Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules	)	ET Docket No. 98-237
With Regard to the 3650-3700 MHz	)	RM-9411
Government Transfer Band	)	
	)	
The 4.9 GHz Band Transferred from	)	WT Docket No. 00-32
Federal Government Use	)	

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

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies[1] (hereinafter, "CORF"), hereby submits its comments[2] in response to the Commission's October 24, 2000, Notice of Proposed Rulemaking in the above-captioned docket ("NPRM"). In these Comments, CORF expresses concern about the potential impact of mobile service operations in the 4940-4990 MHz ("4.9 GHz") band on the Radio Astronomy Service (RAS) and the Earth Exploration-Satellite Service (EESS). Accordingly, the license areas for mobile operations for the newly allocated 4.9 GHz band should be adjusted to take into account nearby radio astronomy observatories, as was proposed in the February 29, 2000, Notice of Proposed Rulemaking

[1] The CORF membership is listed in the appendix.

[2] CORF hereby moves for leave to file these Comments after the filing deadline. CORF believes this late filing will not prejudice any parties, since there is still significant time for such parties to review and comment on the matters set forth herein. Most importantly, CORF believes that these Comments contain significant and substantial information that will contribute to reasoned decision making in this proceeding.

in WT Docket No. 00-32 ("February Notice"). In addition, fixed 4.9 GHz operations should coordinate with affected radio astronomy observatories. In regard to EESS protection, radiation levels consistent with ITU-R Recommendation SA.1029 must be maintained. Lastly, CORF provides updated information on radio astronomy observatories for the new footnote US311 proposed in the February Notice.

I. INTRODUCTION: THE IMPORTANCE OF RADIO ASTRONOMY SERVICE AND EARTH EXPLORATION SATELLITE SERVICE OBSERVATIONS IN THE 4.9 GHz BAND, AND THE UNIQUE VULNERABILITY OF PASSIVE SERVICES TO OUT-OF-BAND AND SPURIOUS EMISSIONS.

CORF has a substantial interest in this proceeding because it represents the interests of the scientific users of the radio spectrum, especially RAS and EESS users. Both RAS and EESS users perform extremely important, yet vulnerable, research.

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. Through the use of radio astronomy, scientists have in recent years discovered the first planets outside the solar system, circling a distant pulsar. Measurements of radio spectral-line emission have identified and characterized the birth sites of stars in our galaxy and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered ripples in the cosmic microwave background, generated in the early universe, which later formed the stars and galaxies we know today. Observations of supernovas have witnessed the creation and distribution of heavy elements essential to the formation of planets like Earth and of life itself.

The EESS represents both a critical and a unique resource for monitoring the state of the global atmosphere and surface, both operationally and experimentally. The techniques of passive and active satellite-based microwave remote sensing represent the only practical means of obtaining uniform-quality atmospheric and surface data encompassing the most remote oceans as well as densely populated areas of Earth. EESS data have contributed substantially to the study of meteorology, atmospheric chemistry, oceanography, and global change. Currently, instruments operating in the EESS bands provide regular and reliable quantitative atmospheric, oceanic, and land measurements to support an extensive variety of scientific, commercial, and government (civil and military) data users. Applications of the data include aviation forecasts, hurricane and severe storm warning and tracking, seasonal and interannual climate forecasts, decadal-scale monitoring of climate variability, medium-range forecasting, and studies of the ocean surface and internal structure, as well as many others. These current benefits of scientific research, obtained through years of work and substantial federal investment, as well as future benefits, must be protected.

The emissions that radio astronomers review are extremely weak—a typical radio telescope receives only about one-trillionth of a watt from even the strongest cosmic source. Because radio astronomy receivers are designed to pick up such remarkably weak signals, such facilities are particularly vulnerable to interference from spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands and from those that produce harmonic emissions that fall into the RAS bands. Similarly, the emissions received by passive EESS radiometers in Earth orbit are weak by comparison with emissions from other services.

Of particular concern in this proceeding is protection of RAS and EESS observations in the 4.9 GHz band. The February Notice (paras. 13-15) properly noted the footnote protection given to the RAS, the EESS, and the Space Research Service in this band. This band is important to passive scientific observations. For example, as set forth in the February Notice, radio astronomy observations in the 4.9 GHz band are extremely useful in studying the brightness distributions of galactic and extragalactic objects such as ionized hydrogen clouds and supernova remnants. Such observations allow scientists to construct detailed maps of such phenomena, to understand their structures and dynamics, and to derive physical parameters from the sources, such as their total masses. It is also crucial to have completely uncontaminated bands at approximately octave intervals to characterize the emission from a number of important physical processes, both in astronomy and in remote sensing. The 4.9 GHz band is important for this use because it is about an octave interval from the passive bands available for scientific use at 2690-2700 MHz and 10680-10700 MHz. Contamination of the 4.9 GHz band would be a serious loss of the octave interval data. The 4.9 GHz band is heavily used for very long baseline interferometry (VLBI), a technique that allows extremely high-resolution images of cosmic objects to be made. The 4.9 GHz band, for example, was used by the international VSOP/HALCA space-ground VLBI mission.

The 4.9 GHz band is useful for sensing ocean surface salinity using microwave radiometers. This band is also used for remote sensing of other ocean and land surface parameters including sea surface temperature and soil moisture. In addition, the use of the 4.9 GHz band by a non-U.S. EESS spaceborne sensor is expected to begin shortly.

U.S. airborne scientific radiometers also employ this band to perform research over oceans and land.

A high density of mobile stations with low-gain antennas emitting substantial radiation in the upward direction could compromise remote sensing measurements in those areas by creating electromagnetic "hot spots," which would mask the natural emissions from the surface and atmosphere. Thus, to protect the EESS use of the 4.9 GHz band, radiation levels consistent with ITU-R Recommendation SA.1029 must be maintained.

II. CORF RECOMMENDS TAKING STEPS TO LIMIT THE IMPACT ON RADIO ASTRONOMY OBSERVATIONS FROM USERS IN THE 4.9 GHz BAND.

In the February Notice, the Commission proposed allocating the 4.9 GHz band to fixed, land mobile, and maritime mobile services. However, the Commission recognized the importance of the 4.9 GHz band to radio astronomy and the importance of U.S. and international footnotes that protect radio astronomy in that band. Accordingly, the February Notice proposed to prohibit aeronautical mobile uses in the 4.9 GHz band and to replace footnote US257 with a revised and updated footnote US311 that would require the Commission to make every practicable effort to avoid the assignment of 4.9 GHz frequencies to fixed and mobile services that could interfere with radio astronomy observations at certain radio astronomy observatories specified in the footnote. CORF supported this approach in its Comments on the February Notice.

While CORF did not oppose the allocation to terrestrial and maritime mobile services in the 4.9 GHz band in its earlier comments, it remains concerned about the

potential harmful impact on radio astronomy from ubiquitous land mobile transmissions in the 4.9 GHz band. While land mobile and fixed services are at low elevation angles relative to the horizon, thus placing their positions outside the main antenna lobes of the radio telescopes operating in the 4.94-4.99 GHz band and the adjacent 4.9-5.0 GHz band, the intensity of their radiation will create significant interference when coupled into the radio telescope antennas via 0 dBi sidelobes. As discussed in ITU-R Recommendation RA.769, the flux density that creates significant interference when coupled into a 0 dBi sidelobe of a radio telescope operating at 4.9 GHz is -240 dB ($W/m^2/Hz$). Because a fixed or mobile unit operating in the 4940-4990 MHz band at the 20 watt EIRP power level specified in Part 27.50 of FCC Rules will create a flux density in excess of -170 dB ($W/m^2/Hz$), even when located 10 kilometers from the radio telescope, the need for coordination and protection is critical. Note that in the same scenario, out-of-band emissions from the fixed or mobile unit could also cause damaging interference in the adjacent 4.99-5.0 GHz band assigned to radio astronomy as an exclusive primary allocation.

In order to limit the potentially harmful interference from mobile services in the 4.9 GHz band, CORF recommends that pursuant to the proposal in paragraph 44 of the February Notice, the Commission should adjust the licensing areas of 4.9 GHz licenses to take into account nearby radio astronomy observatories. CORF recommends that the 4.9 GHz mobile license areas explicitly exclude the geographic areas set forth in proposed footnote US311 (with the modifications of that footnote suggested below). Such an approach would be the best way to fulfill the requirements of proposed footnote US311 (and current footnote US257), in that it would be the most practicable way of

avoiding assignment of frequencies in the 4.9 GHz band to mobile stations that could interfere with radio astronomy observations.

The NPRM also seeks comments on the proposal to pair the 4.9 GHz band with a permitted mobile base operation in the 3650-3700 MHz ("3.6 GHz") band. By linking the 3.6 and 4.9 GHz allocations, the Commission would increase the likelihood of interference to radio astronomy observations from mobile transmitters in the 4.9 GHz band. The Commission, however, has seen that through the use of innovative technologies such as time-division duplexing ("TDD"), such linkage may not be necessary. Thus, if the Commission does not exclude from 4.9 GHz mobile license areas the geographic areas set forth in proposed footnote US311, then it should avoid linking the 3.6 and 4.9 GHz bands, in order to reduce interference to radio astronomy facilities, and to stimulate new technologies such as TDD.[3]

III. PROPOSED ADDITIONS TO FOOTNOTE US311.

As is noted above, the February Notice proposed to replace footnote US257 with a revised and updated footnote US311 that would require the Commission to make every practicable effort to avoid the assignment of 1350-1400 MHz and 4.9 GHz frequencies in

[3] While CORF is primarily concerned with interference from mobile transmitters in the 4.9 GHz band, fixed transmitters present significant concerns as well. While CORF does not suggest the exclusion of 4.9 GHz fixed transmitters from the geographic zones defined in footnote US311, it does recommend that the Commission's rules provide that such fixed facilities coordinate with affected radio astronomy facilities prior to filing applications, in a manner similar to that specified in the provisions of Section 1.924(a) and (d) of the Commission's Rules.

the fixed and mobile services, which could interfere with radio astronomy observations at certain radio astronomy observatories specified in the footnote. CORF supported this approach in its Comments on the February Notice.[4] However, subsequent to the filing of Comments responsive to the February Notice, CORF has learned that two other major radio astronomy facilities will soon be making regular observations in the 4.9 GHz band, and thus will need protection: the NASA facilities at Goldstone, California, and the University of California facilities at Hat Creek, California. The NASA facilities at Goldstone currently receive protection under FCC rules and footnotes to the U.S. Table of Allocations. *See,* e.g., footnotes US251, US262, and US338. Similarly, radio astronomy facilities at the Hat Creek location currently receive substantial protection under the FCC's Rules. *See,* e.g., footnotes US203 and US257. Hat Creek was not originally included in the National Science Foundation proposal for an updated US311, because Hat Creek is not a federal facility. In fact, the Allen Telescope Array (ATA) at Hat Creek, a joint project of the University of California at Berkeley and the SETI Institute, is a privately funded facility with $26 million in committed funding. The ATA is designed

[4] In its previous comments, CORF proposed that two other radio astronomy observatories be added to the list in that footnote: the Woodbury Research Facility and the Morehead Radio Telescope. In retrospect, however, CORF now believes that it would be better policy not to add those facilities to those listed in footnote US311. While observations are made at those facilities in the 4.9 GHz band, those two facilities are primarily teaching rather than research facilities, and the added protection from US311 is thus not as critical for Woodbury and Morehead, as for the other facilities in US311. Thus, CORF withdraws the proposal to add the Woodbury and Morehead facilities to US311. In contrast, Goldstone and Hat Creek are not teaching facilities, but are primary research facilities.

for both SETI and astronomical research. For example, it will be the most powerful radio telescope for studies of early star formation, with nearly 10,000 square meters of collecting area that will make possible many high-spatial-resolution measurements in the 4.94-5.0 GHz band.

Accordingly, the following should be added to proposed footnote US311:

Goldstone, CA	Latitude 35° 18′ N Longitude 116° 54′ W
Hat Creek, CA	Latitude 40° 49′ N Longitude 121° 28′ W

IV. CONCLUSION.

CORF is concerned about the potential impact of operations in the 4.9 GHz band on RAS and EESS observations. Accordingly, the license areas for 4.9 GHz band mobile operations should be adjusted to take into account nearby radio astronomy observatories, as was proposed in the February Notice, and fixed operations should coordinate with affected radio astronomy observatories. To protect EESS use, radiation levels consistent with ITU-R Recommendation SA.1029 must be maintained. In addition, CORF does not support pairing the 3.6 GHz band with the 4.9 GHz band. Lastly, footnote US311 should be modified with the updated information provided above.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

By: --signed--
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