**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, DC 20554**

**In the Matter of:**

| | | |
|---|---|---|
| **Streamlining Licensing Procedures for Small Satellites** | **)** **)** **)** | **IB Docket No. 18-86** |

**To: The Commission**

## COMMENTS OF RADIO AMATEUR SATELLITE CORPORATION

The Radio Amateur Satellite Corporation (AMSAT®), pursuant to Sections 1.415 and 1.419 of the Commission's Rules [47 C.F.R. §§ 1.415 and 1.419], hereby respectfully submits comments in response to the *Notice of Proposed Rule Making and Order*, FCC 18-44, 83 Fed. Reg. 24064, released May 24, 2018 (the Notice). These comments are timely filed. For its comments, AMSAT states as follows.

### I. Background

AMSAT is a scientific and educational non-profit corporation chartered in the District of Columbia in 1969. We design, construct, test, and operate space stations in the amateur satellite service. We also make available a variety of publications, computer programs, educational services, and internet services promoting space science education among radio amateurs and students worldwide[1].

AMSAT has constructed and/or operated 20 amateur satellites, dating to 1970. AMSAT's success constructing and operating small satellites has been a major influence on the "small satellite revolution." In addition to their use as amateur communications satellites, the AMSAT-OSCAR 6 and AMSAT-OSCAR 7 satellites validated the use of Doppler shift analysis to locate ground-based beacons, leading to the COSPAS-SARSAT beacon location system. AMSAT-OSCAR 6 hosted the first mobile-

[1] See www.amsat.org

mobile satellite communication in any radio service. The first ground-satellite-satellite-ground communication in any radio service utilized AMSAT-OSCAR 6 and AMSAT-OSCAR 7.[2,3] Amateur radio operators observing the 435 MHz beacon on AMSAT-OSCAR 6 discovered an "Inverted Doppler" anomaly at UHF frequencies.[4] AMSAT-OSCAR 6 was also used to experimentally relay electrocardiogram data, demonstrating the utility of relaying medical data via satellite.[5] AMSAT-OSCAR 40 carried a GPS receiver to its High Earth Orbit (HEO) and demonstrated the viability of utilizing GPS signals at altitudes above the constellation.[6] As a result of this experiment, future GPS satellites have been designed to a accommodate above-constellation use. Widely used technologies such as battery charge regulators and HELAPS (High Efficiency Linear Amplification by Parametric Synthesis) were developed for and/or proven on AMSAT satellites. Over the past 65 years, amateur satellites have both demonstrated the public utility of the amateur satellite service and proved that small, less-expensive satellites could perform useful scientific experiments, providing reliable communication, store-and-forward messaging, and file transfer for a wide variety of missions. Due to these successes, many groups, including government, non-profit, and commercial organizations became interested in developing constellations of small satellites.[7]

AMSAT's current satellite programs include the Fox-1 and GOLF CubeSats. The Fox-1 program consists of a series of five 1U CubeSats. Three Fox-1 satellites are currently in orbit and operational with two awaiting launch. In addition to providing amateur communications services, the Fox-1

---

2 P. I. Klein and R. Soifer. "Intersatellite communication using the AMSAT-OSCAR 6 and AMSAT-OSCAR 7 radio amateur satellites,." *Proceedings of the IEEE*, vol. 63, no. 10, pp. 1526-1527, Oct. 1975.

3 When illuminated, AMSAT-OSCAR 7 continues to provide amateur communications services to this day — more than 43 years after launch.

4 Ron Dunbar and John Fox. "Preliminary Observations on OSCAR 6 Inverted Doppler." AMSAT Newsletter. Pp. 10-14., June 1973.

5 Joel P. Kleinman. "OSCAR Medical Data" *QST*. Pp 42-43. October 1976.

6 Michael C. Moreau, Edward P. Davis, J. Russell Carpenter, David Kelbel, George W. Davis , and Penina Axelrad. "Results from the GPS Flight Experiment on the High Earth Orbit AMSAT OSCAR-40 Spacecraft." Presented at the ION GPS 2002 Conference, Portland, OR, September, 2002.

7 G. Gould Smith "The Role of AMSAT in the Evolution of Small Satellites." *Small Satellites: Past, Present, and Future*. Henry Helvajian and Siegfried W. Janson, Ed. The Aerospace Press, 2008. pp 137 &143.

satellites carry student-built experiments from several university partners, including Vanderbilt University, Virginia Tech, the University of Iowa, and Pennsylvania State University-Erie. The GOLF program will consist of a series of 3U CubeSats designed to operate in a wide variety of orbits, including Low Earth Orbit (LEO), High Earth Orbit (HEO), and beyond, providing communications services for amateur radio operators worldwide. Like the Fox-1 series, GOLF CubeSats will also carry experiments provided by university and other educational partners. These satellite programs are an efficient use of both orbital and radio spectrum resources. Amateur radio operators worldwide are able to utilize the communications services the satellites provide while also collecting telemetry and experiment data for AMSAT and our partners to utilize. In addition to our own satellite programs, AMSAT partnered with the University of Washington to provide an amateur communications system for its HuskySat-1 CubeSat. This system will provide telemetry and command capability for the satellite and communications services for the worldwide amateur radio community.

Although the Notice does not propose any rule changes directly affecting the amateur satellite service, we would like to offer comments on issues relating to the authorization of small satellites in the amateur satellite service.

**II. Most Small Satellites Built By Universities and Non-Profit Organizations Qualify for an Amateur Satellite Authorization**

The Notice states "because the type of operations that qualify as amateur are narrowly defined, an amateur satellite authorization will not be appropriate for many small satellite operations." [Notice p. 9]. Contrary to the text of the notice, we believe the types of operations that are appropriate for the amateur satellite service to be relatively broad. In addition to providing communications resources to the amateur community, an amateur satellite may also be used for "self-training and technical investigations relating to radio technique." The International Amateur Radio Union (IARU) further defines the radio

technique to mean "having a reasonable possibility of application to radio communications systems." Examples provided of experiments relating to radio technique include a wide variety of experiments commonly included on small spacecraft, including attitude determination, sensors to study spacecraft performance, radiation effects on electronic components, and measurements of the orbital environment.[8] As described in the previous section, amateur satellites have a long history of completing a wide variety of experiments relating to radio technique other than the provision of amateur communications resources.

Section 97.1 of the Commission's rules also recognizes that the basis and purpose of the amateur service extends beyond that of a "voluntary noncommercial communication service." Additional purposes of the amateur service include "the advancement of the radio art" and "advancing skills in both the communication and technical phases of the art." Clearly the construction and operation of new types of satellites fits within these purposes. Through student and volunteer participation in these projects, they serve to expand "the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts." As amateur operators around the world are invited to both utilize amateur satellites and collect and submit telemetry as they pass overhead, their operation serves to "enhance international goodwill" [47 C.F.R. § 97.1]. While a majority of small satellites built by universities and non-profit organizations are not currently providing communications resources to the amateur community, they are generally conducting experiments relating to radio technique and fulfilling the additional purposes listed in Section 97.1 of the Commission's rules. Therefore, these satellites qualify for an amateur satellite authorization.

---

[8] "Amateur Radio Satellites: Information for Developers of Satellites Planning to Use Frequency Bands Allocated to the Amateur-Satellite Service." The International Amateur Radio Union. http://www.iaru.org/uploads/1/3/0/7/13073366/iarusatspec_rev15.7.pdf. Pg. 7. Retrieved 6/18/18.

**III. Amateur Licensing for Satellites Built by Universities and Non-Profit Organizations**

RR 1.56 of the ITU Radio Regulations provides that stations operating in the amateur service must be controlled by individually licensed amateur radio operators acting "solely with a personal aim and without pecuniary interest."[9] Section 97.207 of the Commission's regulations notes that an individual amateur licensee must be the control operator of an amateur satellite and that this indivudla licensee is responsible for the operation of the station. [47 C.F.R. § 97.207] A university or non-profit organization cannot obtain a license to operate an amateur satellite under its own name. Additionally, Section 97.113 of the Commission's regulations prohibits communications in which a licensee "has a pecuniary interest, including communications on behalf of an employer." [47 C.F.R. § 97.113(c)].[10] This is not an insurmountable barrier to amateur authorization. The IARU notes "organisations and amateurs have common interests and work together for their mutual benefit"[11] For example, AMSAT is a non-profit organization that has constructed and launched several amateur radio satellites. An unpaid volunteer serves as the licensee and control operator for these satellites and is legally responsible for the operation of those satellites. AMSAT's interest in the operation of the satellites as the owner, and our volunteer's personal interest in the operation of the satellite as the operator are the same. Any university or other non-profit organization can follow the same model by working with a volunteer, perhaps from the organization's own amateur radio club or another local amateur radio club.

There is one important limitation on the use of the amateur satellite service. In the past, some satellites built by universities and non-profit organizations operating on amateur frequencies have utilized undocumented codes and emission types for the transmission of their data. Satellites operating

---

9 ITU Radio Regulations, RR 1.56.

10 AMSAT believes that "teacher exception" in § 97.113(c) allows professors or others in a teaching position at a university to serve as the control operator and/or licensee of an amateur satellite built at that university.

11 "Amateur Radio Satellites: Information for Developers of Satellites Planning to Use Frequency Bands Allocated to the Amateur-Satellite Service." The International Amateur Radio Union. http://www.iaru.org/uploads/1/3/0/7/13073366/iarusatspec_rev15.7.pdf. Pp 7-8. Retrieved 7/3/18.

in the amateur satellite service may not do so. Although 47 C.F.R. § 97.207(f) states that "space telemetry transmissions may consist of specially coded messages intended to facilitate communications or related to the function of the spacecraft," the Commission has routinely noted that "Section 97.113 is intended to help maintain the non-commercial character of the amateur radio service by prohibiting certain types of transmissions" and "to ensure that the amateur service remains a non-commercial service and self-regulates, amateur stations must be capable of understanding the communications of other amateur stations."[12] Additionally, RR 25.2A of the ITU Radio Regulations states that "transmissions between amateur stations of different countries shall not be encoded for the purposes of obscuring their meaning."[13] The IARU interprets this to require amateur satellite operators to publicly disclose the information necessary to decode telemetry and data transmitted by the satellite and expects missions coordinated to do so. Further, public disclosure benefits missions using amateur frequencies as there are hundreds of enthusiasts around the world ready to decode satellite telemetry and send it to the satellite owner, resulting in an increase in the amount of data available for analysis. However, if a university or non-profit organization requires their satellite's data to remain proprietary, then they must seek another service in which to license and operate the satellite.

**IV. Government Funding Should Not Bar Amateur Authorization**

Amateur satellite projects have recently come under scrutiny for their suitability for authorization within the amateur satellite service based on their ownership and/or funding sources. For example, NASA generally advises universities and non-profit organizations who obtain launches for satellites through their CubeSat Launch Initiative (CSLI) to obtain experimental licenses. NASA guidance states, of amateur authorizations, that "this designation is intended for satellites that will be used by amateur operators only. There can be no Government or commercial involvement in the development or

[12] "Order In the Matter of Don Rolph Petition for Rulemaking to Amend Part 97 of the Commission's Rules Governing the Amateur Radio Service to Provide for Encrypted Communications." DA 13-1918, Federal Communications Commission, Released September 18, 2013.

[13] ITU Radio Regulations, RR 25.2A

operation of the CubeSat. So, if your CubeSat project is being funded by a Government grant, you are disqualified from getting an amateur designation."[14] We find no basis in the Commission's rules to support denying an amateur authorization solely because a satellite is funded by a government grant. Section 97.207 of the Commission's rules state "any amateur station may be a space station" [47 C.F.R. § 97.207(a)]. Generally, the Commission does not regulate the ownership and/or funding sources of amateur station equipment. Rather, the Commission regulates the operation of that equipment. The Commission's regulatory interest is not in the ownership and/or funding source of the satellite, but that the satellite is operated by a duly licensed amateur control operator in full compliance with the Commission's rules.

**V. Satellites Licensed Under Part 5 Should Not Utilize Amateur Frequencies**

AMSAT opposes the licensing of satellites in the amateur bands under Part 5 of the Commission's rules. Satellites not able to be authorized under Part 97 should utilize spectrum outside of frequencies allocated to the amateur or amateur satellite service. As stated above, we believe that most satellite missions currently carried out by universities or non-profit organizations in the amateur bands under Part 5 licenses are eligible for amateur authorizations. These missions should seek amateur authorizations rather than Part 5 licenses.

As the Commission notes, "the ITU definition [of experimental stations] is more limiting than the definition of experimental operations in the Commission's rules and most experimental licenses issued by the Commission are not associated with experimental stations within the meaning of the ITU Radio Regulations" [Notice p. 9]. This conflict between the Commission's regulations and the ITU Radio Regulations is a source of international confusion. We note that the ITU Radio Regulations state "Where there is no risk of an experimental station causing harmful interference to a service of another

[14] *CubeSat 101: Basic Concepts and Processes for First-Time CubeSat Developers.* NASA CubeSat Launch Initiative. Pg. 45. October 2017. https://www.nasa.gov/sites/default/files/atoms/files/nasa_csli_cubesat_101_508.pdf . Retrieved 6/18/18.

country, the administration concerned may, if considered desirable, adopt different provisions from those contained in this Article."[15] It is unlikely that a space station can meet the requirement of there being no risk of causing harmful interference.

Further, the Commission's current "Guidance on Obtaining Licenses for Small Satellites" requires operators seeking a Part 5 experimental license utilizing amateur frequencies to obtain IARU coordination before applying for the license.[16] However, since August 1, 2017, the IARU will only provide frequency coordination for "a non-amateur satellite if an administration directs in writing that it be operated in an amateur-satellite band under an experimental or other non-amateur license."[17] This results in a confusing "Catch-22" situation for satellite builders.

Experimental licenses also limit flexibility for both satellite operators and the amateur radio community. Stations licensed under Part 5 of the Commission's rules are generally only permitted to communicate with other stations licensed under Part 5 [47 C.F.R. § 5.125]. However, there are many scenarios which may require an amateur station to communicate with a satellite in the amateur bands. For example, UoSAT-OSCAR 9, launched in 1982, was disabled for several weeks when both its 145 MHz and 435 MHz beacons were inadvertently activated simultaneously. This resulted in an inability to command the satellite due to both of its command receivers being "desensed" by the beacons. Amateur operators with the ability to generate large amounts of effective radiated power (ERP) from their antenna arrays were contacted in an effort to successfully command one of the beacons off so that normal commanding and operations could resume. Several operators tried sending commands over the course of a few weeks. Eventually one station was able to command one of the beacons off upon which

---

15 ITU Radio Regulations, RR 27.7 § 5.

16 "Guidance on Obtaining Licenses for Small Satellites." Public Notice, Federal Communications Commission. March 15, 2013. https://docs.fcc.gov/public/attachments/DA-13-445A1_Rcd.pdf. Retrieved 6/18/18.

17 "IARU Aligns Satellite Coordination Guidelines with ITU WRC-15 Decisions." June 30, 2017. The International Amateur Radio Union. http://www.iaru.org/news—events/iaru-aligns-satellite-coordination-guidelines-with-itu-wrc-15-decisions. Retrieved 6/18/18.

the satellite resumed normal operations.[18] A similar situation occurred last year with the rescue of I-Inspire-2.[19] Although the Commission's regulations do permit the granting of authority to communicate with non-experimental stations in circumstances such as these, an amateur authorization provides the flexibility for amateur stations to make these rescue attempts without awaiting the approval of the Commission.

The prohibition on stations in the amateur service communicating with satellites licensed under Part 5 also restricts the ability of these satellites to conduct secondary communications missions for the benefit of the amateur community. Much of the commercially available CubeSat hardware can be utilized for amateur radio digital or voice communications. These features could be activated either following the conclusion of the primary mission or at specified times during the primary mission. AMSAT routinely encourages satellite builders and operators to incorporate and activate these features in their satellites. Unfortunately, these features cannot be activated for the benefit of the amateur radio community if the satellite is licensed under Part 5 of the Commission's rules.

For these reasons, we believe that the limited number of non-commercial small satellites not suitable for licensing as amateur satellites should be assigned frequencies outside the bands allocated to the amateur satellite service. Ideally these satellites would be licensed in a appropriate service, rather than under Part 5.

**VI. Conclusion**

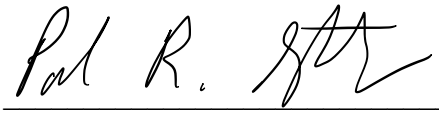
AMSAT appreciates the Commission's interest in examining the licensing rules for small satellites. Builders and operators of satellites in the amateur satellite service continue to provide immense value to the growing field of small satellites by serving as a platform for experimenters to conduct a wide variety of experiments relating to the radio technique. As noted above, experiments

[18] "UoSAT Is Back." *AMSAT Satellite Report.* Number 42, September 22, 1982.
[19] "Amateur radio to the rescue of satellite." AMSAT-UK. https://amsat-uk.org/2017/06/17/amateur-radio-to-the-rescue-of-satellite/ Retrieved 7/3/2018.

conducted by amateur satellites have informed and continue to inform the development of the commercial small satellite industry. Additionally, student participation in amateur satellite projects provides both inspiration for young men and women to pursue careers in the commercial satellite industry and practical experience for those careers. AMSAT and other amateur satellite builders directly inspired the creation of this rapidly expanding industry. A strong and robust amateur satellite service will continue to benefit the public interest and inspire future developments in satellite technology.

RESPECTFULLY SUBMITTED,

Radio Amateur Satellite Corporation (AMSAT)
P. O. Box 27
Washington, DC 20044-0027

By 

Paul Stoetzer, N8HM
Executive Vice President
Email: n8hm@amsat.org

July 9, 2018