ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20054

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements	)	IB Docket No. 99-67
	)	
Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emission Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band	)	RM No. 9165

REPLY COMMENTS OF CORNELL UNIVERSITY

Dr. Paul Goldsmith
Director, National Astronomy
and Ionosphere Center
Professor of Astronomy

Office of the Director
National Astronomy and Ionosphere Center
Cornell University
Space Sciences Building
Ithaca, NY 14853-6801

July 21, 1999

TABLE OF CONTENTS

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 to Implement	)	
the Global Mobile Personal Communications	)	IB Docket No. 99-67
by Satellite (GMPCS) Memorandum	)	
of Understanding and Arrangements	)	
	)	
	)	
Petition of the National Telecommunications	)	RM No. 9165
and Information Administration to Amend Part	)	
25 of the Commission's Rules to Establish	)	
Emission Limits for Mobile and Portable	)	
Earth Stations Operating in the	)	
1610-1660.5 MHz Band	)	

REPLY COMMENTS OF CORNELL UNIVERSITY

Cornell University hereby submits its Reply Comments in response to the Commission's March 5, 1999, Notice of Proposed Rulemaking in the above-captioned docket ("NPRM"). In these Reply Comments, Cornell expresses concern about the potentially harmful impact of Global Mobile Personal Communications Service ("GMPCS") mobile terminal transmissions on radio astronomy observations in the 1.6 GHz band. Cornell supports the proposals in the Comments of the National Academies' Committee on Radio Frequencies ("CORF") and the Comments of the National Telecommunications and Information Administration ("NTIA") designed to protect radio astronomy observations from harmful interference from GMPCS mobile terminals. Cornell also expresses concern about proposals made in some Comments

that suggest weakening or eliminating out-of-band emission limits on GMPCS mobile terminals, or could weaken or eliminate the ability of the Commission to enforce such limits.

I. Introduction: Arecibo Observations in the 1610.6-1613.8 and 1660-1660.5 MHz Bands, and the Vulnerability of Those Observations to Man-Made Transmissions.

Cornell has a substantial interest in this proceeding, as it operates the Arecibo Observatory ("Arecibo"). Arecibo is part of the National Astronomy and Ionosphere Center, a national research center operated under a cooperative agreement with the National Science Foundation ("NSF"). The NSF is an independent federal agency whose aim is to promote scientific and engineering progress in the U.S. Additional funding for Arecibo is provided by the National Aeronautics and Space Administration ("NASA").

Arecibo operates 24 hours per day. As the site of the world's largest single-dish radio telescope, Arecibo is recognized as one of the most important centers in the world for research in radio astronomy and planetary radar. Arecibo has been operating since 1963, and in 1997 work was completed on a multi-million dollar upgrade of the facilities, which significantly expanded the range and sensitivity of the observations that could be made, while increasing the shielding around the telescope in an attempt to reduce interference from man-made sources.

Arecibo has a long history of being the site where very significant accomplishments in astronomy have occurred, including:

-discovery of the first planets outside of the solar system, rotating around a Pulsar;

-discovery of the first pulsar in a binary system, leading to important confirmation of Einstein's theory of general relativity and a Nobel Prize for two radio astronomers; and

-discovery of the correct rotating rate of the planet Mercury, as well as investigation of ice craters on Mercury's polar regions (and similar investigation of the polar regions of the Earth's Moon).

Of particular concern to Cornell in this proceeding is interference to important radio astronomy observations at Arecibo in the 1610.6-1613.8 and 1660-1660.5 MHz bands, both of which are allocated on a co-primary basis to the Radio Astronomy Service), as well as observations in the 1660.5-1670 MHz band. These bands are observed extensively by Arecibo, as described below.

The ground-state transitions of the OH molecule in the 18-cm band lie at 1612.2, 1665.4, 1667.4 (and 1720.5) MHz, and are especially important to radio astronomers using the Arecibo telescope. Apart from the widespread distribution of this molecule in space, strong maser amplification of the OH lines occurs in a range of circumstances, including active galactic nuclei, star-formation regions, the envelopes of evolved giant stars, and the environments of supernova remnants.

The 1610.6 - 1613.8 MHz band contains the 1612.2-MHz transition of the OH molecule, which shows especially strong maser emission from the envelopes of the highly-evolved long-period variables, known as OH/IR stars. Observations of these objects provide unique insight on both the expansion of their envelopes and the evolution of this population of old stars, and their lines can show extreme time variability. Arecibo is a world leader in such research, some 500 new OH/IR stars having been discovered and studied with its facilities. Complementary Arecibo

information on these objects is obtained from observations of weaker maser emission in the OH mainlines at 1665.4 and 1667.4 MHz. Arecibo detection searches are now being undertaken for the faint 1612-MHz emission from maser-emitting stars in nearby galaxies.

Regions of star formation show highly compact maser emission in all four of the 18-cm wavelength OH transitions. Single-dish and Very Long Baseline Interferometry (VLBI) observations of these regions of stellar birth together provide information on their dynamics, magnetic field strengths, and chemical and physical evolution. Arecibo has studied these stellar "nurseries" using all of the OH ground-state transitions. Recent Arecibo observations have detected and monitored the absorption of the continuum emission from background extra galactic sources at 1612.2, 1665.4 and 1667.4 MHz by OH molecules in dense molecular clouds within our own Galaxy. This data is being used to investigate the structure of these clouds on extremely small size scales.

In the early 1980's, Arecibo discovered megamaser emission of the 18-cm wavelength OH transitions from the nuclei of active galaxies. It has remained the world leader in the study of these emissions, finding examples out to considerable cosmological depths. Such observations are used to investigate the concentration of mass at the centers of these galaxies, and reveal the presence there of supermassive black holes. In addition to this important work on the OH molecule, which includes spectral-line VLBI of its 18-cm transitions, the standard band for continuum VLBI observations near 1 GHz is in the 18-cm window, particularly using 1660 - 1665 MHz.

Arecibo has been a participant in such observations for many years, and is just about to put new, far more powerful, VLBI equipment into service to extend existing observations. Here it collaborates not only with other ground-based telescopes around the World, but now with radio telescopes in orbit around the Earth.

In sum, radio astronomy observations at Arecibo in these bands are very important, yet like all radio astronomy observations, are uniquely vulnerable to interference from man made emissions. As passive users of the spectrum, radio astronomers have no control over the frequencies that they need to study, or over the character of the "transmitted" signal. These parameters are set by the laws of nature. Furthermore, the emissions that radio astronomers observe 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 therefore particularly vulnerable to interference from man made transmission from licensed and unlicensed users of neighboring and shared bands. Radio astronomy observations are particularly vulnerable to emissions from mobile transmitters, due to the ubiquity of the transmitters of popular mobile services, and to the fact that in analyzing observational data, the impact of transmissions from mobile transmitters cannot be recognized or accounted for with the same ease as transmissions from known, stationary (fixed) sources.

II. Cornell Supports the Proposals of CORF and NTIA as Necessary to Protect Radio Astronomy Observations From the Potentially Harmful Impact of GMPCS Transmissions.

For the reasons set forth above, Cornell remains greatly concerned about the

impact of GMPCS mobile terminal transmissions on radio astronomy observations at Arecibo. Yet, CORF and the NTIA have made suggestions which could help reduce the threat of harmful interference from GMPCS mobile terminals.

In its Comments CORF distinguished between the lower 1.6 GHz Radio Astronomy Service ("RAS") band (1610.6-1613.8 MHz), the upper 1.6 GHz RAS band (1660-1660.5 MHz), and the 1660.5-1670 MHz band. In regards to the lower RAS band, Arecibo supports the suggestion of CORF and the NTIA that the GMPCS rules should explicitly require compliance with existing requirements on emission limitations and the protection zone requirements set forth in Sections 25.202 and 25.213(a)(1) of the Commission's rules.[1] CORF Comments at page 4, NTIA Comments at page 30. These existing regulatory requirements might significantly reduce the impact of GMPCS on radio astronomy observations. While the requirements in these rules already apply to GMPCS mobile terminals,[2] Cornell agrees with CORF and NTIA that the GMPCS rules should make specific reference to compliance with the requirements of Sections 25.202(f) and 25.213(a)(1). This cross-reference would be particularly helpful in light of the new participants in the GMPCS mobile terminal manufacturing and service provision industries, and the location of these entities in various countries around the world.

Cornell also agrees with CORF that additional requirements are necessary in

---

[1] Pursuant to Section 25.213(a) of the Commission's rules, the Arecibo Observatory is one of the 15 radio astronomy observatories subject to a protection zone *vis a vis* interference from mobile satellite systems.

[2] *See*, NPRM at para. 19.

order to protect radio astronomy observations in the 1660-1660.5 and 1660.5-1670 MHz bands. CORF Comments at page 5. As CORF noted, there is no existing precedent and fewer regulations that on their face apply to the sharing of the 1660-1660.5 MHz band between radio astronomy and MSS operators. Based on footnote 29 of the NPRM, it appears that the provisions of Section 25.202(f) of the Commission's rules apply to GMPCS transmissions in and into 1660-1660.5 MHz, and into the 1660.5-1670 MHz band. However, Cornell agrees with CORF's suggestion that in light of the lack of existing operational precedent, and in light of the great importance of this band to the RAS, the public interest would be best served by enacting specific regulations addressing the sharing of this band, and in prohibiting GMPCS transmissions at 1660-1660.5 MHz until such a regulatory scheme is created. Cornell recommend's adoption of the CORF proposal for sharing the 1660-1660.5 MHz band:

> -a protection zone/coordination requirement similar to that set forth in Section 25.213(a)(1) of the rules; and
>
> -an out-of-band emission limitation for GMPCS transmissions at 1610-1660 MHz, into the 1660-1660.5 and 1660.5-1670 MHz bands. Such a limitation could be similar to the limitation in Section 25.213(a)(1)(iii), or alternatively, similar to the proposed Section 25.216(a). In regards to the creating an approach similar to that proposed in Section 25.216(a), Cornell notes that it should be much easier for GMPCS mobile terminals to protect the small band between 1660 and 1660.5 MHz, than to protect the much larger Aeronautical Radionavigation Satellite band at 1559-1585.42 MHz.

Cornell also agrees that any regulatory scheme for shared use of this band should comply with the requirements of International Footnote S5.376A, as well as other international actions. Comments of CORF at page 5.

III. Cornell Is Concerned About Proposals that Could Weaken or Eliminate Limits on Harmful GMPCS Out-of-Band Emissions, or the Ability of the Commission to Enforce Such Limits.

While Cornell is pleased that the NPRM recognizes the need to limit harmful out-of-band GMPCS emissions, and is pleased that some Commenters have made suggestions that would further such goals, Cornell remains concerned about proposals in other comments that could significantly weaken or eliminate limits on harmful GMPCS out-of-band emissions, or weaken the ability of the Commission to enforce such limits. The Commission should not allow those results to occur.

Some Commenters have opposed limits on out-of-band emissions in the 1605-1610 MHz band, or support weakening the limits in that band. See, e.g., Comments of Inmarsat Ltd. at page 10 and Comments of Norcom Networks Corporation at page 9. Norcom's proposal is based on the desire to reduce the cost of GMPCS mobile terminals. While such a goal is understandable, the Commission must nevertheless recognize the priority of protecting important scientific observations in the lower 1.6 GHz RAS band, and the costs to federally funded research from harmful interference. Similarly, Inmarsat proposes that GMPCS terminals operating in the 1626.5-1660.5 MHz band should not have to comply with interim out-of-band emission limits, because the FCC has determined that GLONASS need not be protected in the U.S. until 2005. However, this proposal ignores the impact on radio astronomy facilities making observations in the upper 1.6 GHz RAS band, and accordingly, should not be adopted.

In its Comments, Globalstar suggests that terminals should not face technical review during blanket licensing, and should not be required to be associated with an

authorized service in order to be certified. Joint Comments of L/Q Licensee, Inc., Globalstar, L.P. and Airtouch Satellite Services, U.S., Inc. at pages 9-13. Cornell requests that the Commission remain mindful of the possibility that the combined effect of "streamlining" and eliminating certification and licensing requirements might be to dangerously short-circuit the Commission's ability to enforce out-of-band emission limits on GMPCS mobile terminals.

On the other hand, Cornell supports the position of Globalstar that GMPCS mobile terminals permanently installed on ships, boats and planes should not be exempted from the certification process. Comments of Globalstar at page 7. Cornell urges the Commission to recognize that airborne sources of interference to radio astronomy observations are particularly destructive, given that such emissions come from the same direction as the objects being directly studied by radio astronomers. Cornell also notes that Arecibo is located on the island of Puerto Rico, and thus is regularly approached or traversed by ships, boats and airplanes, many of which are not regularly scheduled, thus adding to the difficulty of identifying transmissions from GMPCS mobile terminals in observational data. Type certification is critical for ensuring that GMPCS mobile terminals are manufactured to comply with the requirements of the FCC's rules, including rules designed to limit out-of-band emissions. Once a mobile terminal is in operation, the licensee can do little to remedy interference coming from a terminal, other than to shut off service to the terminal. But such a remedy requires identification of the specific offending mobile terminal, which can be a difficult task.

Cornell has similar concerns regarding the suggestion of the Boeing Company that the Commission "clarify" that terminals that may be placed in use with aeronautical mobile satellite systems for the provision of aeronautical mobile satellite service ("AMSS") and aeronautical mobile satellite (route) service ("AMS(R)S") need not go through the certification process. Again, as noted above, airborne transmissions can be particularly harmful to radio astronomy observations. While Boeing suggests that other government agencies (such as the Federal Aviation Administration) have procedures for evaluating communications equipment, the procedures and rules of other agencies are not designed to address all of the same goals as the rules of the FCC, including the goal of protecting services such as the RAS.

Lastly, Iridium LLC suggests that certification of mobile terminals should be voluntary rather than mandatory. Comments at page 4. As was noted above, type certification is critical for ensuring that GMPCS mobile terminals comply with the Commission's technical requirements. Apparently, Iridium suggests that mobile terminals operating in the U.S. should either have FCC certification, or bear the ITU mark. Iridium Comments at page 5. However, this is inconsistent with the Commission's proposal (*See* para. 22) and Iridium seems to admit that it will require checking a data base to investigate whether or not a unit "that bears the ITU mark has met an ITU standard...." *Id.* This uncertainty is inconsistent with the needs of U.S. operators and potentially dangerous to radio astronomy observations.

IV. Conclusion

Observations in the 1.6 GHz bands are critical to radio astronomy, yet are vulnerable to interference from GMPCS mobile earth terminals. As noted above, the Commission should protect observations in the lower of the two bands by making explicit in the GMPCS rules references to the requirement to comply with other existing Part 25 rules. Furthermore, in order to protect observations in the higher of the two bands, the Commission should enact specific regulations addressing the sharing of this band, and prohibit GMPCS transmissions at 1660-1660.5 MHz until such a regulatory scheme is created. Lastly, the Commission should be very careful not to adopt proposals that could significantly weaken or eliminate limits on GMPCS mobile terminal out-of-band emissions, or weaken the Commission's ability to enforce such limits.

Respectfully submitted,

CORNELL UNIVERSITY

Dr. Paul Goldsmith
Director, National Astronomy
and Ionosphere Center
Professor of Astronomy

Office of the Director
National Astronomy and Ionosphere Center
Cornell University
Space Sciences Building
Ithaca, NY 14853-6801

July 21, 1999

CERTIFICATE OF SERVICE

I, Stacy Eveslage, hereby certify that a true and correct copy of the foregoing "Reply Comments of Cornell University" has been sent by first-class mail, postage prepaid, this 21st day of July, 1999 to the following:

Kelly Cameron
Robert L. Galbreath
POWELL GOLDSTEIN
FRAZER & MURPHY LLP
1001 Pennsylvania Ave., N.W.
Sixth Floor
Washington, D.C. 20004
Counsel for Inmarsat LTD.

AKIN, GUMP, STRAUSS, HAUER
& FELD, L.L.P.
1333 New Hampshire Avenue, N.W.
Suite 400
Washington, D.C. 20036
Counsel for Norcom Networks Corporation

Joseph P. Markoski
Squire, Sanders & Dempsey, L.L.P.
1201 Pennsylvania Avenue, N.W.
P.O. Box 407
Washington, D.C. 20044
Counsel for The Boeing Company

IRIDIUM LLC
Patricia A. Mahoney
Assistant General Counsel
Regulatory and Trade Policy
Audrey L. Allison
Counsel, Regulatory Matters
1575 Eye Street, N.W., Suite 800
Washington, D.C. 20005

William D. Wallace
Crowell & Moring, LLP
1001 Pennsylvania Avenue, N.W.
Washington, D.C. 20004
Counsel for Globalstar, L.P., L/Q Licensee, Inc.

Pamela J. Riley
David A. Gross
Steve B. Sharkey
AirTouch Communications, Inc.
1818 N Street, N.W.
Suite 800
Washington, D.C. 20036
Counsel for AirTouch Satellite
Services U.S., Inc.

Kathy Smith
Acting Chief Counsel
National Telecommunications
and Information Administration
U.S. Department of Commerce
Room 4713
1401 Constitution Avenue, N.W.
Washington, D.C. 20230

Stacy Eveslage