Geoscience and Remote Sensing Society

Frequency Allocations in Remote Sensing Technical Committee (FARS-TC)

CORF Spring Meeting

Virtual
May 19, 2022

Introduction

The Frequency allocations in Remote Sensing Technical Committee goal is to ***interface between GRSS and the radio-frequency regulatory world*** by

- educating the remote sensing community on spectrum management processes and issues
- promoting the development of radio frequency interference detection and mitigation technology
- organizing technical sessions at conferences, workshops, etc. on the above processes, issues and technologies
- providing spectrum managers and regulators with technical input and perspective from remote sensing scientists and engineers
- fostering the exchange of information between researchers in different fields, such as remote sensing, radio astronomy, telecommunications, etc. with the common scope of minimizing harmful interference between systems

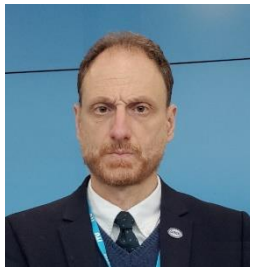
New FARS-TC Leadership

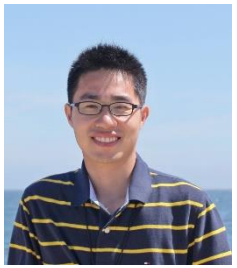
- **Chair:**

  Roger Oliva

- **Co-chairs**:

  Paolo de Matthaeis
  Tobias Bollian
  Ming-Liang Tao





- **Secretary:**

  Priscilla Mohammed

Summary of FARS activities

Education and promotion

- Organization of RFI sessions at conferences (RFI 2022, IGARSS, URSI GASS)
- Webinars, Podcast
- Article on WRC23 Agenda items related to GRSS in IEEE/GRSS journals
- Presentation of FARS activities at different conferences
  (SHARC/RWW, CORF, LPS, RADAR 2021)

Development activities

- Web tools for RFI and Frequency management to support our members
- Monitor activities related to 5G deployment at 24 GHz: PocketQube

Participation in regulatory process

- Involvement and contribution to spectrum management activities:
  ITU, SFCG, FCC
- Development of Standard activities related to quantification of RFI in EESS bands
- Preparation of GRSS Views document on WRC-23 Agenda Items.

Support Organization of RFI 2022 Workshop

- FARS/GRSS supported organizing the latest edition of the RFI Workshop
- RFI 2022 was held virtually by ECMWF on February 14-18, 2022
- The workshop promoted exchange of information and techniques to tackle RFI.
- Remote sensing, astronomy and meteorological communities shared their strategies to mitigate RFI in their respective fields.
- **88** submissions, almost double than for RFI 2019

http://www.rfi2022.org

Other Meetings

IGARSS 2022

- two invited session organized for IGARSS 2022

2022 IEEE Space Hardware and Radio Conference (SHaRC 2022)

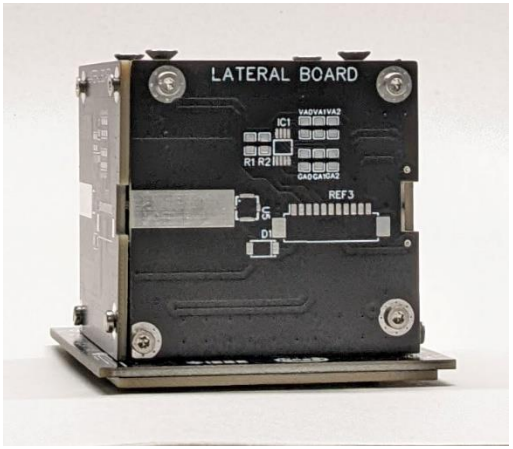
- promotion of GRSS and FARS-TC activities

URSI GASS 2022

- Short course on Spectrum Management and RFI detection and filtering.
- Paolo chaired 3 technical sessions on RFI and spectrum management issues.

POCKETQUBE

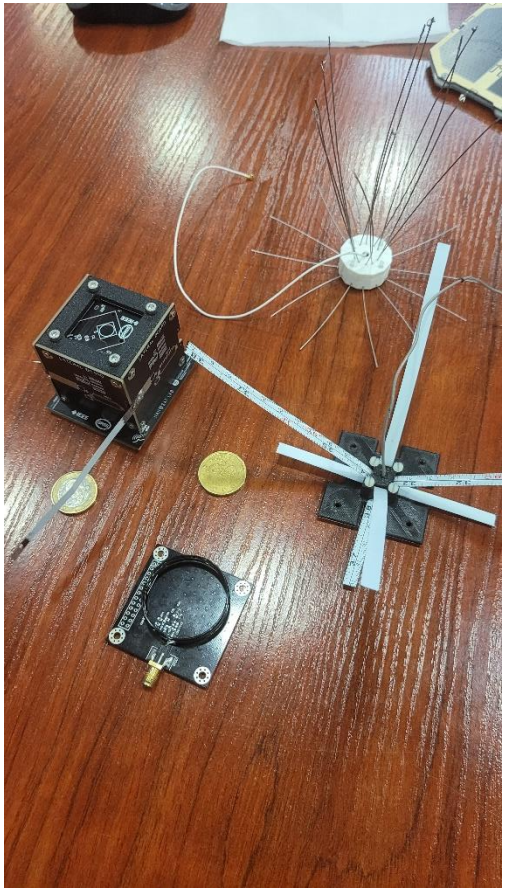
- A new initiative to address the concerns over the 24 GHz band:
- Started as GRSS educational initiative to develop an Open PocketQube Kit with videos and manuals for open education.
- It included two PocketQubes (5cm x 5cm x 5cm):
  - RF Payload at L-band
  - Optical Payload.
- FARS proposed the development of a third PocketQube with RF monitoring capabilities at 24 GHz to follow the deployment of 5G and its impact on this remote sensing frequency band.



NanoSatLab PocketQube mockup

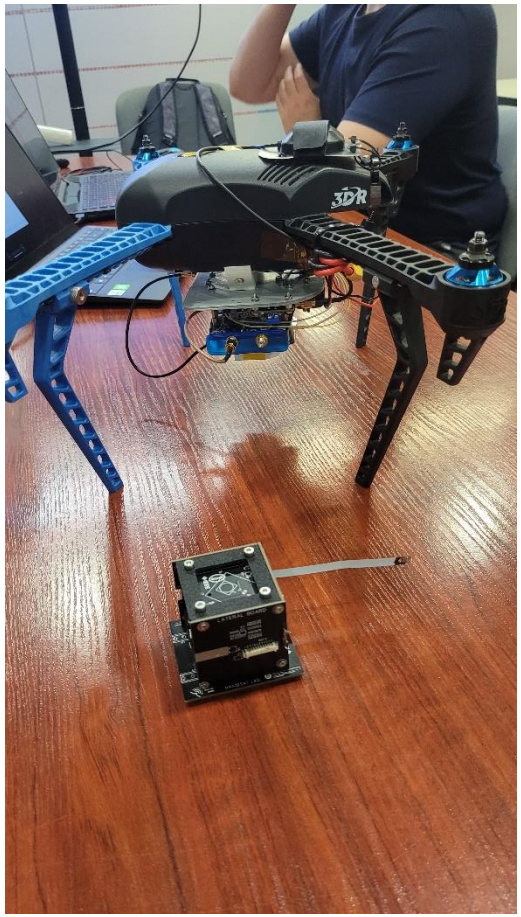
POCKETQUBE

- The RFI-5G payload design and implementation is on-going at the NanoSatLab in the Polytechnical University of Catalonia (UPC).
- Different options for payload design and antenna are currently being evaluated, taking into account requirements, components availability, power consumption and area minimization in mind. Global lack of micro-chips is affecting the design options.
- Pocketqube will be ready for deployment at the end of the current year



POCKETQUBE

- The PocketQube will be initially flown on a drone or balloon to monitor regions where the 5G 24 GHz channel is being deployed
- Eventually it will be sent into orbit for global monitoring



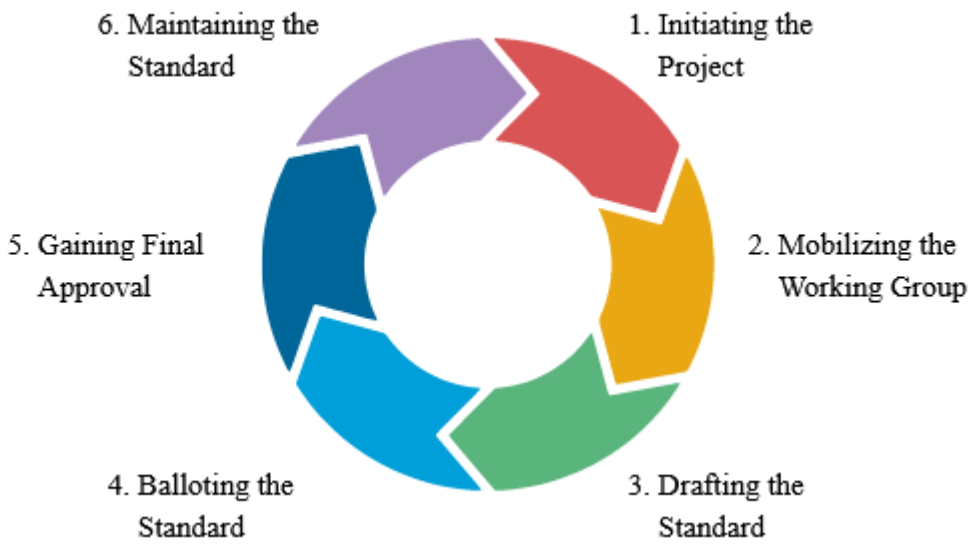
Requirements

RFI5G_01	Measurable input power of -110 dBm in a 10 MHz band.
RFI5G_02	Frequency resolution smaller or equal to 10 MHz.
RFI5G_03	Output voltage range of 0 to 3.6 V
RFI5G_04	Maximum peak power of 1.5 W.
RFI5G_05	Average power, can be duty cycled, smaller than 0.5 W.
RFI5G_06	PCB size: 4 cm side square.
RFI5G_07	Weight smaller than 250 g.
RFI5G_08	Storage temperature range of -40 to 80 ºC.
RFI5G_09	Operation temperature range of 0 to 45 ºC.

New IEEE Standard related to RFI

- **New IEEE standard to define a methodology to quantitatively evaluate the amount of man-made Radio Frequency Interference (RFI) in any given frequency band allocated to space-based remote sensing.**
- Useful in understanding the situation of all the bands allocated to remote sensing, follow their trends and in defining priorities for our spectrum managers.

Cycle of IEEE Standard Development



IEEE SA
STANDARDS ASSOCIATION

CALL FOR PARTICIPATION

First WG meeting took place on
14 June 2021

Timeline (present & future)

2022

- 2022: Drafting of the Standard
- Dec'22: Draft 1.0. Initial draft approved by group

2023

- Sep'23: Draft 2.0: Review and modification of content

2024

- Mar'24: Draft 3.0. Ballot ready draft
- Jun'24: Formation of a Standards Association Ballot Group
- Jul'24: Initiate SA Ballot
- Dec'24: Submit to RevCom

2025

- May'25: Publication

Quantifying Band Contamination: Flowchart

Step 1 - RFI Detection
Acquisition-Reference-Frame

Acq #1
(…)
Acq #N

Eg. For a single acq, sensor, in a given band…

Standard may provide:

- false alarm rate requirement (quality control)
- variety of sensor-dependent detection techniques and detailed implementation procedures
- procedure for usage of custom RFI detection
- List / format of information to be reported

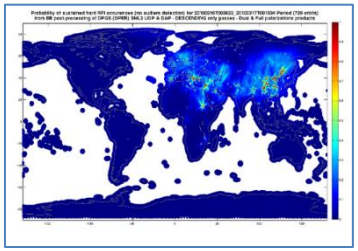
Step 2 – RFI Maps (per Sensor)
Sensor-Reference-Frame

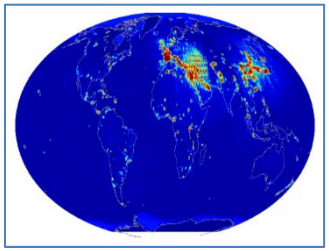
Sensor A Map
(…)
Sensor M Map

Eg. For a given sensor, in a given band…

Standard may provide:

- How and how often to collate acquisitions
- How to geolocate acquisitions: (RFI contamination / RFI sources)





Step 3 – RFI Maps
Global-Reference-Frame

RFI Map for Band

Eg. For a given band.

Standard may provide:

- Transformations to achieve
  - sensor-to-global-conversion
  - global-to-sensor-conversion (e.g., for assessing impact on future missions based on collected standard data)

Step 4 – Output products
RFI characterization

Standard may provide:

- Transformations to quantify / summarize in plots Step3 Maps

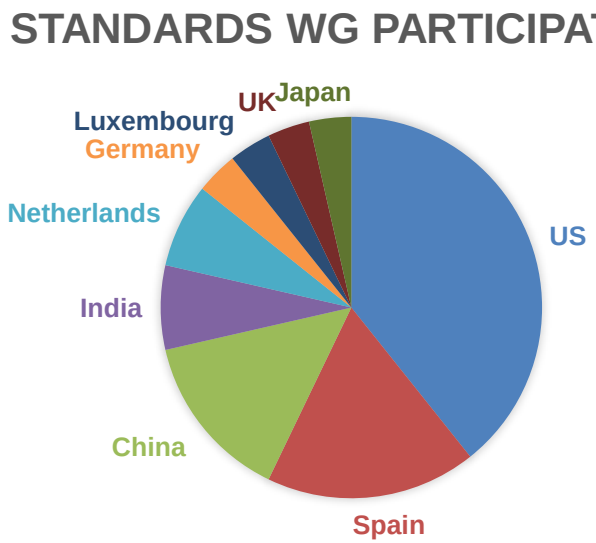
Standards WG Participation

So far, we have had:

6 WG meetings
4 Sub-groups

28 Participants from different countries
20 Voting Members

We welcome participation from everybody:



https://development.standards.ieee.org/myproject-web/app#interests

US Regulatory Issues

- **Letter to US Congress**
  - On July 20, 2021, the Committee on Science, Space and Technology of the United States House of Representatives held a hearing on **Spectrum Needs for Observations in Earth and Space Sciences**.
  - Following the hearing, the FARS Technical Committee prepared a letter that the GRSS President David Kunkee signed and sent to the Committee on Science, Space and Technology to serve as a Statement for Record for the hearing.
  - The letter is available here on the FARS TC webpage under “News”.
- **Filings to the Federal Communication Commission (FCC)**
  - response to **FCC Notice on emission limits at 24.25-27.5 GHz** filed on June 28
  - reply to comments on Notice of Proposed Rule Making (NPRM) on 57 GHz filed on October 19, to prevent expanding flexibility for certain devices.

International Spectrum Management Activities

- Being under IEEE GRSS, the FARS TC can represent the remote sensing community without having to compromise its position with other interests.
- The FARS TC has been involved in spectrum management international activities particularly through the
  - ITU-R Study Groups, starting in 2018;
  - Space Frequency Coordination Group (SFCG), starting in 2015.

International Spectrum Management Meetings

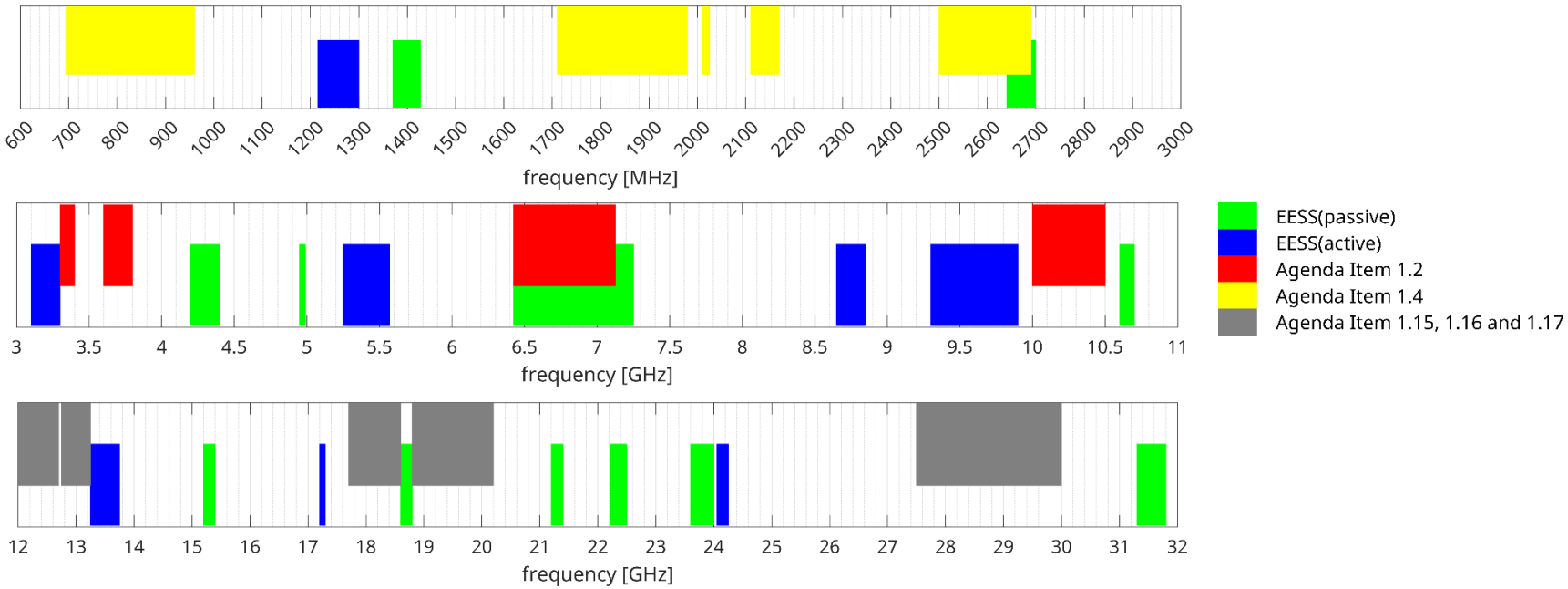
- ***ITU-R Study Groups:***
  - **Working Party 7C (Remote Sensing Systems)**
    - continuing involvement in the ITU-R draft Report on *Analysis of interference received by EESS (passive) sensors in the 18.6-18.8 GHz band*
    - also following WRC-23 AI 1.12 on new secondary allocation to EESS (active) around 45 MHz an other topics
  - **Working Party 3J (Radiowave Propagation Fundamentals)**
    - defining input format and related issues (wind velocity model) for the scattering model for ocean surface at 18 GHz
    - draft new ITU-R Recommendation on *Earth surface bistatic scattering coefficient prediction* has been split into two parts, sea surface and land
    - aiming to send sea surface scattering recommendation to Study Group 3 for approval at the upcoming 2022 WP 3J meeting
  - **Documents are very important for WRC-23 AI 1.16 and AI 1.17 sharing and compatibility studies**

International Spectrum Management Meetings

- **Space Frequency Coordination Group (SFCG)**
  - **After a one-year postponement and a reduced SFCG-40 meeting held virtually in 2021, SFCG-41 will be held in person in Australia in July**
    - **FARS TC will attend representing GRSS**
    - **Extensive discussions of the subgroup on frequency allocations for lunar and martian missions**
    - **Subworking group on passive systems has not convened yet**
  - **The SFCG-41 meeting is now planned in person for July 2022**

GRSS Views on WRC-23 Agenda Items

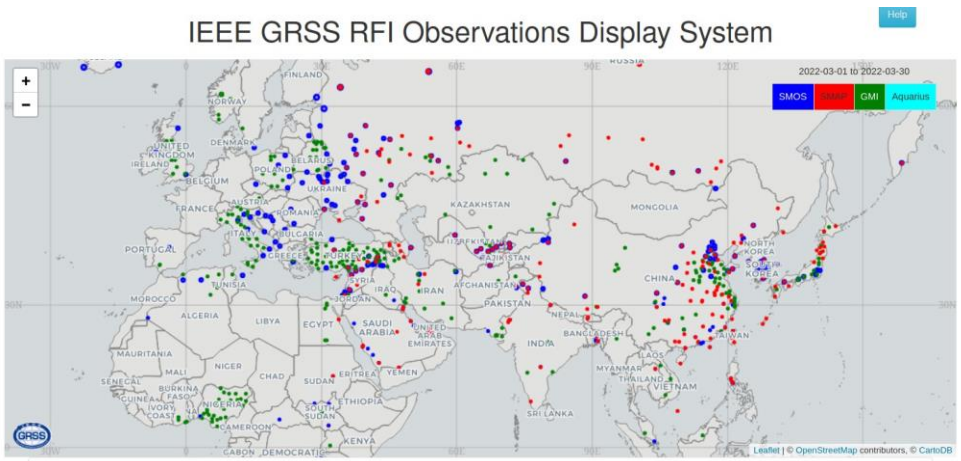
- Official document of GRSS on its position on the WRC-23 Agenda Items that could impact remote sensing
- Good draft under development
- Expected to be ready in the second half of 2022



GRSS FARS Online Tools

RFI Observations

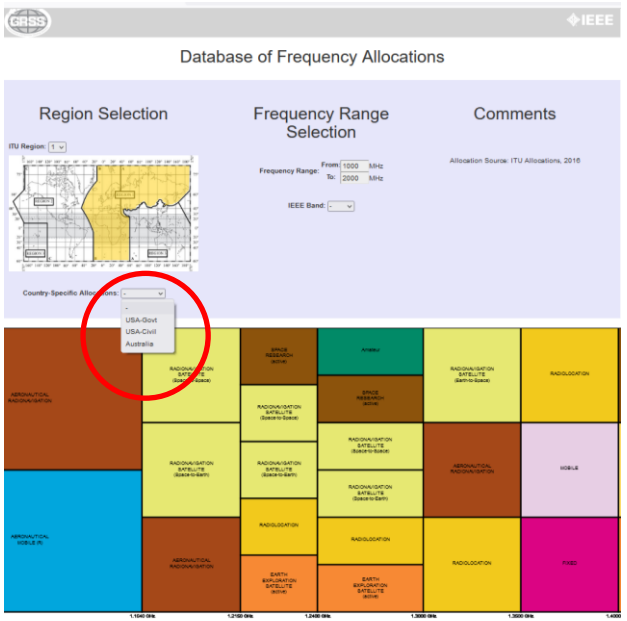
- Up to date locations for SMOS, SMAP, GMI (10 and 18 GHz)



www.classic.grss-ieee.org/rfi_observations.html

Frequency Allocations

- National Tables for USA and Australia



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