Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
The 4.9 GHz Band Transferred from Federal Government Use	)	WT Docket No. 00-32
	)	

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 (hereinafter, CORF),[1] hereby submits its comments in response to the Commission's February 27, 2002, Further Notice of Proposed Rulemaking in the above-captioned docket (FNPRM).[2] In these Comments, CORF reaffirms its concern about the potential impact of operations in the 4940–4990 MHz (4.9 GHz) band on radio astronomy observations. Accordingly, rules for operation of such facilities should provide reasonable protection to radio astronomy observations.

I. Introduction: The Importance of RAS Observations in the 4.9 GHz Band and the Unique Vulnerability of Passive Services to Out-of-Band and Spurious Emissions.

Because it represents the interests of the scientific users of the radio spectrum, including users of the Radio Astronomy Service (RAS), CORF has a substantial interest in this proceeding. Radio astronomers perform extremely important, yet vulnerable research.[3]

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. Using radio frequency observations, scientists have recently discovered

[1] A roster of the committee membership is attached.
[2] That document also contained a Second Report and Order (2nd R&O) in this proceeding.
[3] As noted in previous CORF comments in this proceeding, the 4.9 GHz band is also an important source for observations in the Earth Exploration Satellite Service (EESS). However, these comments will address the Commission's request for information on protecting RAS observations.

the first planets outside the solar system, circling a distant pulsar. Measurements of radio spectral line emissions have identified and characterized the birth sites of stars in our own 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. Many of these elements are detected within dense galactic gas clouds in the form of prebiotic molecules.

As passive users of the spectrum, radio astronomers have no control over the frequencies that they must observe or over the character of the transmitted cosmic signal. These parameters are set by the laws of nature. Furthermore, 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, they are particularly vulnerable to interference from spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands and those users that produce harmonic emissions that fall into the RAS bands.

Of particular concern in this proceeding is protection of RAS observations in the 4.9 GHz band. The 2nd R&O properly noted the Footnote protection given to the RAS in this band, as well as the fact that the Department of Commerce had recommended continued protection of the RAS in this band as a condition of reallocation.[4] CORF is similarly concerned about out-of-band and spurious emissions in the protected RAS band at 4990–5000 MHz. The need for protection in these bands is quite valid. For example, radio astronomy observations in the 4.9 GHz band are extremely useful in studying the brightness distributions of objects such as ionized hydrogen clouds surrounding young stars; remnants of supernovas, which mark the cataclysmic end of stars; and ejecta traveling near the speed of light from

[4] 2nd R&O at para. 8.

black holes in the nuclei of galaxies. 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. Observations of the radio emissions from a source such as a neutron star or a black hole are particularly vulnerable to interference because of the object's intrinsic variability; researchers cannot re-observe such a transient phenomenon at a later time.

The current benefits of such scientific research, obtained through years of work and substantial federal investment, as well as the future benefits, must be protected.

II. CORF Recommends Taking Steps to Limit the Impact on Radio Astronomy Observations from Transmissions in the 4.9 GHz Band.

CORF recognizes the important work performed by public safety agencies and the role that the 4.9 GHz band might play in facilitating that work. Nevertheless, CORF is pleased that the Commission, in crafting licensing and operational rules for the new 4.9 GHz service, has recognized in the FNPRM the need to protect passive use of the 4.9 GHz band for important scientific observations.

In paragraph 45 of the FNPRM, the Commission asks whether any licensing approaches would best implement "the Commission's obligations with respect to radio astronomy stations under Footnote US311. . .." That footnote states that the Commission is to make "[e]very practicable effort to. . . avoid the assignment of frequencies. . . [at] 4950–4990 MHz to stations in the fixed and mobile services that could interfere with radio astronomy observations within the geographic areas" set forth in a table in the footnote.[5]

As the Commission acknowledges in paragraph 13 of the 2nd R&O, CORF previously suggested in this proceeding that in order to best protect radio astronomy observations, as required in Footnote US311, fixed stations within the geographic areas designated in that footnote should be required to coordinate their operations with observatories, while mobile operations should be prohibited in those

[5] See 2nd R&O at p. 40.

zones. CORF still believes that this is the best approach. The Commission rejected those suggestions in paragraph 17 of the 2nd R&O on the premise that owing to the remote location of the observatories listed in Footnote US311, it is unlikely that public safety operations will occur in the vicinity of those observatories, and that any such operations would probably be short term. CORF remains concerned that a number of the listed observatories are in fact near urban areas, including the National Astronomy and Ionosphere Center in Arecibo, Puerto Rico (only 65 kilometers from San Juan), and the Haystack Observatory (40 kilometers from Boston).

The Commission seeks comments on a number of issues involving technical standards and power limits. In paragraph 66, a 1-watt transmitter with a 20-dB gain antenna is mentioned as a possible standard. Assuming a bandwidth of 10 MHz for video transmission, and using a standard ground propagation model (ITU-R P.1546), CORF estimates that a transmitter with such specifications will produce a signal level of –196 dB ($W/m^2/Hz$) at a distance of 10 kilometers and –216 dB at a distance of 80 kilometers. These levels are 45 and 25 dB, respectively, above the level of detrimental interference for RAS use in the shared band under ITU-R RA.769. CORF is concerned that such a power level would cause detrimental interference to radio astronomy observations. Accordingly, if such a power level is to be permitted, then CORF would recommend that the Commission reconsider the use of coordination zones for fixed transmitters and the exclusion of mobile transmitters within such zones, as previously recommended by CORF. If the Commission remains opposed to coordination zones, another approach could be a requirement that fixed and mobile users notify the applicable observatory of the use of 4.9 GHz operations a reasonable amount of time prior to the commencement of operations. Prior notification would not generate the same time and expense burdens as coordination, yet it would at least alert the scientific observers to the location and schedule of nearby users of the band, which could help the observers explain any unusual data in their observations resulting from interference from other 4.9 GHz

band users.[6]

Because it recognizes, in paragraph 62 of the FNPRM, that the RAS is the primary allocation in the 4990–5000 MHz band, the Commission seeks comments on what restrictions may be needed on new users of the 4.9 GHz band in order to protect the RAS observations adjacent to the frequencies allocated in this proceeding. CORF is pleased that the Commission recognizes the substantial potential impact of out-of-band and spurious emissions on passive scientific users. ITU Recommendation RA.769 establishes a level of detrimental interference in this 4.9 GHz band as –241 dB ($W/m^2/Hz$). Using the example discussed above, a 10 MHz, 1-watt, 20-dB gain transmitter, with the transmitter mounted on a 10-meter fixed tower at a distance of 80 kilometers from a radio astronomy observatory, spurious and out-of-band emissions must be suppressed by 85 dB. CORF therefore recommends assignment of the frequencies in the lower portion of the 4940–4990 MHz band to users in the zones around observatory sites listed in Footnote US311. Furthermore, in regards to the Commission's inquiry as to whether the emission mask in Section 101.111 of the Commission's rules should be used in the new 4.9 GHz service, CORF is concerned that much of this rule section was originally designed to control out-of-band and spurious emissions where the adjacent band was not occupied by a sensitive passive service. In this case, the sensitivity of the RAS band immediately above the newly allocated 4.9 GHz band requires tighter standards. At the very least, the 80 dB standard used in Section 101.111(a)(3) for transmitters in the Digital Electronic Messaging Service should be used in this case as well.

In paragraph 68 of the FNPRM, the Commission proposes an Effective Isotropic Radiated Power (EIRP) limit of 55 dBW for fixed transmitters. However, it should be noted that the 55 dBW limit on EIRP dates to a time when microwave receiver performance was far worse than it is today. For example,

[6] Updated contact information for each of the observatories listed in Footnote US311 will be forwarded to the Commission as soon as possible. CORF recognizes that it may not be appropriate to require prior notification by public safety users when such usage is triggered by an emergency such as a fire, natural disaster, crime, or other imminent threat to public safety. In such cases, notification to the observatory after the emergency use would be adequate.

the Bell Service standard for fixed-service microwave towers in the 4 and 6 GHz bands was only 47 dBW in the 1960s. Given the receiver technologies currently available, CORF recommends an EIRP limit of 47 dBW. Past use suggests that this limit is sufficient to provide reliable fixed service, even under extreme conditions, while providing greater protection to the spectral neighbors of users of the new 4.9 GHz service. For similar reasons, CORF also supports the Commission's proposal to require Automatic Transmitter Power Control (ATPC). The use of ATPC will significantly help reduce the power transmitted for the vast majority of transmitters employed in this service.

III. Conclusion.

CORF remains concerned about the potential impact of operations in the 4.9 GHz band on radio astronomy observations. Accordingly, rules for the operation of such facilities should provide reasonable protection for radio astronomy observations, as set forth above.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

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