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AUG - 1 2001

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

August 1, 2001

BY HAND DELIVERY
Ms. Magalie Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

Re: RM-10165, Amendment of Parts 2 and 97 of the Commission's Rules Regarding the 2300-2305 MHz Band

RM-10166, Co-Primary Allocation of 2300-2305 MHz to the Amateur Radio Service and the Miscellaneous Wireless Communications

Dear Ms. Salas:

Pursuant to Section 1.405(a) of the Commission's Rules, on behalf of AeroAstro, Inc., I enclose herewith for filing with the Commission in the above-referenced proceedings the original and six copies of the Comments of AeroAstro.

Kindly date-stamp and return the extra copy of this cover letter.

If there are any questions about this filing, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus

ML:deb

cc: Service List

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 97 of the	)	
Commission's Rules Regarding the	)	RM-10165
2300-2305 MHz Band	)	
	)	
Co-Primary Allocation of 2300-2305 MHz	)	
to the Amateur Radio Service and the	)	RM-10166
Miscellaneous Wireless Communications	)	
Service	)	

Comments of AeroAstro

AeroAstro, Inc.

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August 1, 2001

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Service	)	

Comments of AeroAstro

AeroAstro, Inc. (AeroAstro) files these comments in response to the Petition for Rule Making of ARRL, the National Association for Amateur Radio (ARRL), filed May 7, 2001.[1] AeroAstro had previously filed its own Petition for Rulemaking relating to the same band on April 9, 2001.[2]

The two petitions make inconsistent requests for allocation of the 2300-2305 MHz band. ARRL seeks an *exclusive* primary allocation to the Amateur Radio Service. AeroAstro, in contrast, seeks a *co-primary* allocation to the Amateur Radio Service and the Miscellaneous Wireless Communications service (MWCS). In order to protect Amateur operations, AeroAstro calls for technical rules at 2300-2305 MHz different from the MWCS rules now in force at 2305-2320 and 2345-2360 MHz.

AeroAstro opposes the ARRL petition to the extent that it (1) seeks a primary allocation to the exclusion of commercial operation, and (2) implicitly seeks continued application of the

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1 *See* Public Notice Report No. 24912 (released July 2, 2001).

2 *Id.*

current Amateur technical rules, which permit operation at powers which are far higher that those actually in use today, and which are incompatible with commercial operation.

A. Summary

AeroAstro opposes the ARRL request for a primary allocation of the 2300-05 MHz band solely to the Amateur Radio Service. Instead, AeroAstro asks the Commission to allocate the band on a co-primary basis to the Amateur Radio Service and the Miscellaneous Wireless Communications service.

AeroAstro proposes rules that will enable the Amateur Radio Service and low-power commercial operations to share the 2300-2305 MHz band on a co-primary basis, without causing harmful interference to each other or to the sensitive receivers of the Deep Space Network in the adjacent band at 2390-2300 MHz.

A grant of the requested allocation will make available 5 MHz of commercial UHF spectrum ideally suited for mobile communications, and will give the Amateur community the primary allocation it seeks, while still affording full protection to the Deep Space Network.

B. About AeroAstro

Since its founding in 1988, AeroAstro has focused on lowering the cost of working in space so as to make space activities accessible to a broader community. The company has brought space to students at high school through post-graduate level, scientists operating on very limited research budgets, small start-up businesses, and the general public. In doing so, AeroAstro has pioneered new uses of space and spacecraft that are appropriate to our low cost, highly accessible approaches to aerospace engineering. Moreover, some of the spin-off from that work shows promise for terrestrial communications. For more information on AeroAstro's track record, see Appendix A.

AeroAstro is interested in the 2300-2305 MHz band in connection with its plans to implement a satellite-based system called SENS (Satellite Enabled Notification System). SENS will enable users to transmit short data messages from any location on the globe, for receipt via the Internet in near-real-time. The system will use small, low-cost mobile ground terminals to transmit low-power messages to the satellites, which act as bent pipes to relay the data down to the nearest ground receiver station. For more information on this application, see Appendix B.

AeroAstro proposes to use the 2300-2305 MHz band only for uplinks from low-power terrestrial terminals to satellites. No downlinks will be operated in the band.

C. AeroAstro Agrees with ARRL that Amateur Operations at 2300-2305 MHz Are Entitled to Protection.

AeroAstro acknowledges the many recent incursions of commercial allocations into Amateur spectrum,[3] and agrees that increasing commercial activity in shared Amateur spectrum nearby will result in significant compression of Amateur use at 2300-2305.[4] AeroAstro does not dispute that 2304 MHz is uniquely suited to weak-signal communications,[5] and that the remainder of the 2300-2305 MHz band is suitable for Amateur point-to-point links.[6]

Congress has likewise noted its support for protecting Amateur activity in the band. In requiring NTIA to identify specific bands for transfer to the private sector -- bands that ultimately included the 2300-2305 MHz band at issue here -- Congress included not just one, but two distinct provisions cautioning NTIA to make choices that preserve the integrity of Amateur

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3 ARRL Petition at 2-5, 7-10.

4 ARRL Petition at 10.

5 ARRL Petition at 10.

6 ARRL Petition at 10.

operations. First, NTIA must "seek to avoid . . . excessive disruption of existing use of Federal Government frequencies by amateur radio licensees."[7] And, second, NTIA must consider "the extent to which, in general, commercial users could share the frequency with amateur radio licensees."[8]

The rules detailed below are intended to further the implementation of these policies.

D. AeroAstro's Proposed Rules Will Protect Both Amateur Operations and the Deep Space Network Against Harmful Interference.

AeroAstro envisions a co-primary allocation in which Amateur and commercial users will share the band,. The coordination rules used in some co-primary bands will not be feasible here, where both Amateur and commercial users are likely to deploy widely. It is therefore important to establish technical rules that will reduce the likelihood of interference between the two users tp extremely low levels.

1. Commercial rules

The following proposed rules are calculated to permit commercially useful operation while both protecting Amateur activity. The proposals closely track NTIA recommendations intended to limit interference into the 2290-2300 MHz Deep Space Network receiver at Goldstone, California:[9]

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[7] 47 U.S.C. Sec. 923(c)(1)(C)(iii).

[8] 47 U.S.C. Sec. 923(c)(3).

[9] NTIA recommends:

- prohibiting use of the band for airborne or space-to-Earth links;
- limiting commercial applications to less than 1 watt of power;
- attenuating unwanted emissions commercial applications below

Power: 1 Watt max EIRP average
Modulation: spread spectrum[10]
Out-of-band emissions: 70dB below 1 Watt average[11]
No airborne operation
No space-to-earth operation
No operation at Ft. Irwin, CA.

These rules accommodate a technology that AeroAstro hopes to implement in the band.[12] The rules are not tailored to that technology, however, and in fact can accommodate average powers much higher than AeroAstro requires.[13] We are confident that the proposed level of commercial activity will not cause harmful interference to either Amateur or Government

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2300 MHz by -70 dB below the mean power of the unmodulated carrier; and

- prohibiting commercial operation on Ft. Irwin, CA.

U.S. Department of Commerce, *Spectrum Reallocation Final Report, Response to Title VI - Omnibus Budget Reconciliation Act of 1993,* at Section 4 (NTIA Special Publication 95-32, Feb. 1995) (NTIA 1995 Spectrum Report).

[10] We propose that the Commission accept any spread spectrum modulation that complies with the present (August 2000) version of Section 15.247 (except for operating frequency). Alternative "digital modulations" recently advanced by the Commission would not be acceptable. *See Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices,* ET Docket No. 99-231, Further Notice of Proposed Rule Making and Order, FCC 01-158 (released May 11, 2001).

[11] The Commission should specify out-of-band emissions as an absolute value, not as a reduction below in-band power, so as not to penalize licensees who can use very low in-band power levels.

[12] *See* Appendix B.

[13] Although AeroAstro proposes a 1 W average limit, its own application would use only 1 microwatt average power, 1 W peak.

operations.[14] AeroAstro will not object to more liberal commercial rules, if the Commission concludes they can be implemented safely.

Service rules for commercial operation should mirror the existing Part 27 rules. Commercial licensees should be permitted to provide any type of fixed, mobile, or radiolocation service consistent with the technical rules. There should be no service-specific provisions governing eligibility, permissible communications, common carrier status, spectrum cap, aggregation limits, build-out requirements, or any other considerations not linked directly to interference.

2. Amateur rules

Amateur stations in the 2300-2305 MHz band are presently permitted to operate at 1500W peak envelope power,[15] although AeroAstro understands that actual operations in the band use far less power.

The following proposed rules are (a) based on our best understanding of current Amateur use of the band, and (b) intended to protect commercial operations having the technical characteristics described above.

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[14] Harmful interference (except to radionavigation and other safety services) is defined as interference which "seriously degrades, obstructs, or repeatedly interrupts" communications. 47 C.F.R. Sec. 2.1.

[15] 47 C.F.R. Sec. 97.313(b).

Narrowbeam operation (*e.g.*, earth-moon-earth):

Power: 100 Watts max
Antenna beamwidth: 5 degrees or less[16]
Modulation: CW or SSB

Other operation:

Power: 25 Watts max EIRP
(no other restrictions)

ARRL's Petition does not propose any technical rules. Presumably ARRL favors the continued applicability of Section 97.313(b), which permits 1500W peak envelope power. Operation at that level, however, may be inconsistent with any commercial application. Moreover, AeroAstro disputes ARRL's claim that the Amateur service is "uniquely capable" of protecting space research efforts below 2300 MHz,[17] in view of the high power levels permitted. (Recall that NTIA recommended a 1 Watt maximum for commercial operations.[18]) AeroAstro believes its proposal for a co-primary allocation affords much better protection to space research.

AeroAstro does not seek to cut back current Amateur operations in the band. Nevertheless, some reasonable limitations, consistent with current use, are necessary to ensure compatibility with commercial users.

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[16] We estimate that a 5 degree antenna beamwidth at 2300 MHz requires a dish size of approximately 1.85 m, with an efficiency of 55% (typical for commercial applications). Antenna gain with these parameters is 30.39 dBi.

[17] ARRL Petition at 10.

[18] NTIA 1995 Spectrum Report at Section 4.

E. A Co-Primary Allocation Is in the Public Interest.

The 2300-2305 MHz band is one of only two bands below 300 GHz having no primary allocation.[19] Historically, this anomaly resulted in part from NTIA's transfer of 2300-2310 MHz,[20] followed by Congress's instructions to allocate and auction 2305-2320 MHz.[21] The combination of actions effectively stranded the 2300-2305 MHz segment. But the Commission has had its own concerns about the band. As recently as 1999, the Commission doubted that commercial operation in the band could adequately protect NASA's Deep Space Network, not to mention ongoing Amateur activity.[22]

At least one technology can now use the band for commercial services within the constraints specified by NTIA, and with little risk of interference to Amateur operations. Co-primary allocation of the band, as AeroAstro requests, will add 5 MHz of UHF spectrum to the Commission's useful inventory. The band's propagation characteristics and antenna lengths make it ideally suited to mobile communications. Moreover, the power limitations imposed by NTIA and Amateur compatibility make the band ideal for low-power services, such as AeroAstro's, that

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[19] *See* 47 C.F.R. Sec. 2.106. The other is 2417-2450 MHz, which is heavily used by ISM devices (including millions of microwave ovens), unlicensed transmitters under Part 15 (including wireless LAN systems and wireless Internet access), and Amateur operators.

[20] NTIA 1995 Spectrum Report at Section 4. The Omnibus Budget Reconciliation Act of 1993 (OBRA) required NTIA to transfer at least 200 MHz of spectrum below 5 GHz for non-governmental use, with at least 100 MHz of that coming below 3 GHz. Sec. 6001, P.L. 103-66 (enacted Aug. 10, 1993), *codified at* 47 U.S.C. Sec. 923.

[21] Sec. 3001, Omnibus Consolidated Appropriations Act, P.L. 104-208 (enacted Oct. 4, 1996).

[22] *Principles for Reallocation of to Encourage the Development of Telecommunications Technologies for the New Millennium*, Policy Statement, 14 FCC Rcd 19868, 19881 at para. 28 (1999).

cannot easily coexist with ubiquitous high-power transmitters. The allocation will make possible the delivery of commercial services that are not presently feasible.

The Commission should deny ARRL's request for a sole primary allocation. ARRL's claim that such an allocation represents the "highest and best use of the band"[23] is demonstrably wrong, considering that commercial users can share the band, under the rules proposed above, with little or no adverse impact on Amateur activity.

AeroAstro's requested co-primary allocation should ultimately benefit the Amateur community. Today the Amateur Radio Service has only a secondary allocation in the band. If the Commission instead were to institute a primary allocation for commercial service, the Amateurs would have to accept interference from that service, and would not be permitted to interfere with it. A co-primary allocation with a low-power commercial service, as proposed here, will give Amateur operators almost as much flexibility as would a sole primary allocation, consistent with the applicable technical rules, and with no user having superior rights over them.

AeroAstro is able to propose a co-primary allocation for this band because it can design commercial equipment that protects both the Deep Space Network and Amateur receivers. Similarly, the spread spectrum receivers AeroAstro intends to deploy will be relatively insensitive to interference from Amateur transmitters operating in accordance with the rules proposed above. Although Amateur interests have expressed concern about commercial satellite uplinks in the band, because earth-moon-earth transmitters could saturate satellite receivers passing through the

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[23] ARRL Petition at 6.

beam,[24] the intermittent nature of AeroAstro's proposed operations can tolerate this kind of interference.

Again, AeroAstro does not seek technical rules tailored to its products. Rather, it offers its technology as an "existence proof" that commercial compatibility with Amateur systems and the Deep Space Network is fully practical. AeroAstro urges the Commission to admit any technology to the band that is capable of adequate compatibility.

In short, a co-primary allocation to the Amateur Radio Service and the Miscellaneous Wireless Communications Service, under appropriate technical rules, benefits everyone. NASA will be assured of continued protection to the Deep Space Network. The Amateurs will achieve primary status, albeit shared. AeroAstro (or whoever wins the auction) will be able to serve its customers. And the Commission will have put under-utilized spectrum into full commercial service.

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[24] *See* NTIA 1995 Spectrum Report at Appendix B.

CONCLUSION

The Commission should promptly initiate a rulemaking to allocate the 2300-2305 MHz band to the Amateur Radio Service and the MWCS on a co-primary basis, subject to technical rules calculated to minimize harmful interference between the two services and to protect NASA's Deep Space Network.

Respectfully submitted,

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August 1, 2001

Counsel for AeroAstro, Inc.

Appendix A --About AeroAstro

Since its founding in 1988, AeroAstro has focused exclusively on lowering the cost of working in space so as to make space activities accessible to a broader community. The company has brought space to students at high school through post-graduate level, scientists operating on very limited research budgets, small start-up businesses, and the general public. In doing so, AeroAstro has pioneered new uses of space and spacecraft that are appropriate to our low cost, highly accessible approaches to aerospace engineering.

AeroAstro's first satellite, ALEXIS, is a small spacecraft developed for the Los Alamos National Laboratory to provide high resolution maps of low-energy x-ray sources and ionospheric physics. AeroAstro designed and built the spacecraft bus and the ground station, and also supported the launch and ground operations activities. ALEXIS was launched in April 1993 and is still operational over six years later, far exceeding its design lifetime of six months.

HETE (High Energy Transient Experiment) is a small satellite developed at AeroAstro for the Massachusetts Institute of Technology. Its mission is detection and observation of high energy events in the gamma ray, X-ray, and UV spectra. AeroAstro provided the spacecraft bus, ground stations, and all payload integration and tests. HETE was launched but lost due to a Pegasus XL failure on November 4, 1996.

TERRIERS (Tomographic Experiment using Radiative Recombinative Ionospheric Extreme Ultraviolet and Radio Sources) is AeroAstro's most recently completed satellite, developed at AeroAstro for Boston University. Its mission is to demonstrate global ionospheric tomography and to utilize this technique for the study of ionospheric/ thermospheric processes. AeroAstro provided the spacecraft bus, ground stations, and all payload integration and tests. TERRIERS launched successfully in May 1999.

AeroAstro built the S-band spacecraft radios and S-band tracking ground stations for each of the three spacecraft described above, and developed internally all of the software for both the spacecraft and ground stations. In addition, AeroAstro recently built a set of S-band radios for the Swedish FREJA spacecraft, which have been functioning in orbit for more than 6 months.

In 1997, AeroAstro completed the system architecture and design for a LEO spacecraft-based messaging system for an Australia-based firm, KITComm. This system shares some design features with the proposed SENS system, although it is substantially more complex.

Through the NASA Small Business Innovation Research (SBIR) program, AeroAstro is developing compact, power-efficient, inexpensive X-band radios for nanosatellites. The initial design phase has been completed and prototyping is beginning, with an ultimate objective of developing a product suitable for commercialization. These X-band transponders were also recently selected to provide Earth/Space communications for the NASA New Millennium Program's ST5 mission. This mission, the Nanosatellite Constellation Trailblazer, will provide validation of innovative, new technologies for future space missions.

Under a U.S. Air Force contract, AeroAstro is also developing a compact, inexpensive X-band inter-satellite communications and ranging system, to be used on an Air Force nanosatellite constellation mission known as Techsat-21. This system will launched in approximately 2004. This technology is key to both the Air Force and NASA's plans for using constellations of miniature spacecraft as virtual antennas and/or interferometers.

AeroAstro has performed dozens of system designs and studies for organizations including Jet Propulsion Laboratory, Los Alamos National Laboratory, Naval Research Laboratory, NEC, Canadian Space Agency, NASA, Nissan, Philips Labs, and numerous U.S. universities. The company has also developed numerous spacecraft system components for these

clients, including sun sensors, NiCad and Li-Ion batteries, mass memories, processor boards, power controllers, cold gas thrusters, electromagnetic torquers, and attitude control software.

Appendix B -- About SENS

AeroAstro's Satellite Enabled Notification System (SENS), now under active development, enables users to transmit short data messages from any location on the globe, for receipt via the Internet in near-real-time. The system has three key components: (a) small, low-cost mobile ground terminals, (b) small, low-cost space stations, and (c) fixed ground receiver stations. The mobile terminals transmit low-power, spread-spectrum modulated messages to the satellites, which act as bent pipes to relay the data down to the nearest ground receiver station.

SENS will use the 2300-2305MHz band only for uplinks from mobile terminals to satellites. No downlinks will be operated in the band.

SENS can also be operated in a terrestrial mode, for applications that are confined to an area of a few kilometers. Instead of a satellite, this implementation uses a tower-mounted receiver with line-of-sight to the active terminals. One early application of this type will use SENS terminals to monitor aircraft noise at locations around an airport, under an experimental license. Similar terminals can be used for both terrestrial and satellite applications, if the same frequency band is available for both.

SENS mobile terminals are direct sequence spread spectrum transmitters, operating at one watt or less, in full compliance with Section 15.247 (except for choice of band). These have the lowest cost, complexity, size, and weight, and require the least supporting infrastructure, of any space-based communications system to date. In commercial quantities, the terminals will cost only a few dollars each to manufacture. A global quasi-real-time service will need only two small launches of clusters of very low cost microsatellites. Thus, both the user's terminal and access costs will be very low.

Small size and minimal cost will enable SENS to provide critical services not presently available. Using inexpensive GPS technology, SENS can report basic position as well as status data on millions of deployed, highly miniaturized, autonomous terminals. These will eventually be small enough to build into a wristwatch, a bracelet, or a shoe. Early users of SENS terminals will include hikers, hunters, surveyors, and others whose occupation or pastime puts them at risk in the outdoors. Anywhere in the United States, and eventually the world, the push of a button will provide an alert and position fix. In some applications, units will transmit automatically at fixed time intervals or in response to specified external events. SENS terminals may ultimately become a standard feature in children's shoes, military ID bracelets, and even clothing of people who travel or recreate in wilderness areas. Their families and associates can receive frequent updates via the Internet on the traveler's status and position, with histories over time.

SENS can be used to enhance personal safety and security. Older and infirm persons can use SENS to call for assistance. Children can have SENS terminals clipped to their clothing at amusement parks and similar sites where there is a risk of becoming separated from caregivers. Motorists stranded in isolated areas can summon help. Anyone can use SENS as a personal security device, possibly dangling from a key chain.

The tiny, low-cost, low-power SENS uplink terminal can be attached to packages, utility poles, cattle, fleet vehicles, railroad cars, and other deployed capital assets to monitor their positions and conditions. Trucking companies can gather data on speed, mileage, even engine temperature. Soft-drink and other vending machines can report low-stock conditions. The terminals are so low in cost and small in size that they can be distributed over an agricultural area to monitor water, fertilizer, and pesticide concentrations, along a border crossing to monitor

immigration, at building doors and windows to report intruders, or on smoke, heat, and flood alarms for remote monitoring.

In short, SENS combines personal security, asset and resource management, communications, and remote sensing applications in a communications network. It will be a pathfinder for new services, a first point of entry for many clients into wireless and satellite-based services, and a catalyst for other similar systems. Once the system is in place, users no doubt will identify dozens of other applications.

Technical information. Using direct sequence spread spectrum, very low power, and a very high gain satellite-based receiving antenna, SENS emissions are highly spectrum efficient and non-interfering. Except for choice of band, SENS transmitters comply with the Commission's technical requirements for spread spectrum devices. *See* 47 C.F.R. Sec. 15.247. Like other spread spectrum applications, SENS signals can share spectrum with narrowband or other spread spectrum signals with little risk of harmful interference. Terminal data message length is restricted to 128 bits. Data rate will be 100 bits/second, for a transmission time per message of 1.28 seconds. Terminals can be programmed to transmit 2-3 messages in a 24 hour period, as well as to transmit on command from an attached sensor (to report a button press or an alarm condition). Output RF power from a terminal will be approximately -33 dBm/Hz. Low power output makes the terminals safe in any application.

CERTIFICATE OF SERVICE

I, Deborah N. Lunt, a secretary with the law firm of Fletcher, Heald & Hildreth, P.L.C., hereby state that I forwarded the forgoing COMMENTS OF AEROASTRO, INC. by first-class mail, postage prepaid, this 1st day of August, 2001, to the following:

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