TO: [redacted]
[redacted]
Ofcom
2a Southward Bridge Road
London SW1S2ET

16/12/2024

Re.: Ofcom Request for Additional Information

Dear [redacted],

Thank you for your letter dated November 29th, 2024. Please find Kepler's responses below to each of Ofcom's questions which should facilitate a decision regarding Kepler's NGSO earth station network license application. Kepler would like to highlight that the exact same network under consideration in this application was previously operating under an Ofcom-issued license without any complaints of interference, and that this extensive reassessment by your office has been the result of a misplaced email reminding Kepler to submit payment for the following year for its previously held license.

1. **NGSO Operating Frequencies:** Kepler confirms that it only intends to operate under the Ku-band frequencies, specifically within the range of 14-14.5 GHz in the uplink direction within the United Kingdom.

2. **Coexistence analysis:**
   We request that you provide a publishable narrative explaining the parameters Kepler has chosen to model (for both the NGSO system and its victim) and why Kepler considers they represent the highest potential for interference for operating in the UK, for both the initial study submitted with your application and second study (if different).

   We also invite you to review the results in your technical analysis (provided in your initial and second studies) to ensure that any contradictory results are addressed or explained. We would welcome the results of your second study in a non-confidential format for the reasons explained above.

   Without sharing a significant amount of information between operators, it is not possible to identify the highest potential for interference. Kepler has thus sought to progress its coordination efforts, having completed coordination with one Ku-band operator and begun coordination with the other. Kepler is currently in a holding pattern, however, having requested further information without response from the operator with whom coordination is ongoing. Kepler has not received correspondence from said operator since July 2024.

The highest interference can be shown using a static link budget, but this approach is unreasonable due to the missing statistics of occurrences resulting from such a simplistic interference analysis. Dynamic simulations, which properly capture the varying geometry of the problem, would be the most appropriate approach to assess the level of interference and its related statistical occurrences. Hence, Kepler provided Ofcom with what Kepler deems to be a representative dynamic scenario. As mentioned above, any additional interference analysis requires both parties to share the relevant technical parameters demonstrating how each system works.

The impact of interference on a victim system is assessed using two key metrics: 1) the increase in unavailability (i.e. victim link C/N below the objective C/N due to interference), and; 2) the average throughput degradation (also called average spectral efficiency degradation). Kepler uses a threshold value of 0.1% for the increase in unavailability, and a threshold of 3% for the average throughput degradation.
Kepler used the following assumptions in its assessment of interference for the first and second technical demonstration:

- Atmospheric attenuation is taken into consideration on both victim and interfering links. Since both the victim and the interfering ground stations are assumed to be collocated, this loss is considered correlated. This means that any space-to-Earth or Earth-to-space links have the same probabilistic atmospheric attenuation (i.e. p-value) at each time step. Atmospheric models used are the ones recommended by the ITU, such as the rain (ITU-R P.618), gaseous (ITU-R P.676), cloud (ITU-R P.840) and scintillation (ITU-R P.618) attenuation models.
- Regarding the victim link, the lowest spectral EIRP density has been chosen. This results in a victim system being more sensitive to interference. The impact of interference is assessed by the effect interference has on how often the victim system can meet an objective C/N. Second, the amount of throughput degradation is taken into consideration. A victim system utilizing a low EIRP spectral density will ultimately result in the system hitting the C/N objective less often. This fact makes the victim more sensitive to interference and demonstrates a scenario in which there is a higher potential for harmful interference.
- Regarding the interfering link, the highest spectral EIRP density has been chosen. This results in an interfering system with a higher signal strength received on the ground and in space. When paired with a victim that is especially susceptible to interference, the potential to highlight more instances of harmful interference is increased.

Kepler provided two separate analyses to Ofcom. In the second analysis, the parameters chosen to represent the maximum operational parameters of the Kepler system, per Ofcom's request. This mostly describes how Kepler's second-generation satellites will operate in emergency and backup situations. This assumption remains an overly conservative description of the Kepler system given that Kepler satellites would never continuously operate at maximum emergency power for 5 days (i.e. simulation duration used). A more accurate

representation of the interference environment would require detailed coordination discussions with incumbent UK operators, which Kepler has been trying to complete.

3. **Coexistence with future NGSO systems:** Coexistence among NGSO systems requires minimizing the occurrence and impact of in-line events. Kepler's system is designed to implement effective mitigation measures, including the use of opposite polarization and dynamic frequency adjustments. Using opposite polarization could reduce interference by employing both Left-Hand Circular Polarization and Right-Hand Circular Polarization, allowing Kepler's system to effectively isolate its signals from other systems operating within the same frequency band. The system may be capable of switching between these polarizations to ensure efficient coexistence with other operators. To avoid overlapping frequencies, Kepler implements frequency channelization, allowing the system to adjust its operating frequencies if necessary. As previously stated in Kepler's application, the satellites and user terminals are equipped with software-defined radios, which support adaptive output power and beam steering. These capabilities enable Kepler to optimize transmission parameters and reinforce the system's ability to meet coexistence requirements.
   The exact techniques that Kepler would implement will be determined through coordination discussions with other operators, where the unique operational parameters of all relevant systems will be taken into consideration.

   Kepler understands that the specific characteristics of future NGSO systems cannot be predicted and acknowledges the expectation to reasonably accommodate new licensees. It will comply with all such conditions in good faith.

4. **Coordination status:** Kepler confirms that it has successfully concluded coordination with foreign licensed NGSO systems operating in Ku-Band within the United Kingdom. As noted above, coordination with OneWeb, Ltd. is ongoing as we await a response to our July correspondence. Coordination with HII under 9.7B is ongoing. Coordination with other GSO operators subject to EPFD regulations has been complete by way of a favorable finding from the ITU. Kepler is committed to fulfilling its obligations to facilitate coexistence and coordinating in good faith. The aforementioned captures the status of coordination for the systems which Kepler believes are pertinent to Ofcom's assessment.

5. **Control over the NGSO system:** Kepler has full control over the entirety of its NGSO system, including satellites, Earth stations, and user terminals. The Network Operations Center (NOC), located at Kepler's headquarters in Toronto, Canada, oversees all operational aspects. The NOC can deactivate gateway Earth stations as necessary. Gateway Earth stations can issue commands to Kepler satellites to cease emissions immediately, and Kepler satellites are capable of commanding user terminals to terminate operations when required. Kepler has knowledge of each user terminal on its network and can assist in tracking down, contacting, and resolving possible sources of interference in this way when required.

6. **Kepler's operations and services:** Kepler's NGSO system is designed to provide IoT and data transfer connectivity services across the UK, along with a newly demonstrated optical service, successfully tested in June 2024. This service uses in-space optical links between satellites, enabling high-speed, low-latency data transfer that significantly boosts network capacity and efficiency. It is worth noting that optical operations are currently outside the regulatory scope of both the ITU and Ofcom.

7. **Future gateway:** Kepler does not currently plan to deploy any gateway infrastructure within the United Kingdom. If such plans arise in the future, Kepler will promptly inform Ofcom and provide the necessary details.

8. **Coordination with HII:** Kepler confirms that it has initiated coordination discussions with HII and will continue these efforts to meet licensing and coexistence obligations for the specific earth stations which may not be covered by EPFD and would fall under 9.7B of the Radio Regulations.

9. **UK customers:** At this time, Kepler has no active customers based in the UK. Kepler remains committed, upon award of the requested license, to expanding its customer base in the region and supporting UK industries with advanced satellite services.

Kepler looks forward to the timely granting of the NGSO earth station network license. Should there be any further questions or requests for clarification, Kepler is ready to address them promptly.

Respectfully submitted,

[redacted]

[redacted]
[redacted]
Kepler Communications Inc.