Before the  
Federal Communications Commission  
Washington, D.C. 20554

In the Matter of  
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services  
Comment on Emission Limits for the 24.25-27.5 GHz Band  
)  
GN Docket No. 14-177  
ET Docket No. 21-186  

Comments  
of the IEEE Geoscience and Remote Sensing Society

I. Introduction

The IEEE Geoscience and Remote Sensing Society (GRSS) is a professional and learned society of the Institute of Electrical and Electronics Engineers (IEEE), active in the fields of geoscience and remote sensing. The IEEE GRSS deals with the theory, concepts, and techniques of science and engineering as they apply to the remote sensing of the Earth, oceans, atmosphere, and space, as well as the processing, interpretation and dissemination of this information.

These comments to the Commission Notice were prepared by the Frequency Allocations in Remote Sensing (FARS) Technical Committee of the IEEE GRSS and represent the point of view of IEEE GRSS. The FARS TC was formed in 2000 to serve as a liaison between the remote sensing community and the radio-frequency regulatory world by providing the remote sensing perspective and technical input to frequency regulators and also by assisting remote sensing scientists and engineers on spectrum management matters. The FARS Technical Committee fosters the exchange of information between researchers in different fields, such as remote sensing, radio astronomy, telecommunications, with the unifying goal of minimizing harmful interference between systems.

II. Background

Anthropogenic Radio-frequency interference (RFI) poses an urgent and growing global threat to the utility of passive microwave measurements used for meteorological applications such as numerical weather prediction, flood disaster preparedness, and climate science. Anthropogenic RFI sources threaten the utility of passive radiometric measurements performed by spaceborne microwave radiometers since it corrupts natural thermal emissions that must be remotely
sensed by the radiometer. These parameters are essential inputs to numerical weather prediction models used for weather forecasting. The presence of RFI can cause data loss and use of these measurements containing insidious RFI results in erroneous geophysical parameter retrievals.

It can be said that one person’s signal is another person’s noise. In the general cases of radio-communications, broadcast systems, and radar, the common objective is to detect and maximize known signals, and discard the noise. In passive radiometry the objective is exactly the opposite - discard and/or avoid anthropogenic signals and measure the natural thermal noise emitted by the Earth, which cannot be amplified at the source like man-made signals.

As the Commission solicits input on the candidate emission protection levels for services near the 23.6-24.0 GHz passive band, the FARS-TC would like to provide the following background information:

- Any levels of man-made emissions that are present within the 23.6 - 24.0 GHz spectrum, and that has radio frequency (RF) energy which moves in an upward direction towards space-based passive sensors, (as a result of signal reflections off the ground, or off terrain features or buildings), are likely to be detected by these sensitive radiometers in space, which are measuring a natural RF emission of the atmosphere. Many instruments have a sensitivity on the order of a few tenths of a Kelvin. This means the detected passive microwave signal is very weak and can be easily contaminated by radio frequency interference (RFI) from out-of-band emissions. RFI can create a positive bias and alter the extremely small natural fluctuations of the noise floor which is what the passive sensor is attempting to measure.

- The 23.6-24.0 GHz passive band is used to determine water vapor in the surface boundary layer and to determine the total value of water vapor, called total precipitable water (TPW) in a column across a specific volume of the atmosphere.

- High levels of TPW are indicators of severe weather and other phenomena. Forecasting of meteorological atmospheric rivers\(^1\), near specific coastal areas, depends heavily upon data from this passive band.

- These radiometers operate with different geometries which point at different angles toward the planet and do not strictly point straight down to the Earth, and they cover an area on the Earth measured in tens or hundreds of kilometers.

- Measurements are required worldwide (throughout the volume of the atmosphere) to obtain initial conditions for the global numerical weather prediction (NWP) models necessary for weather forecasting. **Passive microwave observations contribute around 40% of the overall improvement of short-range weather forecast accuracy, plus a further 10% from active microwave.\(^2\)**

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\(^1\) Atmospheric rivers are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. These columns of vapor move with the weather, carrying an amount of water vapor roughly equivalent to the average flow of water at the mouth of the Mississippi River. When the atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow.

• Measurements taken in one of the passive bands are typically combined with measurements in other passive bands in order to extract desired atmospheric parameters. Contamination of the 23.6-24.0 GHz passive band is likely to affect the results of combinations with other passive channel measurements.

Therefore,

a) the emission limit applied to adjacent services,

b) the methodology by which an equipment vendor determines compliance with such limits, and

c) how much that limit prevents unwanted emissions into the adjacent passive band are all important in determining the degree to which weather forecasting accuracy would be impacted.

III. Levels of Contamination

There are three levels of contamination to passive measurements as shown in the figure below: **Obvious, Insidious, and Undetectable.** The figure describes these three levels of RFI contamination and the impact that it has on passive sensing.

The goal of selecting the appropriate out of band emission limit is to avoid both insidious and obvious contamination within the 23.6-24.0 GHz passive band.

IV. Response

In answering the questions posed by the FCC, the following section of text provides the text of the release with the FCC’s comments and questions followed by the comments and/or responses of the IEEE GRSS.
On page 3 of its Public Notice DA 21-482, the Commission seeks “to understand what level of emissions can be expected within the 23.6 - 24 GHz band from UMFUS transmitters, and whether and to what extent harmful interference to passive systems operating in the 23.6 - 24 GHz band is expected to occur from new 5G deployments at the current UMFUS limit.”

The IEEE GRSS concurs with the Commission objective and looks forward to seeing the information that results from this proceeding.

Later on the same page 3, “Recognizing that the unwanted emission limits in Resolution 750 and the current out-of-band emission limits in the UMFUS rules are specified differently, and further recognizing the two-phased approach for the unwanted emissions limits that were adopted in WRC-19,”, the Commission seeks “information on whether and how equipment intended for use under the UMFUS rules in the 24.25-24.45 GHz and 24.75-25.25 GHz bands can be designed to conform to the Resolution 750 limits—both the current limits and the more restrictive limits that apply to new equipment brought into use after September 1, 2027.”

The IEEE GRSS is of the view that the guiding principle that the FCC should follow in making decisions of this nature is that the least amount of power possible from the transmitters considered should be allowed into the 23.6-24 GHz band. Therefore, whichever limit allows for less power to be emitted into the 23.6-24 GHz band should be adopted. The current UMFUS provisions allow for -13 dBm/MHz emission limit, which applies at the edge of the UMFUS band i.e. 24.25 GHz. However, in order to understand what amount of power would be transmitted into a 200 MHz band of the 23.6-24 GHz, it is necessary to have knowledge of the filter roll off characteristics of the UMFUS equipment deployed in the 24.25-25.25 GHz frequency range. We note that the current UMFUS regulations allow for [+75dBm/100 MHz peak emission] for base stations within that frequency range so that we might expect that the UMFUS equipment deployed would have filter characteristics that allow for that peak power as well meeting the band edge restriction. Therefore, the IEEE GRSS requests that the FCC delay making a decision on implementing the Resolution 750 limits or retaining the current UMFUS limits until such time when an evaluation of the equipment filter characteristics can be conducted in light of these two options. The IEEE GRSS notes that if the current UMFUS provisions prove to be more restrictive than the Resolution 750 limits and those current UMFUS limits are kept, then the U.S. would be in compliance with the Resolution 750 limits and the FCC would not need to take any further action to meet the Resolution 750 limits.

“Can licensees meet the WRC-19 TRP limits by the relevant deadlines? Is it possible that licensees can meet the –39 dBW limit for IMT base stations and the –35 dBW limit for IMT mobile stations prior to 2027? What steps, if any, can the Commission take to help accelerate the development and deployment of equipment that complies with the post -2027 limits?”

The IEEE GRSS notes that the European Union, in its Commission Implementing Decision (EU) 2020/590 of 24 April 2020, has set 1 January 2024 as the date in which the stricter power limits of -39 dBW/(200 MHz) for base stations and -35 dBW/(200 MHz) for terminal stations, thus indicating the feasibility for the European industry to meet the September 1 2027 deadline more than three years in advance of the date in the ITU Radio Regulations
It is in the best U.S. interest to enact the EU deadlines in order to avoid a situation in which U.S. manufacturers will be unable to sell non-compliant equipment to Europe while at the same time creating the situation where the U.S. market would become the recipient of excess non-compliant equipment that does not meet the stricter power limit requirements imposed by the EU. To that end, the Commission should have the stricter 2027 ITU limits come into force in 2024 and also put a three-year limit on the use of grandfathered equipment so that by 2027 all deployed equipment would comply with the 2027 ITU-R Res. 750 limits. This action by the Commission would motivate the US industry to accelerate the development and deployment of equipment that complies with the 2027 ITU-R Res. 750 limit and not lose ground to EU equipment manufacturers.

“If the Commission were to adopt the emission limits in Resolution 750 for the 24.25-27.5 GHz band, how should it determine to what stations these limits will apply? Should they only apply to systems that meet the definition of IMT as specified by the ITU? Should the rules apply to point-to-point and point-to-multipoint equipment licensed under the UMFUS? Should any mobile UMFUS equipment be required to comply with these unwanted emission limits regardless of the technology used, the application, and the density of deployment?”

Again, the IEEE GRSS is of the view that the guiding principle that the Commission should follow in making this decision is that the least amount of power possible from the terrestrial services should be allowed into the 23.6-24.0 GHz band. Recognizing that the two proposed limits are not specified in the same manner, the limit that best protects the 23.6-24.0 GHz passive band should be adopted. If the -39 dBW value from Resolution 750 is the lowest level and it provides the least contamination of the passive band, then the IEEE GRSS urges that it be adopted as soon as practical, perhaps similarly to the time frame selected by the European Union, which requires the -39 dBW/200 MHz value by January 1, 2024. Limits should apply to all UMFUS equipment, not just base and mobile stations.

The IEEE GRSS thanks the Commission for the opportunity to provide comments on these important matters. We look forward to the review of the responses of others and wish to continue our interaction in this important decision-making process.

V. Concluding Remarks

The IEEE GRSS thanks the Commission for the opportunity to provide comments on these important matters. We look forward to the review of the responses of others and wish to continue our interaction in this important decision-making process.

Respectfully submitted,

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