Your response

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Question 1: Are there other trends in the space sector (or the broader spectrum environment) that we should monitor and/or take account of in our strategy?	As Ofcom rightly recognizes, certain portions of spectrum are becoming more contentious with the growing deployment of new NGSO constellations. The unprecedented growth of the satellite market is accompanied by a wealth of innovative services being deployed in bands which have previously only been occupied by a few legacy operators. It is important that Ofcom remains cognizant of the changes in service offerings in these bands, and up to date on new markets that are under development such as space utilities for in-space assets. Kepler is in the process of deploying its inter-satellite link network to provide always-on connectivity to other satellite operators' assets, the implementation of which will be conducted through a combination of Kepler-operated satellites and hosted payloads aboard customer satellites in LEO. Kepler recommends Ofcom take account of the growth for such services which are emerging to support the general growth of services provided by operators in LEO.
Question 2: Do you agree with the broad areas we have prioritised for our work?	Kepler agrees with the areas that Ofcom has identified as core priorities in this consultation, particularly the focus on Non-Geostationary Orbit (NGSO) communications. Ofcom highlights the regulatory challenges that are presented by the growing use of NGSO systems, balanced with the value that these systems provide to the space industry. Competition for spectrum is intensifying, and systems using technologies that allow

	for more efficient use of spectrum should be encouraged, rather than upholding a system that provides exclusive licensing.[1] For example, as Ofcom recognizes, new NGSO satellite systems often have the ability to make dynamic use of spectrum.[2] However, such design choices are beneficial to the interference environment. By employing radios which are reconfigurable on-orbit, NGSO operators are expanding their flexibility to coordinate with other systems, while increasing their ease of global operations across jurisdictions with often-conflicting spectrum-use rules. Such technologies should be encouraged by Ofcom. OFCOM is considering placing priority on enabling IoT services via satellite from remote locations, specifically those areas that are "difficult to reach by fixed or mobile connections."[3] Kepler agrees with this decision – narrowband MSS availability is very important in the near-future with the increasing value that satellite-based IoT services hold. Satellite-based IoT is well-positioned to support a variety of uses of IoT, particularly more remote applications such as long-distance asset tracking (e.g. cargo containers, railcar inventory, livestock, and wildlife), maritime and other geographically isolated industry applications (e.g., oil and

[1] *See e.g.* EC Decision 2009/449/EC, "*Commission Decision on the selection of operators of pan-European systems providing mobile satellite service (MSS),"* (published May 13, 2009).

[2] Ofcom: Space Spectrum Strategy at S. 4.8(i) ("Space Spectrum Strategy"). Ofcom noted specifically that "NGSO satellite systems are making more dynamic and intense use of spectrum, creating challenges to managing interference and regulatory issues internationally."

[3] Space Spectrum Strategy at 5.5.

	gas platforms), and rural community accessibility. IoT applications have made a significant step away from merely connecting electronic devices to interconnecting almost every object around us. Satellite-based IoT will be a cornerstone of comprehensive, ubiquitous IoT networks, particularly for mobile IoT devices. In order to ensure continuous connectivity wherever an IoT device is installed or roams, IoT network coverage must be seamless between terrestrial and satellite services. Ofcom's proposed strategy is taking the appropriate action to ensure that this happens. OFCOM is also considering enabling connectivity directly between terrestrial terminals and satellites.[4] Though Kepler agrees that the technology is in early stages, there are active efforts being carried out to develop MSS technologies to bridge the gap between space and terrestrial mobile services.[5]For the purposes of its MSS, Kepler is considering the implementation of technologies such as such as Long Range (LoRa, NB-IoT, etc.). Doing so would facilitate better integration between space and terrestrial services through uniformity in user terminals across both services. Ofcom has indicated that it does not believe that agenda item 1.18 is a priority in

[4] Space Spectrum Strategy at 5.19 ("sharing mechanisms between satellite and terrestrial service should be explored to ensure that satellite services do not cause interference to terrestrial users").

[5] 3GPP, "Technical specification group radio access network; solutions for new radio (nr) to support non-terrestrial networks (ntn) (release 16)," vol. 3GPP TR 38.821, January 2020; *see also, e.g.,* S. E. Group. Esa and gatehouse telecom sign contract to develop space-based nb-iot network. [Online]. Available: https://www.satellite-evolution.com/single-post/2020/03/17/ESA-and-GateHouse-Telecom-sign-contract-to-develop-space-based-NB-IoT-network.

	the UK, noting limited to no evident demand.[6] Kepler, however, does not agree with this opinion – 1.18 is a high-priority item for new and emerging MSS operators. Ofcom itself identified the need to address spectrum availability for IoT applications in 2014, recognizing the growing demand even at that time. This demand has grown exponentially in the eight years that have followed that consultation;[7]The Department for Digital, Culture, Media and Sport (DCMS) estimates that there will be approximately 75 billion connected devices by 2025,[8] with the enterprise market capturing a significant proportion of IoT uses.[9] Moreover, Ofcom identified IoT, specifically in light of industrial applications, as a trend that is likely to require more analysis into spectrum management in the coming years.[10] By prioritizing 1.18, Ofcom would bolster the growth of IoT by enabling MSS operators to provide the necessary services. In particular, it would allow for improved global coverage of MSS systems without the need to hop between bands. Ofcom is considering replacing license exemptions with general network licenses that would authorize an "unlimited number

[6] Space Spectrum Strategy at 5.21.

[7] Ofcom Consultation: Promoting investment and innovation in the Internet of Things, 23 July 2014 (https://www.ofcom.org.uk/__data/assets/pdf_file/0014/29012/iot-cfi.pdf)

[8] DCMS and RSM UK Consulting LLP, "Evidencing the cost of the UK Government's proposed regulatory interventions for consumer IoT," published 2020.

[9] GSMA Intelligence, "The Mobile Economy, Europe 2021",(GSMA_ME_Europe_2021_R_Web_Singles.pdf)

[10] Ofcom "Supporting the UK's wireless future: Our spectrum management strategy for the 2020s" (published 19 July, 2021) at 15.

	of terminals".[11] Though Kepler agrees that network licenses hold distinct value, specifically in that they act as a simplified licensing mechanism, licensing exemptions should not be replaced entirely. They ought to be kept for standard hardware that is already compliant with international standards, such as those set by CEPT. Ofcom should distinguish between such hardware, and issue licenses accordingly.
Question 3: Are there other issues and actions that are likely to be important over the next 2 – 4 years?	---
Question 4: Do you have any evidence on whether specific actions should be a high priority?	---
Question 5: Do you have any other issues you wish to comment on?	---
Question 6: Are there other issues and actions specifically relating to NGSO communication systems that are likely to be important over the next 2 – 4 years?	Kepler agrees that it is necessary to extend earth station network licenses for Ku-band NGSOs for Earth Stations in Motion (ESIMs).[12] It would provide operators with a greater degree of flexibility for the deployment of these terminals. Ofcom also discussed its proposed strategy for handling of NGSO-NGSO interference, highlighting the importance of evidence-based investigations of interference.[13] Kepler commends Ofcom for this action but would like to highlight the importance of defining the specific standards by which they will judge said interference.

[11] Space Spectrum Strategy at 5.75.

[12] Space Spectrum Strategy at 6.20.

[13] Space Spectrum Strategy at 6.39

	Regulatory certainty as well as administrability on the part of operators should be a core consideration of Ofcom when establishing standards. Moreover, Ofcom has not identified what would constitute as "clear evidence…on the impact of interference" that it indicates it will require from operators.[14] It is important that this is clarified as part of Ofcom's plan to develop their approach to NGSO-NGSO interference, and that Ofcom strive to keep concurrently licensed systems on equal negotiation footing. Ofcom should also note that in their coordination discussions, NGSO operators are not seeking to exclusively resolve potential for interference in the UK, but their whole operations on a global basis, reflecting the international nature of modern NGSO service providers. OFCOM is considering adding additional spectrum for FSS Ku user terminals and ESIM, specifically 14.25 - 14.5GHz.[15] Kepler agrees that this would significantly assist the expansion of Ku-band services. There is a clear need for such spectrum, as NGSO FSS operators are subject to operational limitations throughout the Ku-band, with limited access posing a risk of constraining the provision of innovative services. OFCOM is also considering adding additional license conditions on NGSO

[14] Ibid.

[15] Space Spectrum Strategy at 5.7.

	downlinks.[16] It is unclear as to what additional benefit the addition of conditions would provide – NGSO operators are already required to comply with the relevant EPFD limits in order to complete coordination at the ITU with incumbent GSO operators, which Ofcom has recognised.[17] Kepler therefore does not agree that this should be introduced as an explicit condition.
Question 7: Do you have any evidence on whether specific actions relating to NGSO communication systems should be a high priority?	A high priority item very relevant to NGSO operators is that currently under study by WP4a in Agenda Item 7, which is considering orbital tolerances for NGSO filings in relation to their notified positions. It is important that the outcomes of this agenda item are not overly restrictive given the reality of operating in Low Earth Orbit (LEO), that is, taking into account the natural variation of orbits over time due to space weather and trace atmosphere combined with the reality of many small NGSO satellites not having propulsive orbit-raising capabilities and instead operating in an ever-decreasing altitude until disposal.
Question 8: Do you have any other comments relating to NGSO systems?	

[16] Space Spectrum Strategy at 6.46.

[17] ITU Radio Regulations, Article 22.