

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



Minutes of RFI Meeting at MicroRad 2020

Date: November 18, 2020

Location: Virtual MicroRad 2020 Symposium

Participants:

Paolo de Matthaeis, Tobias Bollian, Roger Oliva Balague, Thomas von Deak, Mustafa Aksoy, Matteo Alparone, Mike Bettenhausen, Sayak Biswas, Ada Vittoria Bosisio, Damon Bradley, Alexandra Bringer, Marco Brogioni, Kaushal Buch, François Cabot, Francisco Ceba Vega, Raffaele Crapolichio, Sandra Cruz-Pol, Giovanni De Amici, Antonio de la Fuente Estebanez, Steve Ellingson, Al Gasiewski, Siri Jodha Khalsa, Yann Kerr, Edward Kim, Steen Savstrup Kristensen, David Le Vine, Gianluigi Liberti, Alvaro Llorente Ibanez, Nick Laneman, David Lubar, Giovanni Macelloni, Edoardo Marelli, Priscilla Mohammed, Ryo Natsuaki, Manuel Martin Neira, Hyuk Park, Emanuele Santi, Luca Salghetti Drioli, Emma Turner, Ekhi Uranga, Aravind Venkitasubramony, Jerome Vialard, Werner Wiesbeck, Igor Yanovsky, Ashley Zauderer

Agenda:

1. Presentation by Dr. Bevin Ashley Zauderer, Electromagnetic Spectrum Management Program Director at the US National Science Foundation (NSF), on the NSF proposal for a National Center for Wireless Spectrum Research
2. Introduction of FARS-TC proposal to standardize the quality assessment of remote sensing frequency bands with regards to Radio Frequency Interference (RFI)

Introduction

Paolo shares the introductory slide and welcomes everyone to the meeting. He explains that the meeting will cover two topics: the first will be a presentation by Dr. Bevin Ashley Zauderer about the NSF Spectrum Innovation Initiative for a National Center for Wireless Spectrum Research. The second topic will be a FARS proposal for the development of standards to assess the quality of remote sensing frequency bands in terms of man-made RFI. Paolo then hands the floor to Ashley Zauderer.

Presentation by Dr. Bevin Ashley Zauderer

Ashley Zauderer points out that the spectrum is becoming more crowded and that the NSF is therefore looking into supporting research to use the spectrum more efficiently. Research with respect to this at NSF is across the board and spans from astronomy to wireless devices, to game theory on how spectrum auctions are performed. In addition, a spectrum innovation initiative was

launched last year across all directorates. This proposed program has four pillars, which will be presented in detail in the following:

- A. National radio dynamic zone
- B. National center for wireless spectrum research
- C. Spectrum research integrative activities
- D. Education and workforce development

A. National radio dynamic zone

One idea is to have dedicated geographic areas for RFI test beds to research enhanced spectrum usability (passive and active). These zones are controlled areas, with the requirement that spectrum users outside the zone do not interfere with (passive) users and their research inside the zone. The test bed could also be used to demonstrate how RFI corrupts data outside of the zone, or to study ways in which interference could be created intentionally inside the zone to facilitate RFI mitigation studies. A further idea is to study dynamic hopping of cellular services for a more efficient utilization of the spectrum. Hereby, the cellular services would jump to a different frequency if, for example, a research station is beginning to operate at one of the frequencies. Progress to date is a Dear Colleague Letter NSF 20-079 active through summer 2021. The NSF seeks answers on what areas could be used for these zones, the specific frequency bands, etc.

B. National center for wireless spectrum research

Ashley Zauderer points out that there is a lot of research going on in the US in many different places but there is no center that combines all research and acts as a platform to connect the individual researchers. This is a further point that is going to be addressed by the proposed national center for wireless spectrum research. NSF started in FY20 with supporting planning grants for this center. A current solicitation is NSF 20-557 with a \$5M/year budget, for 5 years, starting FY21.

The center is supposed to connect multidisciplinary groups, ranging from atmospheric research, astronomy, advanced wireless communication, federal agencies.

C. Spectrum research integrative activities

NSF has been funding for decades research in all the different groups (astronomy, advanced wireless, etc.) but these communities were never brought together. Therefore, in FY20 (NSF20-537) NSF started to promote research on increased and more effective use of spectrum for passive and active applications, specifically on activities of cross-disciplinary nature.

D. Education and workforce development

The goal of the center is also to grow the spectrum workforce of the future, by creating education and training, and by broadening the STEM participation. Every grant awarded at NSF keeps this goal in mind.

Discussion

Paolo thanks Ashley Zauderer for her presentation and opens the floor for questions.

Roger Oliva asks how these test beds would work for spaceborne microwave sensors since coordination for international remote sensing satellites would require more than simple national effort as in the case when creating radio quiet zones. Thomas von Deak points out that international observations are impacted no matter where you pick a zone.

Ashley Zauderer says that the zones would not mess with existing remote sensing missions. Frequencies being used internationally are off limits. Establishing such zones also requires a thorough coordination with systems transmitting at selected frequencies. In the future, most systems will have the capability of operating at two or three different frequencies so they can change

frequency over a test bed zone. However, in general, the test beds will start with few, picked frequencies that are allocated in the US only. In addition, she points out, the zones could also be used to create interference on purpose to research RFI in a known-setting instead of modelling unknown RFI.

Paolo wonders if such an approach would be allowed under the ITU regulations, to produce RFI intentionally. Ashley Zauderer responds that there are thousands of requests for Special temporary authorizations in the US to temporarily break rules all the time. It would therefore make sense to condense all of these authorizations in a geographic area, where everyone is aware that interference is occurring. This would also make it easier to coordinate these RFI appearances.

David Lubar asks if NSF will play a role in advocating users about the critical difference between active and passive users, who are trying to detect the natural noise floor and are affected by smallest emissions.

Ashley Zauderer says this is a great example of what they are trying to do with their workshops that bring engineers and private industry together. Edward Kim comments that engaging two communities that compete for spectrum is a good idea but it requires good will on both sides. However, corporations that know they can make huge profits and have much power have probably no incentive to engage. Ashley Zauderer says it is important to start at the university level here, and to educate future engineers and decision makers about this problem before they begin working at such companies.

Paolo asks how the remote sensing community can participate more actively. Ashley Zauderer says once the center is established there will be a series of workshops that one can sign up for. Also, if the community does not agree with information in one of their solicitations, they should feel free to reach out to NSF.

Paolo says that FARS will continue to follow this initiative and will provide updates to the FARS members. If anyone wants to get more involved, they should get in touch with FARS.

Paolo thanks Ashley Zauderer again and moves to the second point on the agenda.

Presentation by Roger Oliva on RFI standards

Roger Oliva points out that the amount of RFI has been increasing with time but it is unknown how it has been increasing and the effect on microwave remote sensing. This is one of the questions that FARS is aiming at answering with its activity on RFI standards. The initiative for the standards was first suggested at the FARS annual meeting at IGARSS 2019, with the idea to evaluate the quality of frequency bands with respect to RFI. A proposal was submitted to the IEEE Standards Association (IEEE SA) in August 2019 and accepted shortly thereafter. Plans for exploring the establishment of standards were compromised by the COVID-19 crisis, nevertheless a study group was formed to draft an initial document. This draft document lays out what FARS aims to achieve with the creation of these standards.

A goal is to ensure a continued and consistent measure of RFI across all remote sensing frequency bands. This information is then to be used to inform policy decision makers and the public, so that they are aware of the situation and can react.

Roger Oliva presents the first required steps to develop an IEEE standard, which consists of forming a working group (WG) and submitting a project authorization request (PAR) to the IEEE SA. The PAR states the reason for the project and the WG will develop the standards with input and feedback from the stakeholders. Officially, this standard needs to be created within 4 years.

Roger Oliva points out that there are different types of standards, ranging from mandatory

requirements, recommended practices to guides that describe good practices. It still needs to be decided which of these types the standard will consist of, and that decision will be made as the work on the standard proceeds.

The currently identified issues up for discussion are: how to quantify RFI and characteristics, which important parameters to consider, how to tackle the fact that RFI impact is different pending on the type of sensors, sensitivity and mission objectives. In addition, it is important to differentiate between global and regional RFI and account for mission criteria. The relationship to recommendation ITU-R RS.2017 also needs to be determined. Finally, interaction with ITU and spectrum managers and space agencies is essential.

Roger Oliva presents tables showing types of RFI for different passive and active sensors at each frequency band. Updating and filling out these tables could constitute an initial step into the work for the standards definition.

The work plan is to have an initial discussion during the present meeting and to form the WG by the end of November 2020. The draft of the PAR will be shared with the WG and a first virtual meeting will be held early 2021. Permitting the Covid-19 pandemic, there will be an in-person meeting with the remote sensing community in late 2021 to report on the progress of the WG work.

Roger Oliva says FARS welcomes any input from remote sensing scientists and engineers on this initiative and their willingness to actively contribute or on any other aspects and challenges that need to be considered.

Discussion

Edoardo Marelli stresses the point from the presentation that interacting with spectrum managers is very important. While RFI quantification is useful for the scientists, active reporting needs to be established to inform decision makers. Roger Oliva agrees.

Thomas von Deak points out that one of the ideas that came up when working with FARS on the standards in the past year was to present this topic to the SFCG, so that it could be coupled with the activities of spectrum managers. It is important to develop the standard in a way that it can provide the space agencies the feedback they need for their work.

Roger Oliva asks engineers and scientists in the room how easy they think it will be to develop these standards and with how many challenges they will likely be faced. Edward Kim asks the floor what quantities should actually be standardized.

Paolo points out that the goal of this activity is not to measure RFI but to develop a standard that represents a framework for assessing interference presence. There are several aspects to consider, such as the issue of assigning a score to frequency bands with respect to RFI. What FARS would like to define with the standard is how to quantify, for example, the goodness of the band. At L-band in the passive allocation, there are different kinds of instruments and applications, all with different requirements and acceptable RFI levels. Here, FARS is trying to define a standard for all the instruments, which could define the acceptable levels or the way how the grading of the band with respect to RFI is done.

David Lubar agrees that involving the SFCG is a good idea. One could even schedule an all-day session at SFCG so we can concentrate on this topic and get the attention of the spectrum management community. Paolo says this is an interesting proposal and he will suggest it for the SFCG meeting in 2021.

Edoardo Marelli points out that when developing the standards it is important to be careful not to “shoot in our own foot” by contradicting ITU-R Recommendation RS.2017. Especially because future systems will have higher sensitivity and therefore be more sensitive to RFI, the standards need to

account for this fact. It is therefore difficult to define the acceptable RFI level.

Thomas von Deak notes that the ultimate goal of the standard in his view is to be able to effectively measure what the level of RFI actually is and to quantify its impact on operations. There is a relationship to ITU recommendations to a degree, but the standard is not a replacement for sharing studies within the ITU-R.

Roger Oliva says that anyone who wants to help work on the WG or wants to follow the initiative, please send an email. FARS will then form the WG and share the draft of the PAR.

Edward Kim says it would help if it were clearer what is actually meant with standard.

Roger Oliva explains that the standard has the purpose to define a consistent methodology for RFI measurements that can be applied for all missions. This does not mean that specific missions can not do additional measurements in their own way, but a consistent methodology will help to compare different missions and frequency bands and the change over time.

Edward Kim suggests to let people know what information of their current RFI measurement process to provide so that the standard can be developed.

Beau Backus points out that he has often noticed RFI that slowly arises in an image before it is even flagged as RFI, and it is also critical to address this dynamic change. Thomas von Deak calls this the "tip of the iceberg" problem: we do not know the entire extent of RFI, we only know about the RFI that we have detected.

David Le Vine argues that reporting needs to be made mandatory and become a part of mission requirements. A way of pushing this would be developing criteria for reporting on what kind of parameters need to be reported. This would help to get a better picture of the RFI problem. Roger Oliva agrees and that this might be included in the development of the standardization process. Edward Kim points out that NASA has a reporting requirement on missions but the problem is that it is not widely known or enforced. David Le Vine says that their RFI reporting on SMAP is done voluntarily and he is not aware of this requirement. Edward Kim will look up the requirement number and share it. He thinks this requirement is literally extending to everything that impacts a satellite mission, even interference encountered at launch sites.

David Lubar points out that there are two different types of RFI: illegal transmissions from inside a band and RFI that is from adjacent bands but within the assigned emission limits. For the latter type of RFI, no help can be obtained from the spectrum managers because the interferer is adhering to the regulations. Similarly, the word mitigation should not be used because to a spectrum manager it indicates that the problem is fixed. Beau Backus agrees that using the word mitigation is dangerous because generally RFI is not actually mitigated and only a way to live with it is found with these methods

Thomas von Deak highlights that the standard is supposed to be a specific tool, not a solution.

Concluding the discussion, Roger Oliva thanks everyone and gives the floor to Paolo for the final remarks and closing the meeting. Everyone who is interested in joining the WG or following the discussion on the standards should reach out to the FARS-TC Chair and Co-Chairs by e-mailing fars_chairs@grss-ieee.org.