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

In the Matter of Lynk Global, Inc. Application to launch and operate space stations to provide mobile-satellite service under the FCC streamlined small space station authorization process, 47 CFR 25.122.	)	IBFS File Nos. SAT-LOA-20210511-00064 Call Sign: S3087

Opposition

National Radio Astronomy Observatory and Green Bank Observatory

I. Introduction

1. Here, the National Radio Astronomy Observatory ("NRAO", "the Observatory"), comments on behalf of itself and the Green Bank Observatory (GBO), opposing the Application to launch and operate space stations to provide mobile-satellite service under the FCC streamlined small space station authorization process, 47 CFR 25.122 ("the Application") from Lynk Global, Inc ("Lynk").

2. The National Radio Astronomy Observatory and its sister Green Bank Observatory (http://greenbankobservatory.org/) are operated by Associated Universities, Inc. (http://www.aui.edu) under a cooperative agreement with the National Science Foundation. Their facilities include the Jansky Very Large Array (VLA) in New Mexico, the 100m Robert C. Byrd Green Bank Telescope (GBT) in West Virginia and the 10-element Very Long Baseline Array (VLBA) that is distributed from St. Croix to Hawaii, including Brewster, Washington.

II. The Lynk chimera

3. Lynk's Technical Narrative Statement[1] begins by describing the proposed system as follows:

[1] https://licensing.fcc.gov/myibfs/download.do?attachment_key=7345368

"I Lynk Smallsat System

The proposed Lynk Smallsat System will contain both a space and ground component. The space component will have ten (10) small satellites operating in the non-geostationary ("NGSO") mobile satellite service ("MSS"). The ground component will be made up of fixed earth stations at specific locations in-and-outside the United States to operate feeder links and Telemetry, Tracking, and Command ("TT&C"). Also comprising the ground component are the service links connecting off-the-shelf cellular devices with Lynk's satellites using UHF frequencies. The Lynk Smallsat System is a cellular-based satellite communications network that will provide global GSM and LTE cellular services by operating on most cellular frequencies used globally in the 617-960 MHz band."

4. As shown in Table 1 below, no spectrum in the frequency range 617 – 960 MHz is allocated to the MSS in any ITU-R Region. Rather, there are allocations to the mobile service (MS):

Table 1: Frequency allocations to the mobile service in the frequency range 617-960 MHz

ITU-R Region	MS secondary	MS primary	Except Aeronautical Mobile
1		694-960 MHz	694-960 MHz
2	614-698 MHz		
2		698-960 MHz	890-942 MHz
3		617-960 MHz	none

5. The MS and MSS are defined separately in Articles 1.24 and 1.25 of the Radio Regulations (RR) respectively, just as space stations (satellites) and mobile stations are separately defined in RR. 1.64 and RR. 1.67. Stations operating in the mobile service communicate with each other and not with satellites. The MSS is not a subset of the MS and MS spectrum is not at the disposal of MSS operations.

6. In this way, the proposed Lynk system is a chimera that uses MSS spectrum in more or less accepted ways (some intersatellite links (ISL) operate under RR. 4.4) to support improper communications between mobile and space stations using spectrum allocated only to other services for other purposes.

III. Radio astronomy operations and radio quiet zones

7. It is not accidental that frequency allocations to mobile-satellite (space-Earth) are not shared with allocations to the mobile or radio astronomy services. Moreover, much of the spectrum allocated to the mobile service is qualified with "except aeronautical mobile" as shown in Table 1.

8. The efficacy of radio astronomy observing depends in large measure on this segregation: Potential interference from terrestrial sources is eliminated by geographic coordination, allowing cosmic radio waves at those frequencies to be

observed. This principle is embodied in the US National Radio Quiet Zone[2] and the other radio quiet zones[3] that surround more than a dozen of the world's radio telescopes, but it is practiced even more generally.

9. These carefully-conceived protections for radio astronomy would be mooted by allowing Lynk to downlink in spectrum allocated to mobile and especially mobile (except aeronautical mobile) spectrum that is not allocated to satellite operations.

IV. Lynk service power fluxes and radio astronomy interference thresholds

10. Antenna gains, service power flux levels and other operational parameters are given in Lynk's Attachment Sched S Tech Report[4]. Properties of the UHF satellite downlink are given in Table 2 below as excerpted from that document, assuming the same 18 MHz wide channels that Lynk used to convert from power flux to power flux density in its descriptions of the transmitting beams:

Table 2: Peak Gain and Power Flux (dB W/m^2) per 18 MHz-wide UHF downlink channel vs beam angle from Lynk's Attachment Sched S Tech Report

Beam	Peak Gain dBi	0^o-5^o	5^o-10^o	angle 10^o-15^o	15^o-20^o	20^o-25^o	25^o-90^o
3	21.44	-106.1	-103.1	-100.7	-98.7	-96.9	-87.7
4	24.32	-103.2	-100.2	-97.9	-95.8	-94.0	-84.9

11. By way of comparison, Table 3 gives the power flux limits applicable in the National Radio Quiet Zone in the frequency range 470 - 1000 MHz and as interpolated in Table 1 of Recommendation ITU-R RA. 769[5]. Values in Table 3 assume 0 dBi gain for the radio astronomy antenna:

Table 3: Power flux limits (dB W/m^2) appropriate to the National Radio Quiet Zone and from Table 1 of Recommendation ITU-R RA. 769

Use case	Power flux
NRQZ	-170
RA. 769	-180

12. Radio astronomy operations need 70-90 dB of isolation from Lynk's downlinks in the static case with 0 dBi radio astronomy gain, even in the far off-axis limit of the Lynk downlink beam. A proper calculation would require an epfd simulation and could indicate the need for greater isolation.

13. It is unfortunate enough that the system will interfere outside the US where Lynk proposes to operate. But there is also no way to limit the potential for interference from the Lynk system to regions outside the US. Radio astronomy operators inside

[2] See 47 CFR 1.924(a) Quiet Zones (NRAO)
[3] https://www.itu.int/pub/R-REP-RA.2259
[4] https://licensing.fcc.gov/myibfs/download.do?attachment_key=7407314
[5] https://www.itu.int/rec/R-REC-RA.769/en

the US, including within the National Radio Quiet Zone, cannot help but see these satellites at levels in excess of radio astronomy interference thresholds.

V. ISL and the 1610.6 – 1613.8 MHz radio astronomy band

14. In several places, for instance the table of "ISL Operational Parameters" on page 27, Lynk's Technical Narrative describes use of an ISL downlink at 1613.75 – 1616.25 MHz, within frequency bands at 1610.6-1613.8 MHz and 1613.8-1626.5 MHz that are allocated to MSS (Earth-space) on a primary basis. The primary frequency allocation to the radio astronomy service at 1610.6 – 1613.8 MHz is subject to RR. 5.372 which forbids harmful interference to the radio astronomy service from MSS operations in the immediately aforementioned MSS bands.

VI. Lynk ground stations

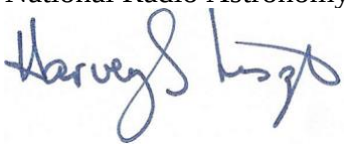
15. Section II "Space Station Antennas" of Lynk's Technical Narrative shows images of satellite feeder link beams projected on the terrain "near Brewster, WA". NRAO was surprised to find Brewster, WA, site of a VLBA radio astronomy antenna (see US 131, 161, 385), used for this purpose, even as an example.

VII. Summary

16. Lynk's proposed operations are irregular and should not be authorized and imposed on spectrum users whether outside the US (where Lynk proposes to operate) or not. The potential for interference is global and the operation of the National Radio Quiet Zone will be compromised.

Respectfully submitted,

National Radio Astronomy Observatory



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