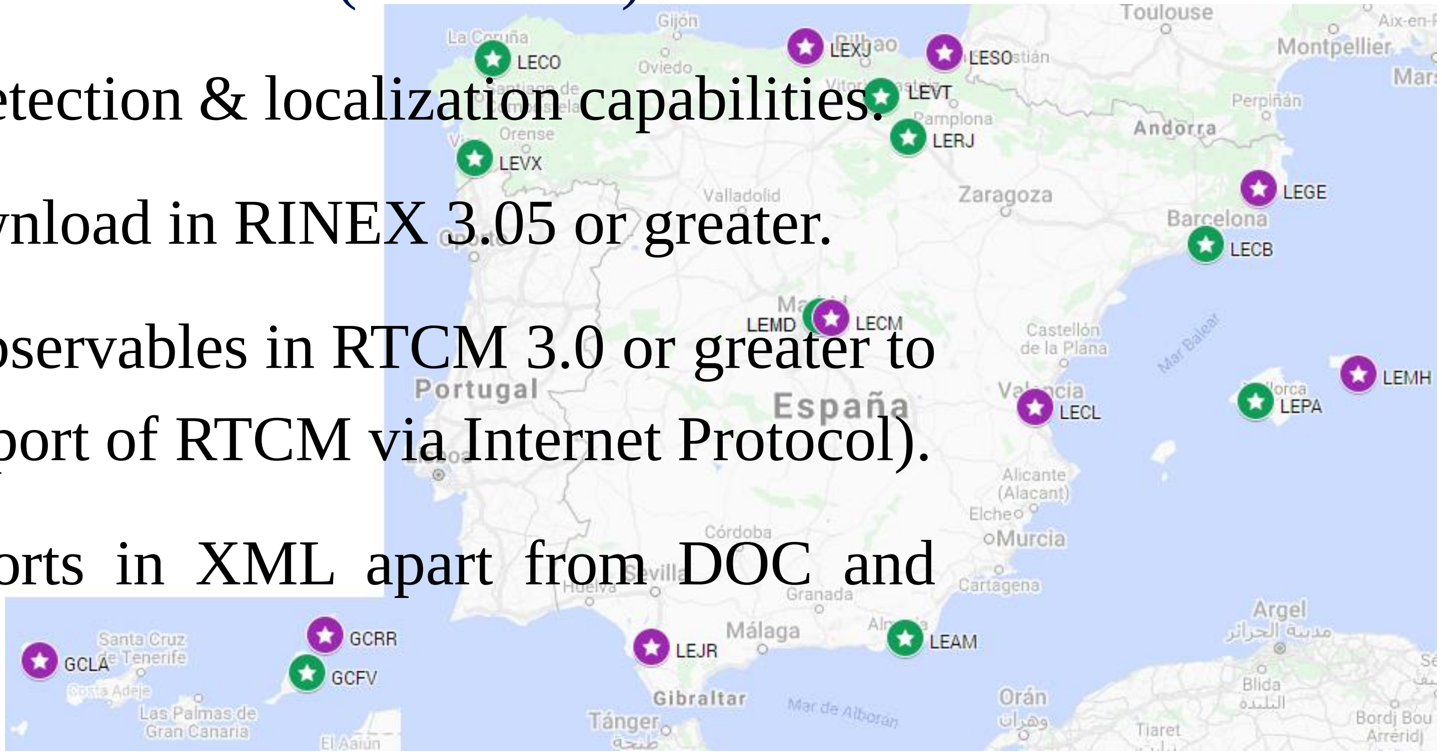
ENAIRE has a GNSS performance assessment and Radio Frequency interference (RFI) monitoring network in operation since early 2000, with GNSS receivers and RFI detectors (without geolocation capabilities) at Spanish airports with published PBN (Performance Based Navigation) procedures. It is in continuous evolution (retrofits and new installations).

Main new features:

- ✓ Separated antenna modules: optimal solution (mounted in towers).
- ✓ Increased monitored bandwidth per GNSS band (> 60 MHz).
- ✓ Improved jamming and spoofing detection & localization capabilities.
- ✓ GNSS observables storage and download in RINEX 3.05 or greater.
- ✓ Real time transmission of GNSS observables in RTCM 3.0 or greater to a NTRIP-Caster (Networked Transport of RTCM via Internet Protocol).
- ✓ Generation of pre-established reports in XML apart from DOC and PDF formats.



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Interference Scenario in S band

NavIC Experience

Pravin Patidar

Space Applications Centre

Indian Space Research Organisation

Ahmedabad, India

Conclusion

Next available spectrum after L band.

Crowding at L band may lead to migration to this band for new services, signals and systems.

- The S band RDSS spectrum is important for currently operational satnav systems as well as for future systems and services.
- Significant interference from terrestrial systems has been observed to the S band RDSS signals.
- The interference from terrestrial systems needs to be discussed at forums such as ITU and ICG.
- The interference among RDSS system operators/providers has to be resolved through bilateral coordination.
- Concerted efforts of GNSS community is required for protection of S band RDSS spectrum from interference threats of existing terrestrial systems and future system such as HIBS.