Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
The Establishment of Policies	)	IB Docket No. 99-81
and Service Rules for the Mobile	)	RM-9328
Satellite Service in the 2 GHz Band	)	

COMMENTS OF THE
NATIONAL ACADEMIES'
COMMITTEE ON RADIO FREQUENCIES

The National Academies, through the National Research Council's Committee on Radio Frequencies (hereinafter, CORF; membership list attached), hereby submits its comments in response to the Commission's March 25, 1999, Notice of Proposed Rulemaking (NPRM) in the above-captioned docket. In these Comments, CORF expresses concern about interference from out-of-band emissions created by proposed feeder downlinks in the lower Ku band (10.7-11.7 GHz) into important observations made by scientific users of the 10.6-10.7 GHz bands where the Earth Exploration-Satellite Service (EESS) and Radio Astronomy Service (RAS) have primary allocations. Accordingly, if the Commission decides to designate the lower Ku band for feeder downlinks, it must require that downlink transmissions protect RAS and EESS observations at the level required under International Telecommunication Union Radio Sector (ITU-R) Recommendation RA.769-1, as was proposed by the Commission under similar circumstances in ET Docket 98-206. In addition, the Commission should also modify Part 25 of its rules to provide for a stringent filtering requirement to assure that these levels are met. Such proposed modifications are necessary if RAS and EESS observations in this band are to be protected in a meaningful manner.

I. Introduction: The Importance of RAS and EESS Observations in the 10.6-10.7 GHz Band, and the Unique Vulnerability of Passive Services to Out-of-Band and Spurious Emissions.

CORF has a substantial interest in this proceeding, as it represents the interests of the scientific users of the radio spectrum, including users of the RAS and EESS bands. Both RAS and EESS observers 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 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 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.

The EESS represents both a critical and unique resource for monitoring the global atmospheric and surface state operationally and experimentally. Both passive and active satellite-based microwave remote sensing represents the only practical methods of obtaining uniform-quality atmospheric and surface data encompassing the most remote oceans as well as densely populated areas of Earth. In the most general terms EESS data has contributed substantially to the study of meteorology, atmospheric chemistry, oceanography, and global change. Currently, instruments operating under the EESS 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, studies of the ocean surface and internal structure, as well as many others.

These benefits of scientific research using the RAS and EESS, which have been obtained through years of work and substantial federal investment, as well as future benefits, must be protected.

As passive users of the spectrum, radio astronomers and Earth scientists have no control over the frequencies that they must observe, or over the character of the "transmitted" signal. These parameters are set by the laws of nature. Furthermore, the emissions that radio astronomers measure are extremely weak—a typical radio telescope receives only about one-trillionth of a watt from even the strongest cosmic source. Because RAS receivers are designed to pick up such remarkably weak signals, its observatories are therefore particularly vulnerable to interference from spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands and those bands whose harmonic emissions fall into the RAS bands.

Similar to the RAS, the EESS must utilize frequencies that cannot be arbitrarily chosen. The emissions received by passive microwave EESS radiometers in Earth orbit are likewise weak by comparison with emissions from various other services. Although, in general, EESS receivers will not directly receive downlinks in their main antenna beam, surface-directed emissions originating from other Earth-orbiting satellites can be received in the antenna sidelobes, for example, when they originate near the EESS sensor’s horizon. Reflections from Earth’s surface (primarily oceans) may also redirect the emissions upward and into the main beam of an orbiting EESS radiometer, albeit with some additional reduction of intensity. Finally, EESS-allocated frequencies are utilized regularly by various ground-based (and sometimes airborne) upward-looking

radiometers, primarily experimental in nature, which would be particularly vulnerable to surface-directed spurious and out-of-band emissions.

Of particular concern in this proceeding is interference to RAS and EESS observations in the 10.6-10.7 GHz band from feeder downlinks in the 10.7-11.7 GHz band, as set forth in paragraph 50 of the NPRM. The 10.60-10.68 GHz and 10.68-10.70 GHz bands are allocated to RAS and EESS on a co-primary basis. There is a reason for these primary allocations: the 10.6-10.7 GHz band is especially important to both radio astronomy and Earth remote sensing because it provides a substantial bandwidth (nearly 1%) at a wavelength that is still long enough so that Earth's atmosphere does not provide substantial opacity. This makes possible the most sensitive continuum measurements, which are required for the passive services. Radio astronomers make detailed continuum measurements of the cosmic background in these bands. Earth scientists make extensive radiometric measurements in these bands of sea state and wind directions over oceans, which are extremely important in tracking hurricanes and protecting maritime activities. EESS observations in these bands are also used to monitor Earth surface developments and vegetation.

In sum, scientific observations in the 10.6-10.7 GHz band are important, yet, like all passive scientific observations, they are uniquely vulnerable to interference from out-of-band and spurious emissions.

II. Significant Regulatory Requirements Would Be Necessary to Protect RAS and EESS Observations at the Appropriate Emission Levels.

As a general matter, historically the placement of satellite downlink allocations immediately adjacent to RAS and other passive service allocations has often resulted in harmful interference to, and loss of flexibility and scientific yield from, large numbers of radio astronomical facilities. Therefore, given the high likelihood that without mandatory protections, the operation of feeder downlinks will cause harmful interference to important RAS and EESS observations in the 10.6-10.7 GHz bands, CORF strongly encourages the Commission to explicitly mandate that a condition of the licensing of such downlink operations is specific and appropriate protection of RAS and EESS observations in the 10.6-10.7 GHz band.

CORF believes that the appropriate reference for protection of RAS and EESS observations is given by the requirements of ITU-R RA.769-1, which, incidentally, provides protection at the levels required for EESS as given by ITU-R SA.1029-1. Indeed, recently in almost identical circumstances, the Commission explicitly relied on RA.769-1 in proposing rules for 10.7-11.7 GHz non-geostationary-satellite-orbit gateway downlinks. See the Notice of Proposed Rulemaking in ET Docket 98-206 (released November 19, 1998; hereinafter 98-206 NPRM) at para. 82.

As the Commission correctly pointed out in Paragraph 82 of the 98-206 NPRM, in order to comply with the requirements of RA.769-1, downlink transmitters would have to limit out-of-band emissions in these frequency ranges so as to maintain ground levels at or

below -255 dBW/m^2/Hz when they are within 5 degrees of the main beam of the radio telescopes and levels at or below -240 dBW/m^2/Hz at all other times. This will be especially challenging since the flux densities in the downlink band are on the order of -206 dBW/m^2/Hz.

In sum, it will be difficult for operators of feeder downlinks to comply with the appropriate out-of-band emission limitations, based on RA.769-1. Thus, if the Commission decides to make this designation, the out-of-band emission limitations similar to those proposed by the Commission in ET Docket 98-206 are critical to the protection of important RAS and EESS observations. Furthermore, the Commission should modify Part 25 of the Rules to require that the feeder downlink transmissions use filters that can provide at least 50 dB of suppression in the adjacent RAS and EESS band. While these requirements might cause some increase in the cost of gateway Earth stations and/or satellite stations, they constitute a technically realizable approach for assuring compatibility of the downlinks with adjacent-band scientific observations.

III. Conclusion.

If the Commission decides to designate use of the 10.7-11.7 GHz band for satellite feeder downlink operations, it must require that such transmissions protect RAS and EESS observations from harmful interference. As the Commission recognized in the almost identical situation in ET Docket 98-206, the appropriate level of protection is that set forth in ITU-R RA.769-1. In addition, the Commission should also modify Part 25 of its rules to provide for a stringent filtering requirement to assure that these levels are met. Such proposed modifications are necessary if important scientific observations in the adjacent band are to be protected in a meaningful manner.

Respectfully submitted

NATIONAL ACADEMIES'
COMMITTEE ON RADIO
FREQUENCIES

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Attachment: CORF Membership

Footnote 1

Current major EESS operations include t he joint NASA/NASDA (Japan) Tropical Rainfall Measurement Mission (TRMM). One of the instruments on this mission is the TRMM Microwave Imager (TMI), which operates in the 10.6-10.7 GHz band and would be especially sensitive to out-of-band emission scatte r ing off the ground or water from non-geostationary-orbit (NGSO) feeder downlinks operating between 10.7 and 11.7 GHz. This system is used to monitor ocean winds, ocean surface conditions, and Earth surface developments and vegetation. In the next 24 mon t hs, NASA will launch the Earth Observing Satellite (EOS), which will contain an instrument called the Advanced Microwave Scanning Radiometer (AMSR-E), which operates in the 10.6-10.7 GHz band. This instrument will likewise be susceptible to interference from emissions in the 10.6-10.7 GHz band emitted from NGSO feeder downlinks. Its research mission is similar to that of the TMI.