Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to Facilitate the Use of Cellular Telephones and Other Wireless Devices Aboard Airborne Aircraft	)))	WT Docket No. 04-435

**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] (CORF), hereby submits its comments in response to the Commission's February 15, 2005, Notice of Proposed Rulemaking in the above-captioned docket (NPRM). In these Comments, CORF supports proposals in the NPRM that could have the effect of reducing the likelihood and severity of interference from airborne cellular telephone transmissions to sensitive radio astronomy observations.

I. Introduction: The Role of Radio Astronomy, the Unique Vulnerability of Passive Services to Interference, and the Importance of Observations in the 1660-1670 MHz Band.

CORF has a substantial interest in this proceeding, as it represents the interests of the passive scientific users of the radio spectrum, including users of

[1] Members of CORF are listed in Attachment A.

the Radio Astronomy Service (RAS) bands. RAS 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. Radio astronomy provided evidence for 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 that were imposed on the signals by acoustic vibrations of the early universe, which evolved into today's stars and galaxies. Observations of supernovas have allowed us to witness the creation and distribution of heavy elements essential to the formation of planets such as Earth, and of life itself.

It is important to remember that the frequencies at which radio astronomers observe are dictated by the laws of nature. Furthermore, the emissions that radio astronomers receive at these frequencies 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 those that produce harmonic emissions that fall into the RAS bands.

In addition to the gains in scientific knowledge that result from radio astronomy, CORF notes that such research spawns technological developments that are of direct and tangible benefit to the public. For example, radio astronomy techniques have contributed significantly to major advances in the following areas:

> — *computerized tomography* (CAT scans) as well as other technologies for studying and creating images of tissue inside the human body;
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> — increasing abilities to *forecast earthquakes* by the use of very-long-baseline interferometric (VLBI) measurements of fault motions; and
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> — use of VLBI techniques in the development of *wireless telephone geographic location technologies*, which can be used in connection with the Commission's E911 requirements.

Continued development of new critical technologies from passive scientific observation of the spectrum depends on scientists having ongoing access to interference-free spectrum. More directly, the underlying science undertaken by radio astronomy observers cannot be performed without access to interference-free spectrum. Loss of such access constitutes a loss for all people of their scientific and cultural heritage, as well as the loss of practical applications from the information learned and the technologies developed.

Of particular concern in this proceeding is protection of RAS observations of the hydroxyl radical (OH) at 1660-1670 MHz. The importance of spectral line observations at 1665.402 and 1667.359 MHz, and of continuum observations at 1660-1670 MHz, has been specifically noted in Tables 1 and 3 of ITU-R RA.314-10. The study of OH is of importance for investigating the physical phenomena associated with the formation of protostars and the initial stages of star formation. Observation of signals from OH, a building block of water, is also crucial to understanding the network of chemical reactions involved in the formation of atoms and molecules. Such data helps astronomers understand the physics of stellar interiors, the chemistry of the interstellar medium, and the physics of the early universe. In addition, observations at these frequencies allow astronomers to study OH megamasers, whose characterization is extremely important for understanding the violent interaction and merging of galaxies. For these reasons the RAS has primary allocations at 1660-1670 MHz. The valuable research conducted in that band must be protected not just from interference caused by primary transmissions, but also from harmonics of transmissions on other frequencies as well, specifically those of cellular telephone transmissions.

II. CORF Supports NPRM Proposals That Could Reduce the Risk of Interference to RAS Observations.

CORF's primary concern in this proceeding is that spurious emissions of second harmonics of cellular telephone transmissions at 830-835 MHz could create damaging interference to radio astronomy observations in the 1660-1670 MHz band. As discussed below, the harm from such transmissions could be significant, and the airborne nature of the transmissions substantially increases the likelihood of such interfering events. Accordingly, CORF supports proposals in the NPRM that require the use of picocells and that modify the required emission mask for cellular telephone hand units, which could reduce the possibility and severity of such interference.

Harmonics occur at integer multiples of the transmitted frequency. For example, the second harmonic of 830 MHz is 1660 MHz. Hence, any transmission in the band at 830-835 MHz has the potential to radiate a second harmonic in the RAS band at 1660-1670 MHz. The signal level of such harmonic transmission at an RAS site is significantly increased when the propagation path is directly in the line of sight, as occurs in the case of airborne transmissions from aircraft above the observatory's horizon. Such transient interference requires, at a minimum, that the affected data be identified and removed from the observation data set. These added steps reduce the effective observing time for such observations. Even more serious is the case in which the interference is too weak to be identified and removed, potentially affecting the accuracy of a scientific result.

CORF takes no position as to whether the Commission should authorize the airborne use of cellular telephones, but CORF strongly supports the proposal to permit airborne use only if the handsets are controlled by an airborne picocell. (NPRM at para. 16) so that the likelihood and severity of interference to RAS facilities is minimized. Control by picocells would limit transmissions on the primary cellular telephone frequencies to communications within the aircraft, obviating the need for transmissions to the ground, and would accordingly limit the power of cellular handset transmissions within the aircraft — reducing the potential for interference to RAS observations. In addition, CORF supports the proposal to adjust the limits on out-of-band and spurious transmissions to account for airborne transmissions (NPRM at para. 16). Specifically, adjustment of the Commission’s permissible out-of-band and spurious emission limits on cellular handsets should include tighter constraints on permissible second harmonic levels.[2]

III. Conclusion.

CORF remains concerned about interference from airborne use of cellular telephones to sensitive and important radio astronomy observations at 1660-1670 MHz. If such cellular telephone use is to be authorized, CORF suggests that the requirements for use of airborne picocells and modification of the handset emission mask described above be enacted as well.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

By: /s/
Bruce Alberts
President

May 26, 2005

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[2]A calculation presented to the committee by Dr. Andrew Clegg of the National Science Foundation's Electromagnetic Spectrum Management Office showed that harmonic and out-of-band emissions (-13 dBm/MHz) can exceed ITU-R RA.769 limits by 44 dB when as few as seven cellular telephones are used. The calculation reflected the following assumptions: the devices are of the lowest power class defined for Global system for Mobile Communications (GSM) Base Transceiver Station (BTS)/mobile stations (0 dB per European Telecommunications Standards Institute GSM 05.05 specifications for radio transmission and reception for mobile stations), a 20 dB average attenuation of signals propagated outside of the aircraft, an average slant-range path of 5 miles, an average of 10 visible aircraft, an average of 7 users per GSM carrier aboard the aircraft (fully loaded GSM Broadcast Control Channel), and a noise-equivalent bandwidth of ~200 kHz. The expected spectral power flux density on the ground is -182 dB(W/m^2/Hz). A single aircraft at 100 mile slant range exceeds ITU-R RA.769 limits by 19 dB.

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Attachment A

CORF Membership List:

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