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

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of)	
)	
Modification of Licenses Held by)	File Nos.
)	
Iridium Constellation, LLC and)	SAT-MS-200305015-00089
Iridium, US LP)	SES-MS-200305015-00666
)	
For an MSS System in the 1.6 GHz Band)	

To: Deputy Chief, Satellite Division, International Bureau

Received

MAY 30 2003

Policy Branch
International Bureau

COMMENTS OF CORNELL UNIVERSITY

Cornell University, by its attorney, hereby submits comments in response to the May 16, 2003 Order to Show Cause (the "Order") in the above-captioned proceeding. Herein, Cornell expresses its concern about the possibility of additional harmful interference from the proposed use by Iridium Constellation LLC and Iridium US LP ("Iridium") of 2.5 megahertz of additional spectrum. While Cornell recognizes the importance of supporting the communication needs of U.S. forces in the Middle East, the Commission should be mindful of the potential impact of expanded Iridium frequency use on passive users of the same band whose rights are protected by FCC rules and private agreements with Iridium.¹ Thus, Cornell does not oppose the short

¹ Such mindfulness is especially important as the Commission contemplates the same issue in the context of a proposed permanent expansion of Iridium's authorized frequencies in a different proceeding. See, Notice of Proposed Rulemaking, Review of Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands, FCC 03-15, released February 10, 2003 ("MSS Spectrum Sharing NPRM").

term temporary expansion of Iridium's authorized frequencies, as long as such operations do not cause prohibited interference to Arecibo, and Cornell is given advanced notification of and a right to comment on such temporary changes in operations in the future. Lastly, Cornell assumes that such temporary expansion of Iridium authorized frequencies will not prejudice the Commission's action in the *MSS Spectrum Sharing* proceeding.

I. **Background**

Cornell has a substantial interest in this proceeding, as it operates the Arecibo Observatory ("Arecibo") in Arecibo, Puerto Rico. Arecibo is part of the National Astronomy and Ionosphere Center ("NAIC"), 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").

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.² Arecibo has been operating since 1963, and in 1997 work was completed on a multi-million dollar upgrade of the facilities, which significantly

² Arecibo has a long history of being the site where very significant accomplishments in astronomy have occurred, including: the first discovery of planets outside of our own Solar System; discovery of the first pulsar in a binary system, leading to important confirmation of Einstein's theory of gravitational waves and a Nobel Prize for two radio astronomers who performed their research at Arecibo (the third Nobel Prize for radio astronomy in its short 50 year history); and discovery of the correct rotation rate of the planet Mercury, as well as the discovery of ice in craters on Mercury's polar regions (and similar investigation of the polar regions of the Earth's Moon).

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 ground radiation.

The emissions that radio astronomers review are extremely weak -- a typical radio telescope receives less than one-trillionth of a watt from even the strongest cosmic source. Because radio astronomy receivers are designed to pick up such remarkably weak signals, observations by radio astronomers 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.

Of particular concern to Cornell in this proceeding is interference to radio astronomy observations in the 1610.6-1613.8 MHz band. This band is allocated on a co-primary basis to the Radio Astronomy Service ("RAS"). There is a reason for this primary allocation: observations in and around these frequencies are among the most important for the science of radio astronomy, for spectral line observations of the hydroxyl (OH) molecule. Such observations are of great importance to scientists studying stellar expansion velocities. Indeed, the ITU's Handbook on Radio Astronomy (Geneva, 1995) includes observations of the Hydroxyl molecule at the rest frequency of 1612.231 as being among the spectral lines of greatest importance to radio astronomy. *Id.* at Section 3.3, Table 2. Due to Doppler shifting of such cosmic emissions, the

Handbook suggests that the minimum preferred band for such observations includes the band 1606.8-1613.8MHz.

It is for the above reasons that the Commission has established certain inter-service coordination requirements for satellite systems operating in the 1610-1626.5 MHz band. These requirements are contained in Section 25.213 of the FCC's Rules and Regulations, and Section 25.213(a)(4) states:

"Mobile Satellite Service space stations transmitting in the 1613.8-1626.5 MHz band shall take whatever steps necessary to avoid causing harmful interference to [list of observatories, including Arecibo] during periods of observation."

At the encouragement of the Commission, and in order to facilitate coordination of Iridium's responsibility to avoid interfering with observations at Arecibo along with Arecibo's obligation to avoid scheduling radio astronomy observations during peak MSS traffic periods to the greatest extent practicable, the previous Iridium licensees and Cornell negotiated and signed a Coordination Agreement in March of 1998.³ In granting MSS licenses to Iridium, the FCC made Iridium's fulfillment of the terms of that Agreement an express condition of the MSS licenses.

II. Cornell Does Not Oppose the Short Term Temporary Expansion of Iridium's Authorized Frequencies, as Long as Such Operations Do Not Cause Prohibited Interference to Arecibo, Cornell is Notified of Such Operations in the Future, and This Action Does Not Prejudice FCC Action in the *Spectrum Sharing* Proceeding.

As was noted above, Cornell recognizes the importance of supporting the communication needs of U.S. forces in the Middle East. Nevertheless, Cornell is

³ That Agreement was updated to reflect the Commission's grant of the licenses to the current Iridium licensees. A copy of the updated Agreement is attached hereto.

concerned that up to this point, neither the Commission nor Iridium appear to have been mindful of the potential impact of expanded Iridium frequency use on passive users of the same band, whose rights are protected by FCC rule and coordination agreements. Cornell was surprised to read in the *Order* that the Commission had already granted special temporary authority to Iridium to use expanded frequencies, and that Iridium had been operating on them, with no apparent thought of notifying Arecibo, either in advance or after the fact. Cornell is currently reviewing the Coordination Agreement to ascertain whether such operations are consistent with the Agreement. However, even if use of expanded frequencies is not a violation of the Agreement, the requirements of Section 25.213, as well as common sense and courtesy, suggest that Arecibo should have been notified in advance.

Cornell's concerns are not based on propriety for its own sake, but rather on the real need (and right) to make observations at 1.6 GHz without prohibited interference. Given the short time between the publication of the *Order* and the deadline for filing these comments, Arecibo's staff has not had a chance to fully analyze the impact, if any, of Iridium's use of expanded frequencies on observations at 1.6 GHz. However, a brief review of a five hour observing run before Iridium's use of expanded frequencies, with one made after Iridium's use of expanded frequencies, shows increased presence of interference in the second observation, though this interference cannot with certainty be directly attributed to Iridium at this time. Nevertheless, Cornell strongly believes that the closer Iridium transmissions are to 1610.6-1613.8 MHz, the more difficult it will be

for them to comply with their obligation to avoid creating harmful interference in that band. Accordingly, Cornell assumes that it will receive advanced notice of any future requests by Iridium for an extension of this temporary use, and requests that the Commission grant any future temporary expansions of Iridium's authorized frequencies only after an opportunity for comment is given to other users of the same band with protected rights.

Lastly, Cornell notes that it is not entirely comfortable with the approach taken by the Commission in this proceeding, *i.e.*, modifying Iridium's permanent license (albeit with a temporary condition) rather than granting an extension of an STA. While one benefit of this approach is that public notice of the action was required, the implications of expanding Iridium's authorized frequencies on its permanent license, while a proposal to take similar action is pending in the *MSS Spectrum Sharing* proceeding, are disconcerting. Cornell recognizes that the *Order* states that action in this proceeding will be taken without prejudice to Commission action in the *MSS Spectrum Sharing* proceeding, and Cornell takes the Commission at its word. Cornell expects that the Commission will fully evaluate the record created in the *MSS Spectrum Sharing* proceeding regarding Iridium's actual demonstrated permanent need for the additional spectrum, and the impact of such use of additional frequencies on other services and users, without regard to Iridium's current temporary use of the expanded frequencies.

In sum, Cornell does not oppose the short term temporary expansion of Iridium's authorized frequencies, as long as such operations do not cause prohibited interference

to Arecibo, and Cornell is given advanced notification of and a right to comment on such temporary changes in operations in the future.

Respectfully submitted,

CORNELL UNIVERSITY



Paul J. Feldman
Its Attorney

FLETCHER, HEALD & HILDRETH, PLC
1300 North 17th Street, 11th Floor
Arlington, Virginia 22209
(703) 812-0400

May 23, 2003

Coordination Agreement Regarding the Operation of the IRIDIUM® System and the Arecibo Radio Astronomy Observatory

1. Introduction

This Coordination Agreement arose out of discussions between representatives of Space System License, Inc., a wholly owned subsidiary of Motorola, Inc. under contract to Iridium LLC; and Cornell University, operator of the National Astronomy and Ionosphere Center ("NAIC").¹ Those discussions led to a Framework Agreement dated March 19, 1997, and then to a Coordination Agreement dated March 1, 1998. In light of the pending assignment of the Mobile Satellite Service License that is the subject of the Coordination Agreement, from Space System License, Inc. to Iridium Constellation LLC ("ICL"), a wholly owned subsidiary of Iridium Satellite LLC ("ISL") (ICL and ISL shall hereinafter be referred to collectively as "New Iridium"), NAIC and New Iridium have entered into this new Coordination Agreement which is intended to ensure that the mutual obligations set forth in the March 1, 1998 Coordination Agreement in connection with coordination between the IRIDIUM System and the Arecibo Radio Astronomy Observatory are fulfilled by New Iridium and NAIC.

2. FCC Regulations

The FCC has established certain inter-service coordination requirements for satellite systems operating in the 1610-1626.5 MHz band. These requirements are contained in Section 25.213 of the FCC's Rules and Regulations. They include:

47 CFR 25.213(a)(2):

"Mobile Satellite Service space stations transmitting in the 1613.8-1626.5 MHz band shall take whatever steps necessary to avoid causing harmful interference to [list of observatories, including Arecibo Radio Observatory] during periods of observation."

47 CFR 25.213(a)(4):

"The Radio Astronomy Service shall avoid scheduling radio astronomy observations during peak MSS/RDSS traffic periods to the greatest extent practicable."

¹ The National Astronomy and Ionosphere Center is operated by Cornell University under a Cooperative Agreement with the National Science Foundation.

3. Principles of Coordination

The following basic principles have been agreed upon regarding the coordination of the IRIDIUM[®] System² with the Arecibo Radio Astronomy Observatory ("Arecibo"):

- a) New Iridium will operate the IRIDIUM System in a spectrum efficient and economic manner, without causing harmful interference to Arecibo. It is recognized that the main area of concern is potential interference to the radio astronomy observations scheduled at Arecibo in the 1610.6-1613.8 MHz band from the IRIDIUM System downlinks, covered by international RR S5.372.
- b) Arecibo is to be protected from harmful interference during those periods that radio astronomy observations are conducted in the 1610.6-1613.8 MHz band. The scheduling of these periods will, to the greatest extent practicable, be done in such a way as to coincide with the minimum traffic periods for the IRIDIUM System. It is anticipated that observations at Arecibo will not unnecessarily inhibit the ability of New Iridium to operate the IRIDIUM System in a spectrum efficient and economic manner.
- c) The IRIDIUM System mobile earth terminals will be capable of terminating operations after the first position fix of the terminals.
- d) The NAIC will provide New Iridium with scheduling information, either directly or through the Electromagnetic Spectrum Management Unit of the National Science Foundation ("ESMU"), regarding the periods when radio astronomy observations in the 1610.6-1613.8 MHz band are expected to be conducted at Arecibo.
- e) Motorola/Iridium has provided to the NAIC, at no charge, an air interface to the IRIDIUM System that provides a signal with a blanking period during approximately 50% of each 90 millisecond time frame. This signal will indicate when the transmitters on board the IRIDIUM System space vehicles are active. It is understood that the use of the air interface reduces the sensitivity of the Arecibo telescope, and that it allows carrying out only some types of radio astronomy observations. Nevertheless, it will enable NAIC, at its option, to conduct certain observations at Arecibo at any time, by "seeing through" the IRIDIUM System transmissions.
- f) The parties recognize that the provisions of this Coordination Agreement are based on the unique conditions and facilities of Arecibo, and may not apply to New Iridium's coordination with any other radio astronomy observatory in the U.S. or elsewhere.

² IRIDIUM is a registered trademark and service mark of Iridium Satellite LLC.

- c) A few observations of special celestial objects (comets, supernovae, and other celestial objects of heretofore unknown type) may need to be accommodated outside the agreed 10 p.m.-6 a.m. scheduling window. To the greatest extent practicable, these observations will be carried out using the blanker described in 3(e), above. Special observations that cannot be done using the blanker will be protected to the $-238 \text{ dBW m}^{-2} \text{ Hz}^{-1}$ level as set forth in 4(b), above. Such observations shall not exceed 8 passes per calendar year.
- d) New Iridium will comply with Section 25.213(a)(2) of the FCC's Rules as currently formulated (see Section 2 herein) as applied to the Arecibo Observatory.
- e) New Iridium will attempt to reduce emissions of any future generation satellites in the IRIDIUM System into the 1610.6-1613.8 MHz band. The NAIC will continue to attempt to decrease the Arecibo telescope's susceptibility to interference from spaceborne systems (e.g., by reducing sidelobe levels, effects on the antenna pattern due to screen illumination, and by incorporating blanking or other signal processing techniques into the observations).

5. Disclosure

The terms and provisions of this coordination agreement will not be held as confidential. Certain information, to be exchanged under the terms of this agreement, and information that was exchanged in the course of negotiations leading to the March 1, 1998 Coordination Agreement, and was or is marked as "Confidential Proprietary," will remain confidential.

6. Modification

This Coordination Agreement may be modified only by mutual agreement, in writing. In the event the parties reach an impasse on changes to this Coordination Agreement, they agree to submit the issue to the FCC and NTIA for mediation and resolution.

7. Review

The parties agree to work on the items listed in the Annex and to meet annually beginning in February 1999 to review this Coordination Agreement.

8. Benefit

This Agreement shall inure to the benefit of and be binding upon the parties hereto and their respective successors or assigns.

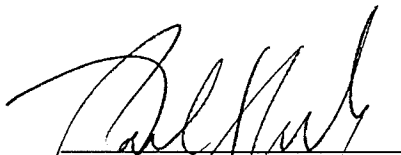
9. Assignment.

ICL agrees to notify NAIC prior to or the day of the filing with the FCC of an application to assign or transfer control of its Mobile Satellite Service License to a third party. ICL also agrees to obtain from such third party and deliver to NAIC prior to any assignment or transfer of the Mobile Satellite Service License, a written assumption of this Coordination Agreement, with such assumption being effective upon the consummation of the assignment.

ACCEPTED AND AGREED UPON:

It is understood that the undersigned have the actual authority necessary to bind their respective companies and organizations to this Coordination Agreement.

This agreement may be executed by counterparts, each of which shall be deemed to be an original but all of which together shall constitute one and the same instrument.



Dr. Paul F. Goldsmith
Professor
Cornell University
Director, NAIC

[officer]
Iridium Constellation, LLC

[officer]
Iridium Satellite, LLC

May 7, 2001

Date

Date

Date

9. **Assignment.**

ICL agrees to notify NAIC prior to or the day of the filing with the FCC of an application to assign or transfer control of its Mobile Satellite Service License to a third party. ICL also agrees to obtain from such third party and deliver to NAIC prior to any assignment or transfer of the Mobile Satellite Service License, a written assumption of this Coordination Agreement, with such assumption being effective upon the consummation of the assignment.

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Dr. Paul F. Goldsmith
Professor
Cornell University
Director, NAIC
[officer]

David O. Berman
[officer]
Iridium Constellation, LLC
President and CEO

David O. Berman
[officer]
Iridium Satellite, LLC
President and CEO

Date

Date

4/30/01

Date

4/30/01

ANNEX

1. Areas of Investigation by Motorola

In accordance with the "Areas for Further Investigation" in the Framework Agreement dated 19 March 1997, and the associated Work Plan, Motorola has:

- a) Provided preliminary information on expected 24-hour IRIDIUM System traffic patterns, ranked hourly. No weekday/weekend data is currently available, but it is expected that such data will become available as the system becomes operational.
- b) Provided estimates of SPFD of a single IRIDIUM System burst transmission in the band 1610.6 - 1613.8 MHz, and the spectral signal characteristics of the IRIDIUM System within the same band, as a function of loading.
- c) Investigated the grouping of carriers to higher frequencies and local channel crowding, and found that this approach will not reduce emissions into the band of interest to radio astronomy under the current constraints on the IRIDIUM System. Channel crowding will be further investigated in future generation IRIDIUM System satellites.
- d) Conducted a study on the IRIDIUM System satellite elevation angle statistics at Arecibo. The study shows that, in relation to the Arecibo telescope, all IRIDIUM satellites are at off-axis angles of:
 - i) More than 48° about 80% of the time;
 - ii) More than 30° about 95% of the time;
 - iii) More than 19° about 98% of the time.
- e) Provided information on filters used during testing of the IRIDIUM System with National Radio Astronomy Observatory, which reduce emissions from the IRIDIUM space vehicles in the 1621.35-1626.5 MHz band.

2. Areas of Investigation by NAIC

In accordance with the "Areas of Further Investigation" in the aforementioned Framework Agreement, and the associated Work Plan, NAIC has:

- a) Determined, based on 1988 data, that:
 - i) Most Arecibo observations in the 1610.6 - 1613.8 MHz band could be scheduled between 8 p.m. and 6 a.m. local time every day of the week and one full day per week, e.g., Saturdays or Sundays;

- ii) A small number of observations (approximately 36 hours during the year) could not be fit into such a schedule and require additional time.
- b) Provided a study of bandwidth and integration time distribution, based on 1988 data, to show that, relative to the $-238 \text{ dBW m}^{-2} \text{ Hz}^{-1}$ detrimental interference level specified in ITU-R RA.769:
 - i) 5% of the observations required 3-6 dB less sensitive measurements;
 - ii) 13% of the observations require 0-3 dB less sensitive measurements;
 - iii) 18% of the observations require 0-3 dB more sensitive measurements;
 - iv) 52% of the observations require 3-6 dB more sensitive measurements;
 - v) 12% of the observations require 6-9 dB more sensitive measurements.
- c) Provided information on the current estimate of the Arecibo telescope's sidelobe structure.
- d) Provided information showing that using simulations of dual beam switching techniques of the Arecibo receivers reduced the effect of GLONASS interference to an acceptable level approximately 70% of the time.

3. Future and Ongoing Work

- a) The NAIC will, as soon as practicable, measure the actual Arecibo antenna sidelobe characteristics. NAIC will promptly provide a copy of the results to New Iridium.
- b) New Iridium/NAIC will evaluate the effect of interference from the IRIDIUM System using techniques similar to those employed in 2(d) of this Annex.
- c) The parties agree to jointly evaluate new data and techniques which may affect this Agreement. This evaluation includes, but is not limited to, data regarding actual traffic loads and actual demand for observing time; test results of the levels of interference generated by the IRIDIUM System; averaging techniques that would ameliorate interference from the IRIDIUM System; and improvements to the Arecibo antenna's sidelobes.

CERTIFICATE OF SERVICE

I, Joan P. George, a secretary in the law firm of Fletcher, Heald & Hildreth, do hereby certify that a true copy of the *Comments of Cornell University* was sent this 23rd day of May, 2003 by hand where indicated and via United States First Class Mail, postage prepaid, to the following:

Iridium Constellation LLC
1600 Wilson Blvd. Suite 1000
Arlington, VA. 22209

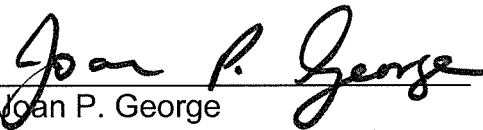
Globalstar, L.P.
3200 Zanker Road
San Jose, CA 95134

Jennifer Hinden, Esq.
Wiley Rein & Fielding LLP
1776 K St NW
Washington, DC 20006

Dr. Fred Lo
Director
National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903-2475

Fern Jarmulnek*
FCC
International Bureau
445 12th Street, SW
Washington, DC 20554

Qualex International *
Portals II
445 12th Street, SW, Room CY-B402
Washington, DC 20554


Joan P. George