Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Emission Limits in the 24.25-27.5 GHz Band	))	ET Docket No. 21-186 GN Docket No. 14-177
	)	

**COMMENTS OF THE
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES**

The National Academy of Sciences, through its Committee on Radio Frequencies (hereinafter, CORF),[1] hereby submits its Comments in response to the Commission's April 26, 2021, *Public Notice* (DA 21-482) in the above-captioned docket ("*Public Notice*"). In these Comments, CORF discusses passive scientific use of the 23.6–24.0 GHz band, as well as the application of out-of-band emission ("OOBE") limits necessary to protect such uses.

I. Introduction: Earth Exploration-Satellite Service (EESS) and Radio Astronomy Service (RAS) at 24 GHz and the Unique Vulnerability of Passive Services to Interference.

CORF appreciates the Commission's recognition in the *Public Notice* of the critical importance of protecting the 23.6–24.0 GHz band, which is reserved for passive scientific use, from the neighboring 24.25–24.45 GHz and 24.75–25.25 GHz bands in the Upper Microwave Flexible Use Service ("UMFUS"). Such passive uses are described below.

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1 See the Appendix for the membership of the Committee on Radio Frequencies.

A. EESS/Earth Remote Sensing

The Commission has long recognized that satellite-based Earth remote sensing is a critical and uniquely valuable resource for monitoring aspects of the global atmosphere, oceans, land, and cryosphere. For certain applications, satellite-based microwave remote sensing represents the only practical method of obtaining atmospheric and surface data for the entire planet. The 23.6–24 GHz band is an essential component of this method. EESS data have made important contributions to the study of meteorology, atmospheric chemistry, climatology, and oceanography. Currently, instruments operating in the EESS bands provide regular and reliable quantitative atmospheric, oceanic, land, and cryospheric measurements to support a variety of scientific, commercial, and government (civil and military) data users. EESS satellites represent billions of dollars in investment and provide data for major governmental users, including the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), the Department of Defense (DoD), the Department of Agriculture, the U.S. Geological Survey, the Agency for International Development, the Federal Emergency Management Agency, and the U.S. Forest Service. These agencies use EESS data on issues impacting hundreds of billions of dollars in the U.S. economy, as well as the safety of life, national security, and scientific investigation.

Satellite remote sensing data are a key resource for accurate weather prediction. NOAA and its National Weather Service are major users of these data. NOAA has estimated that about *one-third of the U.S. economy*—some $3 trillion—is sensitive to weather and climate.[2] A recent NOAA report[3] estimated that weather forecasts generated $35 billion in annual economic benefits to U.S. households in 2016. NOAA has also stated that "NOAA weather forecasts and warnings are critical to people living in areas subject to severe weather, and to all Americans who depend on the economic vitality that these regions contribute. Accurate predictions of extreme weather location and severity are essential. Having time to prepare for extreme events limit their impact."[4]

Space-based measurements in the EESS bands are a critical part of the bedrock upon which state-of-the-art weather forecasting is founded. Measurements from each of the EESS bands are vital for forming a complete and unambiguous picture of the state of Earth's atmosphere, ocean, and surface. Individual bands considered in isolation not only do not provide the complete picture, they do not even provide a clear view of a specific part of that picture (e.g., surface temperature). Each band is affected to different degrees by the surface and by atmospheric water vapor, temperature, clouds, and precipitation, etc. Consequently, only with a full complement of reliable observations can the complete view be obtained. Thus, the inability to utilize a previously reliable EESS band greatly weakens the entire global observing system. The specifics of how interference in the 23.6–24 GHz band affects the overall observing system are described below. The complementary characteristics of each band are dictated by fundamental physics (e.g., positions and strengths of spectral lines for water vapor and oxygen) and the physical characteristics of phenomena to be observed, meaning that

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2 *See* "Weather," NOAA, https://www.noaa.gov/weather (last viewed April 29, 2021).
3 *See* "NOAA *by the* Numbers," June 2018, at page 8, https://www.performance.noaa.gov/economics/.
4 *See* "NOAA's Contribution to the Economy; Powering America's Economy and Protecting Americans," NOAA, 2018, at page 8, https://www.performance.noaa.gov/economics/.

one cannot simply choose to switch to a new band if another one is rendered unusable (in contrast with telecommunications or broadcasting services, which typically have a wide range of viable alternatives).

Remote sensing/EESS measurements in the 23.6–24.0 GHz band have different characteristics from different sources. These characteristics (see Figures 1 and 2) are exploited for multiple applications that are important for observing Earth's atmosphere, ocean, cryosphere, and land. Over oceans, this band is highly sensitive to the total atmospheric water vapor due to the low degree of surface emissions (which are a function of sea-surface temperature and surface roughness, the latter being driven by surface wind speed) and high atmospheric emission. Accordingly, oceanic measurements from multiple sensors in this band are routinely "assimilated" into the models used by weather forecasting centers, helping to continuously inform the models' depiction of atmospheric humidity. "Assimilation" in this context refers to the judicious correction of a model's estimate of the state of the atmosphere, surface, etc., in order to better match the observed signals.

By comparison, over land, the high surface emissivity (surface emission) dominates the atmospheric emission, and the sensitivity to total atmospheric water vapor is low. This changes the balance of information provided, such that over land, the 23.6–24.0 GHz signals are particularly sensitive to water vapor in the lowest ~1 km of the atmosphere—information that is unavailable from other EESS-passive bands. One study has shown that omitting 23.6–24.0 GHz information results in a greater than 20 percent degradation in the precision of water vapor estimates obtained over oceans and a greater than 12 percent degradation over land.[5] Given the nonlinear nature of weather systems, such differences can have outsized impacts on the accuracy of weather forecasts, with clear consequences for society. Accurate weather forecasts are critical for safety of life and many aspects of the economy. Early weather prediction can reduce costs of a natural disaster. Hitherto, assimilation of 23.6–24.0 GHz observations over land has been challenging. However, the state-of-the-art understanding of surface emissions, which complicate interpretation of these measurements, has evolved to the point where assimilation of over-land 23.6–24.0 GHz observations is now routinely employed by NOAA, with other agencies to follow.

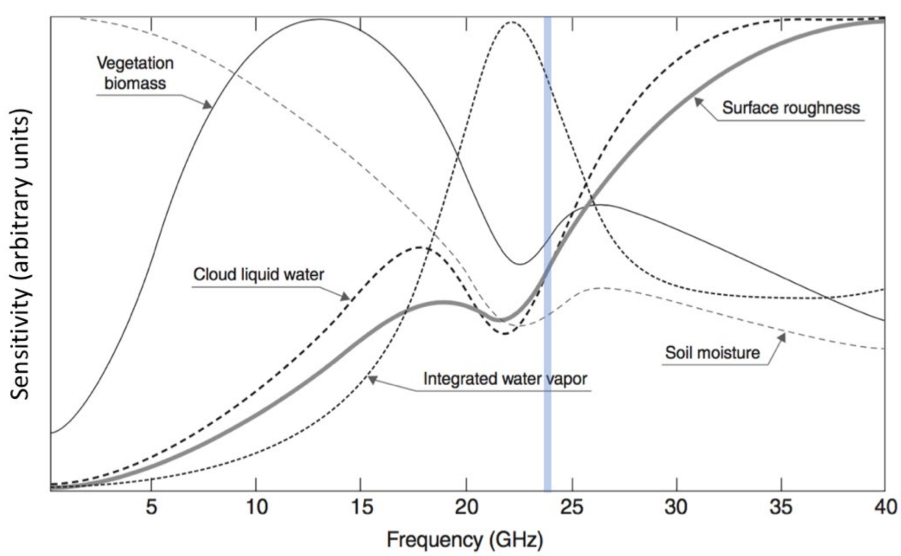

FIGURE 1 Relative sensitivity of brightness temperature to geophysical parameters over land surfaces as a function of frequency. The 23.6–24 GHz band is highlighted in blue. SOURCE: National Academies of Sciences, Engineering, and Medicine, *Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses: Second Edition*, The National Academies Press, Washington D.C., 2015. Page 55.

5 *See* Q. Liu, C. Cao, , C. Grassotti, and Y.K. Lee, "How Can Microwave Observations at 23.8 GHz Help in Acquiring Water Vapor in the Atmosphere over Land?" *Remote Sensing* 13(3): 489, 2021, https://doi.org/10.3390/rs13030489.

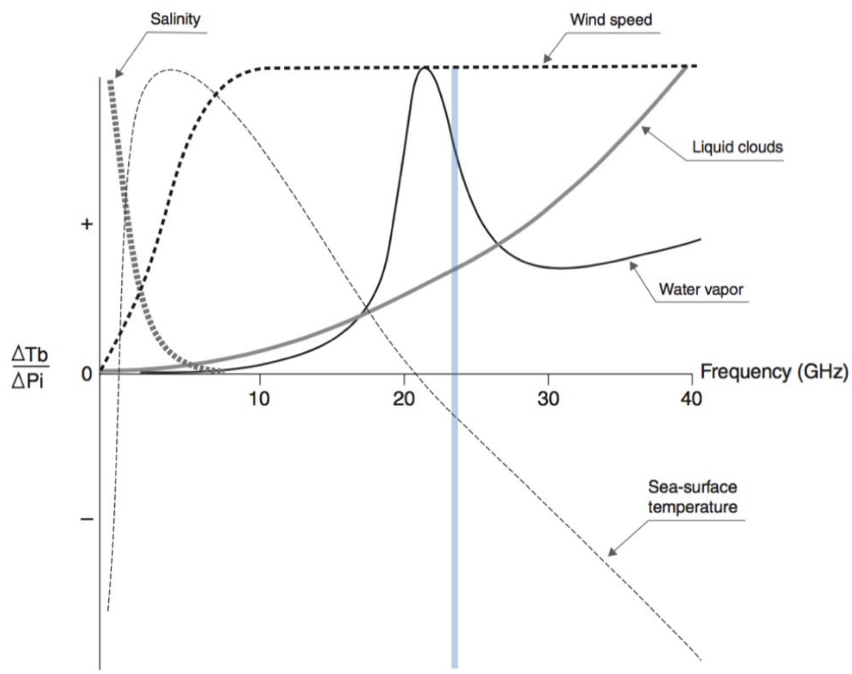

FIGURE 2 Relative sensitivity of brightness temperature to geophysical parameters over ocean as a function of frequency. The 23.6–24 GHz band is highlighted in blue. SOURCE: National Academies of Sciences, Engineering, and Medicine, *Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses: Second Edition*, The National Academies Press, Washington D.C., 2015. Page 55.

In addition to their use in data assimilation over oceans and land, the 23.6–24.0 GHz measurements are heavily used in weather forecasting over both land and oceans to aid interpretation of observations in other bands. Specifically, 23.6–24.0 GHz signals are used in combination with those from the 31.4 GHz and 36.5 GHz channels, which have strong sensitivity to cloud liquid water content, in order to identify the contributions from clouds. Accurate knowledge of these cloud contributions is needed for the robust assimilation of information from the 50–60 GHz oxygen absorption band that is the primary source of atmospheric temperature information in weather forecasting models, having the largest impact on forecast accuracy. A similar multichannel approach is used to retrieve ocean surface winds, sea-surface heights, significant wave heights, and ocean currents. For these applications, the 23.6–24.0 GHz band is a key source of data needed to remove the effects of clouds and total atmospheric water vapor. Thus, given the central role played by water vapor in all forms of extreme weather, from drought to hurricane, observations at 23.6–24.0 GHz are a core part of a robust observing system essential for societally critical weather forecasting.

Table 1 lists select current and planned EESS passive sensors observing in the 23.6–24.0 GHz band.[6] In addition to their centrality to operational meteorology, CORF notes that orbiting EESS (active) instruments using radar (in other bands) to measure sea-surface height and salinity typically include an EESS (passive) sensor in the 23.6–24.0 GHz band to measure total water vapor amount, which is needed to correct for the contribution of water vapor to the refraction-induced path delay in the radar signal.

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[6] Table 1 includes select satellites/instruments operated or to be operated by NASA, NOAA, and DoD, along with those from their European, Indian, and Japanese counterparts. Other countries operate additional satellites that observe data in the United States, which are important to weather forecasting and climate science. All of these microwave sensors are in a low Earth orbit (primarily polar), and any given satellite/sensor will, at best, provide global coverage twice per day. The goal is to have at least a 4–6 hour revisit time to observe the same point on Earth by a satellite observing the same or similar weather information. The current 4–6 hour revisit rate is achieved through the shared use of satellite observations provided by multiple space agencies. These observations are distributed as part of the WMO Integrated Global Observing System (WIGOS) that provides a framework for the integration and sharing of observational data from National Meteorological and Hydrological Services (NMHSs) and other sources. It also should be noted that weather is not stationary, and accurate weather forecasts depend on having global observations for accurate initialization of numerical weather forecast models.

TABLE 1 Select Satellites/Instruments for Observation at 23.6–24.0 GHz

Agency Satellite	Instrument	Band Center Frequency (GHz)	Bandwidth (MHz)
NASA GPM	GMI[a]	23.8	400
NASA JASON-3	AMR[b]	23.8	400
NOAA-15/18/19	AMSU-A[c]	23.8	270
NOAA SNPP, NOAA-20 (JPSS-1)	ATMS[d]	23.8	270
EUMETSAT Metop A, B, C	AMSU-A[e]	23.8	270
JAXA GCOM-W	AMSR-2[f]	23.8	400
CNES SARAL	Altika[g]	23.8	200
ESA Sentinel-3 A, B, *C, D*	MWR[h]	23.8	200
ESA Sentinel-6A "Michael Freilich," *6B*	AMR-C[i]	23.8	400
NOAA JPSS-2/3/4	*ATMS*[j]	*23.8*	*270*
NASA ISS COWVR	*COWVR*[k]	*23.8*	*475*
DMSP	*WSF-M*[l]	*23.8*	*370*
NASA SWOT	*MW radiometer*[m]	*23.8*	*400*
EUMETSAT Metop-SG-B1/B2/B3	*MWI*[n]	*23.8*	*400*
JAXA GOSAT GW	*AMSR-3*[o]	*23.8*	*400*

NOTE: Italics denote sensors yet to be launched.
[a] NASA, "GPM Microwave Imager (GMI)," https://gpm.nasa.gov/missions/GPM/GMI.
[b] NASA, "Jason 3: Instruments," https://podaac.jpl.nasa.gov/JASON3?tab=instruments.
[c] NOAA, "AMSU-A Brightness Temperature," https://www.ncdc.noaa.gov/cdr/fundamental/amsu-brightness-temperature.
[d] NASA, "JPSS-1 ATMS Level 1B Brightness Temperature Version 2 Data Release," https://disc.gsfc.nasa.gov.
[e] EUMETSAT, "ASMU-A," https://www.eumetsat.int/amsu-a.
[f] JAXA, "Global Change Observation Mission - Water "SHIZUKU" (GCOM-W)," https://global.jaxa.jp/projects/sat/gcom_w/.
[g] eoPortal Directory, "SARAL (Satellite with ARgos and ALtiKa)," https://earth.esa.int/web/eoportal/satellite-missions/s/saral.
[h] ESA, "MWR," https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-3-altimetry/instrument/mwr.
[i] Maiwald et al., "Completion of the AMR-C Instrument for Sentinel-6," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 13: 1811-1818, 2020, doi: 10.1109/JSTARS.2020.2991175.
[j] NOAA, "Advanced Technology Microwave Sounder (ATMS)," https://www.jpss.noaa.gov/atms.html.
[k] WMO, "COWVR," https://www.wmo-sat.info/oscar/instruments/view/cowvr.
[l] eoPortal Directory, "WSF-M," https://directory.eoportal.org/web/eoportal/satellite-missions/content/-/article/wsf-m.
[m] NASA, "SWOT Payload," https://swot.jpl.nasa.gov/resources/91/swot-payload/.
[n] EUMETSAT, "Microwave Imager," https://www.eumetsat.int/eps-sg-microwave-imager.
[o] WMO, "GOSAT GW," https://www.wmo-sat.info/oscar/satellites/view/gosat_gw.

B. Radio Astronomy

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. The critical scientific research undertaken by RAS observers, however, cannot be performed without access to interference-free bands. Notably, the emissions that radio astronomers receive are extremely weak—a radio telescope receives less than 1 percent of one-billionth of one-billionth of a watt (10^{-20} W) from a typical cosmic object. Because radio astronomy receivers are designed to pick up such remarkably weak signals, radio observatories are particularly vulnerable to interference from in-band emissions, spurious and out-of-band emissions (OOBEs) from licensed and unlicensed users of neighboring bands, and emissions that produce harmonic signals in the RAS bands, even if those human-made emissions are weak and distant.

CORF recognizes that the primary focus in the *Public Notice* is protecting EESS. Nevertheless, the RAS has a co-primary allocation at 23.6–24.0 GHz. Coexistence between EESS (passive) and RAS is assured, as both are passive services. This frequency band includes one of the most important sets of spectral lines, from ammonia at rest frequencies 23.694, 23.723, and 23.870 GHz, for the studies of how stars form.[7] This particular molecule is only excited in regions of relatively high density. It has recently been discovered that it traces long filaments of gas in molecular clouds created by supersonic shock waves. Stars and clusters of stars form at the intersections of these filaments. The details of how gas—at enhanced density at these intersections—undergoes gravitational collapse to form stars is being investigated intensively with

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[7] *See* ITU-R Recommendation RA.314 at Table 1.

these ammonia transitions. High-resolution images from instruments such as the Very Large Array, which can determine the precise spatial-velocity structure of the clouds, are leading to important advances in the precise mechanisms responsible for the formation of stars.

Radio astronomy continuum observations in the 23.6–24.0 GHz band are used to distinguish the spectral signature of cosmic sources that arise from synchrotron emission from high-energy electrons, free-free emission (bremsstrahlung), and thermal emission. Observations of the continuum intensity determine the characteristic spectra of sources using frequency bands spaced at intervals of about an octave. As designated in ITU-R Recommendation RA.314-10, the 23.6–24.0 GHz band is one of the preferred frequency bands for radio continuum observations. ITU-R Recommendation RA.314-10 also designates 23.61-23.71 GHz, 23.64-23.74 GHz, and 23.79-23.89 GHz as the suggested minimum bands for observations of the three ammonia lines.

II. Protection of Passive Services at 23.6-24.0 GHz.

As discussed above, important and extensive Earth remote sensing research (as well as radio astronomy) is performed with passive scientific instruments at 23.6–24.0 GHz. It is critical that such observations be protected as much as possible from harmful interference in the form of OOBEs from UMFUS operations. The low levels of atmospheric attenuation in this band (only 1 dB in the vertical direction in wet conditions,[8] less still for dry), which make the band useful for remote sounding of the

[8] 1 dB zenith absorption from sea level is computed using the ‘am’ code (https://doi.org/10.5281/zenodo.640645) for a tropical annual median atmosphere, derived from zonally-averaged NASA MERRA-2 reanalysis data. The zenith precipitable water vapor for this case is 40 mm.

lowermost region of the atmosphere and surface, dictate that particularly strong protection be implemented. Such protection, particularly for EESS/Remote Sensing, was the intent of the modification of Res. 750 at WRC-19 regarding 23.6–24.0 GHz.

It is important to note that the 23.6–24.0 GHz band is protected by RR 5.340, where "All emissions are prohibited…." Notwithstanding that, as a practical matter, the starting point for any consideration of interference into EESS passive bands is ITU-R Recommendation RS.2017, which establishes a –166 dBW in 200 MHz limit for the 23.6–24.0 GHz band, to be met over 99.99 percent of a 10,000,000 km² area. CORF notes that, per assessments by the World Meteorological Organization[9] (WMO) and others, the limits specified in ITU-R Resolution 750 (Rev. WRC-19), when applied to likely International Mobile Telecommunications (IMT) implementations, and taking into consideration typical characteristics of orbiting EESS sensors (described in ITU-R Recommendation RS.1861) fail to meet this criterion, particularly when considering the aggregate interference from the vast multiplicity of transmitters that are inherent to the nature of IMT deployments. In CORF's view, the OOBE limits recommended by others going into WRC-19, including the European Commission (–42 dBW in 200 MHz) or, further, those of the WMO (–54 dBW in 200 MHz), are more in line with the degree of OOBE attenuation required to meet the ITU-R Recommendation RS.2017 interference thresholds.[10]

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[9] *See* Study B (and its associated annexes 1 and 2) in Part 2 of Annex 3 of the "Chairman's Report for WRC-19 Task Group 5/1, document CPM19-1/478-E, available from the ITU website (www.itu.int) for registered users.

[10] The mismatch is likely greater for proper protection of RAS, for which more stringent interference thresholds are specified in ITU-R RA.769.

At page 3 of the *Public Notice*, comments are sought on the manner of modifying the Commission's rules in response to the unwanted emission limits and international allocation table footnotes adopted for the 24.25–27.5 GHz band at the WRC-19. The Notice states that "[t]hese rule changes could include, for example, adding footnotes to the United States Table of Frequency Allocations or aligning the Commission's technical rules." CORF urges the Commission to enact changes to the OOBE standard in the Part 30 UMFUS rules, regardless of whether or not corresponding footnotes to the Table of Frequency Allocations are enacted. As part of the Code of Federal Regulations, such footnotes have the status of law, yet given the importance of implementation and compliance with OOBE standards, such standards should be specifically stated in the Part 30 UMFUS rules. Indeed, the current standards for UMFUS emission limits are stated inside the Part 30 UMFUS rules,[11] and placement of an updated more stringent standard elsewhere in the Commission's rules could only lead to confusion and non-compliance. CORF urges the Commission to update the Part 30 rules specifically to include the revised UMFUS OOBE limit and look skeptically at any rationale given for <u>not</u> doing so.

At page 4, the *Public Notice* states that UMFUS rules allow licensees flexibility to deploy mobile services as well as fixed point-to-point and point-to-multipoint systems. The *Notice* goes on to state that the "unwanted emission limits of Resolution 750 apply only to IMT base stations and mobile stations" and that the "Commission's rules do not define IMT…." The *Notice* then goes on to ask that if "the Commission were to adopt the emission limits in Resolution 750 for the 24.25–27.5 GHz band, how should it determine

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[11] 47 CFR §§ 30.203(a) and 30.404(a).

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?" In response, CORF urges the Commission to support the broad purpose of OOBE standards generally, and Res. 750 specifically, in this proceeding. The broad purpose is to protect passive services from OOBE. It is of limited value to protect passive uses from OOBE from mobile service equipment, but not from equipment used for UMFUS fixed services. Accordingly, CORF recommends that a consistent OOBE standard apply to all UMFUS equipment operating at 24 GHz: mobile and base stations (regardless of whether they meet the definition of IMT), as well as UMFUS fixed point-to-point and point-to-multipoint equipment.

CORF recognizes that in Footnote 20, the *Notice* states that "Commission licensees and Federal agencies have deployed nearly 40,000 point-to-point microwave links in the 21.2–23.6 GHz band immediately adjacent to the 23.6–24 GHz passive band that operate with the same unwanted emission limits that apply under the UMFUS rules. There is no indication these point-to-point links have caused harmful interference to passive sensors in 23.6–24 GHz." CORF cannot verify whether or not these point-to-point links have caused harmful interference to passive sensors at 23.6–24.0 GHz. Strong interference corrupts observations in clearly recognizable ways, and affected data can be excised, but only at the cost of reducing the number of available measurements for both the EESS and RAS. Weak levels of interference, on the other hand (such as may have resulted from the potentially 40,000 sources cited in the *Public Notice*), result in EESS observations that, while not discernibly corrupted, are sufficiently impacted that they provide incorrect information to weather forecasting systems, undermining the reliability and value of their predictions. Given the hopes of both the Commission and industry for the widespread use of UMFUS equipment to provide 5G services, there likely will be a very large difference between the impact of 40,000 existing point-to-point links spread across the United States and potentially millions of UMFUS devices. Furthermore, the fact that fixed UMFUS operations will not be individually licensed distinguishes them from the individually licensed status of most links in the fixed microwave services, and will make the remediation of interference from the UMFUS operations difficult, if not impossible.

As noted above, CORF asserts that standards such as the –54 dBW in 200 MHz advocated by the WMO should have been adopted in Res. 750 for IMT base stations, particularly given the aggregate interference from numerous devices within the footprint of an EESS sensor. At very least, however, going forward the OOBE standard for fixed UMFUS operations should be no less stringent than that established in Res. 750 for IMT base stations.

Given the significant differences between the nature of the services and the equipment used, there can be significant differences between the methods for protection of radio astronomy and Earth remote sensing. Depending on the mission, remote sensing may need to observe very large geographic areas; whereas radio astronomy uses a limited number of observatories in specific geographic locations. One method for protection of radio astronomy involves geographic requirements to place minimum distances between active transmitters and radio astronomy facilities, through use of protection zones[12] and quiet zones or coordination zones.[13]

Currently, U.S.-based RAS facilities observing at 23.6–24.0 GHz include the Green Bank Observatory in West Virginia, the Haystack Observatory in Massachusetts, the Very Large Array near Socorro, New Mexico, and the 10 stations of the Very Long Baseline Array. In the longer term, the Next Generation Very Large Array will also be capable of observations in this band.[14]

In considering proper separation distances for UMFUS mobile and fixed stations from protected radio astronomy observatories, CORF uses the limit from Table 1 of ITU-R Recommendation RA.769 of –233 dBW/(m² Hz) in the following analysis. Atmospheric attenuation must also be accounted for. While the U.S. standard atmosphere model is used for many compatibility studies, radio astronomy facilities are typically located in high, dry sites, and observations are conducted during the best atmospheric conditions in order to detect faint cosmic sources. Using the methods described in ITU-R Recommendation P.676-12 and analysis of MERRA-2 data to determine atmospheric characteristics,[15] typical atmospheric conditions for the Very Large Array result in horizontal attenuation of A=0.07 dB/km at this frequency band. Adoption of A=0.07 dB/km and the OOBE limits of Resolution 750 (Rev. WRC-19)

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[12] *See, e.g.,* Section 25.213(a) of the Commission's rules.

[13] *See, e.g.,* Section 1.924(a) of the Commission's rules (NRAO Quiet Zone), Section 1.924(d) of the Commission's rules (Puerto Rico Notification/Coordination Zone). *See also* Section 2.106 of the Commission's rules at Footnote US161 (coordination of 81-86 GHz, 92-94 GHz, and 94.1-95 GHz fixed links with radio astronomy stations, using specific distances or completion of the coordination procedure utilizing an automated mechanism, per Section 101.1523 of the rules).

[14] *See* http://ngvla.nrao.edu/image/ngvla-main-array. The main array of the ngVLA will have 214 antennas, primarily in New Mexico and Texas.

[15] *See* R. Gelaro et al., "The Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2)", *Journal of Climate* 30(14): 5419–5454, 2017, doi:10.1175/JCLI-D-16-0758.1.

results in separation distances of 60–70 km for fixed and mobile stations, respectively, to achieve ITU-R Recommendation RA.769 levels for a single isotropic emitter.[16] Thus, at the minimum, if more stringent OOBE limits are not imposed, coordination zones for fixed base stations within 60 km of radio astronomy observatories that operate at 23.6–24.0 GHz must be implemented to protect radio astronomy observations from harmful interference.[17] Further, mobile units should be excluded within a radius of 70 km from these facilities. Coordination should be arranged through NSF's Electromagnetic Spectrum Management Unit (esm@nsf.gov).

III. Conclusion.

CORF appreciates the Commission's recognition in the *Public Notice* of the critical importance of protecting the 23.6–24.0 GHz band, which is reserved for passive scientific use, from OOBE of UMFUS operations at 24.25–24.45 GHz and 24.75–25.25 GHz. The Commission should use the information provided herein to enact such OOBE protections.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

By: Marcia McNutt
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[16] While this *Public Notice* does not raise the issue, CORF notes that the FCC has the option to adopt more stringent limits than that currently stated in ITU-R Resolution 750 (Rev. WRC-19). A reduction in OOBE limits to −42 dBW in 200 MHz would significantly reduce the required separation distances between RAS facilities and both mobile and IMT base stations. Please note that the above analysis is for a single transmitter with isotropic radiation. Multiple transmitters, and transmitters with beams directed toward a radio astronomy facility, will increase the radio frequency interference received at the telescope and thus will require even greater separation distances.

[17] *Cf.* Section 30.205 of the Commission's rules for similar UMFUS geographic coordination requirements.

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