



NATIONAL RADIO ASTRONOMY OBSERVATORY

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Procedures to Govern the Use of Satellite Earth)
Stations on Board Vessels in the 5925-6425 MHz/) IB Docket No. 02-10
3700-4200 MHz Bands and 14.0-14.5 GHz Bands)
)

Comments of the
National Radio Astronomy Observatory
Charlottesville, VA 22903

I. Introduction and Background

1. The National Radio Astronomy Observatory (NRAO) is pleased to provide comments in response to the Commission's Notice of Proposed Rulemaking (FCC 03-286) governing the use of satellite earth stations on board vessels (ESVs) in the 5925-6425 MHz/3700-4200 MHz bands and 14-14.5 GHz/ 11.7-12.2 GHz bands (IB Docket No. 02-10).

2. The NRAO (<http://www.nrao.edu>), operated by Associated Universities, Inc. (<http://www.aui.edu>), under a cooperative agreement with the National Science Foundation, is the largest radio astronomy observatory in the world and is responsible for much of the basic research conducted by the Radio Astronomy Service nationally and internationally. It currently operates the Very Large Array in Socorro, New Mexico, the Robert C. Byrd Green Bank Telescope in Green Bank, West Virginia, and the Very Long Baseline Array, two components of which are the subject of these comments. NRAO facilities are open to all members of the international community. In 2002, the last year for which complete statistics are available, NRAO instruments were used by 1,050 uniquely-identifiable investigators (150 students) representing 190 institutions around the world, resulting in more 500 publications.

3. Comment is sought (NPRM at 38) on the extent to which the 14.4-14.5GHz band is used by the Radio Astronomy Service. As already noted by the Commission (NPRM at footnote 79), 13 stations of the Radio Astronomy Service operate in the United States in the 14.47-14.5 GHz band and so could be affected by the proposed rules. With the sole exception of Arecibo Observatory, these stations are facilities of the NRAO. Of the 12 noted NRAO stations, two are likely to be affected by the operation of ESVs, namely those in St. Croix, VI, and Mauna Kea, HI. Both stations are located in regions with substantial sea traffic and are within clear line of sight distance of the ocean. The antenna on Mauna Kea, HI, is sited at 12,000 feet elevation some 25 km inland and consequently has a horizon distance well in excess of 125 km. The St. Croix antenna, sited only 16 m above sea level, has a horizon distance of 30 km when the vertical extent of the structure is considered: the interaction distance will be increased somewhat owing to the height of the transmitting ESV antenna.

4. The potential victim stations comprise the southernmost antennas of the 10-station Very Long Baseline Array (VLBA) (<http://www.aoc.nrao.edu/vlba/html/>), one of the NRAO's three major existing facilities. The VLBA is an interferometer whose overall efficiency of operation depends

on the number of baselines which can be drawn between pairs of contributing stations. This number of baselines varies as the square of the number of contributing stations, in which case the loss of one or two of the 10 stations causes operation to be at best only 80 percent, or 62 percent as efficient as operation with all 10. The potentially-affected VLBA stations are sited at the east-west and southern extremities of the instrument and so are especially important in attaining the highest resolving power of which the instrument is capable.

5. Ku-band observing is fundamental to operation of the VLBA. This frequency is sufficiently high to provide excellent spatial resolution yet well below the K-band telluric water emission. For this reason, a large, ongoing internationally-based survey of the most astronomically-important objects is being conducted in the Ku-band: the fruits of this work can be viewed online at <http://www.cv.nrao.edu/2cmsurvey/>. Compromising VLBA operations in the Ku-band would constitute the most serious sort of damage to international scientific cooperative projects.

II. Threshold levels of harmful interference.

6. Comment is sought (NPRM at 16) on whether to adopt the Ku-band eirp and eirp density limits toward the horizon cited in Resolution 902 (WRC-03): these are 16.3 dBW and 12.5dB W/MHz, the latter corresponding to 16.3 dBW spread over 2.4 MHz bandwidth. According to Table 4 of Rec. ITU-R RA.769-1, the threshold level for interference with VLBI observations at 14.5 GHz is -188 db W/m²/Hz, equivalent to -128 db W/m²/MHz. At the outermost coordination radius of 125 km, these thresholds correspond respectively to -75 db W/Hz and -15 db W/MHz. Line of sight transmission at higher levels than these, or transmission at these levels within line of sight distances less than 125 km, will result in levels exceeding the recommendations.

7. Thus, the eirp and eirp density limits adopted in Resolution 902 (WRC-03) are inadequate for the protection of the Radio Astronomy Service: they are at least 12.5 dB + 15 dB = 27.5 dB higher than those needed to protect VLBA observations.

III. Tracking of ESVs.

8. Comment is sought (NPRM at 96) on various aspects of a database to track and provide the locations of ESVs, possibly in real time.

9. Real-time intervention to ameliorate the effect of harmful interference from ESVs is not practicable due to the basic nature of the VLBA observing. The potential victim VLBA antennas, although they take data nearly continuously, only function as part of a larger network and are largely unattended. Their datastreams are not interrogated until after transfer (on tape) to a central location in New Mexico for correlation with data from all the other antennas. This period of latency can range from days to weeks, after which the correlated but still somewhat raw data are disseminated to the researchers who "own" them. Moreover, radio astronomers typically study signals well below the usual noise floor and harmful interference cannot be assessed until the data have been fully reduced and examined in the greatest detail, introducing even further delay.

10. Nevertheless, NRAO supports the creation and maintenance of such a registry either under the password-protected Internet registry option or through a single point of contact for location of ESVs. NRAO believes that minimizing the number of contacts necessary to locate a prospective source of interference in a literal sea of possible contributors is an important goal of the intended registry. Should interference to radio astronomy operations in the Ku-band be noted, a location database would prove invaluable to the process of attribution and therefore to the prospect of preventing future instances of interference by the same ESV. Moreover, the considerations of paragraph 9 above show that the database location information would remain relevant for some substantial time after an observation is performed. Consequently, NRAO favors retention of entries within the location database for a period of at least 90 days, as described in paragraph 14 below.

IV. Summary; measures needed to protect radio astronomy.

11. The calculations and discussion presented here in paragraphs 6, 7, and 9 demonstrate the great potential for harmful interference from ESV and the difficulty of assuaging a particular instance of such interference once it begins. We therefore recommend that ESVs not be allowed to transmit in the 14.47-14.5 GHz band while inside exclusion zones to be established about the antennas in Mauna Kea, HI, and St. Croix, VI. For the St. Croix site, the exclusion zone would extend 45 km about the site in all directions, corresponding to the calculated horizon distance of 30 km and an allowance for the height of the ESV. For the Mauna Kea site, transmission should not occur within 125 km of the site while the ESV is east of the site and between latitudes 19d40' and 20d30'.

12. Comment is sought (NPRM at 30) on whether the FCC "should require ESVs in the Ku-band to operate on a non-harmful interference basis to the secondary Ku-band services, as would be typical for operations that are non-conforming to the allocation table." We most strongly urge that the FCC adopt this requirement.

13. As well, despite the inadequacies of the eirp limits embodied in Resolution 902 (WRC-03), as demonstrated here in paragraphs 6-7, we most strongly endorse the proposed footnote (NPRM at 41), to the effect that "ESV operators shall take all practical steps to comply with ITU Resolution 902 (WRC-03)."

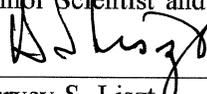
14. As noted here at paragraph 10, we favor the creation of a tracking registry for ESV. Entries should be retained for at least 90 days after the ESV has completed its passage through the exclusion zones described here in paragraph 11.

15. The Commission seeks comments on the conditions under which U.S. licensees of an ESV network should be allowed to communicate with vessels of foreign registry that may operate near the U.S. Coast (NPRM at 100). NRAO favors prohibiting such communications in the 14.47-14.5 GHz band within the two zones described here in paragraph 11. Similarly, NRAO believes that, in order to protect radio astronomy operations, the Commission should not authorize transmissions from ESVs located on ships of foreign registry within the 125 km exclusion radius, in the vicinity of the Mauna Kea and St. Croix sites (NPRM at 103). We encourage the FCC to use its good offices to the fullest extent possible in the protection of domestic incumbent services, which it clearly recognizes to be important national assets (NPRM at 1).

Respectfully submitted,
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