Your response

- OneWeb welcomes Ofcom's consultation on its proposed strategy for managing radio spectrum used by the space sector.

- OneWeb – a UK company - is the world's second biggest satellite operator. As a global communications company powered from Low Earth Orbit ("LEO" and therefore a non-geostationary orbit, or "NGSO"), OneWeb is building an advanced satellite constellation to connect businesses, telecom, and governments with high speed, low-latency, internet connectivity.

- OneWeb brings secure, resilient connectivity, through a network of distribution partners, from pole to pole, across oceans and continents. OneWeb is committed to the responsible use of Space and sustainable practices on Earth, to bridge the digital divide and to serve communities currently denied schooling, health, and online government services.

Question	Your response
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?	Confidential? – N 1. To ensure the sustainable and safe use of space it is essential that satellite operators adopt responsible design and operational practices. Specifically, operators should be able to identify their assets, have full awareness of where they are, and be in full control of their trajectories at all times. 2. OneWeb therefore suggests that Ofcom work with other regulators (including Space regulators) to consider whether potential updates to international rules/processes are required to minimise the risks posed by satellite operations that do not adhere to the responsible use of space. This could include action to prohibit the launch of satellites without propulsion systems above a certain altitude (e.g. 400km), as well as ensure robust Collison Avoidance capabilities. 3. Additionally, OneWeb believes having knowledge of the satellite selection and beam pointing (which satellite and beam is being used to serve which area on Earth) would further aid in ensuring an efficient use of space resources, preventing possible RF conjunctions between operators which could result in interference scenarios.
Question 2: Do you agree with the broad areas we have prioritised for our work?	4. Yes. OneWeb agree with Ofcom that 'Communications' should be a priority area; as well as 'Understanding and enabling safe access to space'. Space sustainability is a core principle for OneWeb. 5. Underpinning all the priority work areas Ofcom has identified is the need to promote and defend UK industry positions in the ITU and other international fora. This strongly aligns with Ofcom's function

	of "representing UK interests internationally through engagement with relevant international bodies". 6. The space sector has always shared spectrum, both with other satellite systems and with other technologies, and has even pioneered technologies for the more efficient use of spectrum. As the ITU filing regime recognizes, earlier-designed technologies cannot predict the future, thus cannot foresee the 'growth' that might come – however, those future technologies can quite well know and adapt to existing users and systems. With the shorter lifetimes of their satellites -- 6 to 8 years as compared to 15 years for geostationary satellite orbit (GSO) satellites, NGSO systems can evolve and take into account state-of-art technology at a much faster pace than traditional GSO systems. However, the vague admonishment to "not create undue constraints on the growth of other users" is ill-defined and thus difficult to quantify or regulate. Such technological evolutions should be left to operators to define and pursue. 7. In Para 4.3, Ofcom states that "When space users are deploying, redesigning or upgrading systems they will need to ensure that they are using equipment that offers good resilience to interference and does not itself cause interference to others". However, it is not just "space users" who need to ensure this, it is the responsibility of <u>all</u> users of spectrum (e.g. terrestrial, mobile, space) to ensure their related equipment/receivers are resilient to interference and do not cause unacceptable interference to others.
Question 3: Are there other issues and actions that are likely to be important over the next 2 – 4 years?	<u>Work Area 1: Communications</u> 8. OneWeb agrees with Ofcom's aim of enabling delivery of improved satellite services to places that are difficult to reach, including better connectivity for passengers on aircraft and ships, and better mobile coverage through satellite backhaul solutions. These aims align to the mission of OneWeb, and we look forward to working with Ofcom to help deliver them. 9. We strongly agree with Ofcom's proposal to consider additional spectrum access to provide greater bandwidth for user terminals (14.25-14.5 GHz), Q and V bands for gateways, and ESIMs – and would be interested in working with Ofcom on any proposal to make available the four guard bands in Ka band. Further comments follow: *14.25-14.5GHz* 10. OneWeb agrees with Ofcom that the Ku band uplink 14.25-14.5 GHz could be used more efficiently, and that reviewing its use for

satellite services should be considered a high priority. This is a critical frequency band for enabling the true benefit of satellite broadband services to UK consumers and businesses, and to ensure adequate competition in the satellite market in the UK.

11. The current UK requirement for satellite user terminals to coordinate with a limited number of fixed service links in the 14.25-14.5GHz band places a significant constraint on the provision of domestic satellite services (which is not the case in most other European countries). The time frames associated with site-by-site coordination simply do not work well in deploying a service to customers. As a result, most satellite operators focus their offerings in the UK to the 14.0–14.25 GHz band. This results in congestion that prevents the optimal deployment of satellite services in the UK (such as OneWeb, which has the capability to provide capacity throughout the whole 14.0–14.5 GHz band).

12. To maximise the provision of connectivity across the country, the deployment of satellite user terminals for the whole 14.0-14.5 GHz should be on an uncoordinated and ubiquitous basis. We look forward to Ofcom's consultation on this topic later this year.

Q/V Band

13. Q/V bands will play a critical role in enabling feeder links for the next generation of high throughput satellite systems. OneWeb are intending to use extensively the FSS allocation in Q/V band (between 37.5 to 50.2 GHz) for feeder links for our next generation of gateways. As such, OneWeb has already submitted satellite filings at the ITU and submitted a request in the FCC processing rounds regarding these frequency bands. Any new approach to licensing gateway earth stations in the Q/V band should be based on ensuring access to substantial, contiguous spectrum particularly in the uplink direction for operation of commercial satellite services in the UK. OneWeb are also considering feeder links in higher frequencies, including E-band.

ESIMs

14. OneWeb agree with Ofcom's proposal to update ship, aeronautical and network licenses for ESIMs in the Ku and Ka bands, including ESIMs communicating with NGSO systems. However, it is important that individually licensed earth stations are protected from any possible extension of ESIM authorisations to a larger range of frequencies within the 27.5-30 GHz band and that considerations are given to ensuring GSO ESIMs provide necessary protection from their off-axis emissions towards co-frequency NGSO systems such as the limitations adopted by WRC-19 in Resolution 169.

Communications to/from mobile handsets and other terrestrial devices

15. OneWeb supports regulatory frameworks that enable the creative use of satellites in unlicensed bands, such as enabling communication directly to users' mobile handsets and connecting IOT devices. As stated in the consultation document, an assessment of the potential benefits to UK users from such services should be carried out as the associated technology/capability develops.

International allocations for Mobile Satellite Services (MSS)

16. OneWeb agrees with Ofcom that identification of new allocations for the future development of narrowband mobile-satellite systems is not a high priority.

Protection criteria for Fixed Satellite Services (FSS)

17. OneWeb fully supports the work of the ITU's Working Party 4A (WP4A) and agree that there is value in reviewing the protection criteria recommendations for FSS to reflect the current/future sharing environment.

18. Specifically, WP4A has been studying the issue of NGSO-to-NGSO coordination and protection criteria for some time. Unlike GSO coordination, NGSO-to-NGSO coordination is highly complex as each system's architecture is different and the interference between the systems must be modelled through dynamic computer simulations. It is therefore essential that the obligation to coordinate under the ITU Radio Regulations ("the ITU Coordination process") continues to be promoted and upheld (by Ofcom and other international regulators) so that operators have the flexibility to determine the right approach to coordinating their systems. When/if the international NGSO community converges on a common set of agreed criteria, its implementation to complement the ITU Coordination process should be considered.

19. Any definition of protection criteria, while drawing from other work in the ITU such as the criteria used by WRC-19 for protecting GSO systems in Q/V frequencies, should take in account differences for extension of such protection criteria to lower frequency bands and assess whether alterations are needed for application to this situation of NGSO systems sharing. In addition, OneWeb recommends inclusion of another criteria to protect systems against loss of synchronization of the modems due to high levels of short term interference.

Work Area 2: Earth Observation and Navigation

Consideration of inter-satellite links

20. Given the benefits ISLs can offer for NGSO satellites, we agree with Ofcom on engaging and monitoring international work in this area. However, it is important that if existing FSS bands are opened up for ISLs, that existing satellite services – like OneWeb's user terminal and gateway links -- are adequately protected and that their future growth is not constrained. OneWeb is considering the use of optical inter-satellite links (ISLs) for its Gen-2 satellites.

Spectrum requirements to support resilient PNT

21. OneWeb is fully supportive and engaged in the UKSA's Space Based PNT Programme (SBPP) as part of the UK's wider PNT strategy to address the critical need to improve PNT resilience. We look forward to continuing our engagement with UKSA, Ofcom and other government departments and agencies on this crucial work. Consideration should be given to alternative systems that utilise existing systems to provide these services within FSS bands.

Work Area 3: Understanding and enabling access to space

Safe use of space

22. OneWeb is dedicated to responsible space practices which are essential to support the long-term use of space for all. The orbital environment must support healthy competition and cannot be allowed to become polluted, dangerous, or disruptive to scientific, educational, government, and commercial endeavours. More information on OneWeb's 'Responsible Space' initiative can be found here.

Cross-Cutting Actions

Greater use of network licensing

23. OneWeb supports Ofcom's consideration of greater use of network licenses in the space sector, in particular to cover some satellite communication equipment that is currently exempted from licensing. This would provide Ofcom with greater capability to deal with harmful interference, and generally lead to a better operating environment for users. However, any new network license regime must be implemented in a way to ensure that existing holders of licenses (network or other) are adequately protected.

Conditions on satellite downlinks

	24. It is noted that an approach like that set out in the consultation document has already been implemented in Ofcom's recent update to the NGSO network licensing process. In expanding this approach to other types of operators, it will be important for Ofcom to consider the business models of the satellite service providers if/when placing additional conditions on UK authorised equipment, e.g. business-to-business models would require 'distribution providers' or end-users to hold their own equipment license separate to the satellite operator, and would not be in control over the satellite transmissions.
Question 4: Do you have any evidence on whether specific actions should be a high priority?	25. As mentioned above, proposals to increase access to the 14.25-14.5 GHz band should be a high priority for Ofcom. The doubling of uplink capacity of Ku band user terminals would greatly increase the satellite broadband capabilities and competition on offer for consumers – especially through NGSO systems that are currently in the process of being deployed in the UK. This is particularly important as the UK is currently at an international disadvantage when it comes to the provision of such services given similar restrictions do not exist in most European countries.
Question 5: Do you have any other issues you wish to comment on?	26. The satellite industry needs long-term certainty regarding access to harmonised spectrum to ensure the necessary investment and continued development of existing and new satellite capabilities. It is therefore essential that Ofcom's policy and approach ensures spectrum in which the satellite industry is currently operating - and looking to provide future services - is adequately protected from other spectrum users. This should be an overarching aspect of Ofcom's Space Spectrum Strategy.
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?	<u>Spectrum Access for NGSO systems</u> 27. OneWeb agree with Ofcom's proposal to consider providing NGSO systems access to the same spectrum as GSO systems where it is currently not possible and where new spectrum may be provided for satellite systems generally. This approach would be a 'win-win' for both satellite operators and UK consumers. In some frequency bands, the ITU Radio Regulations have a detailed sharing regime between NGSO systems and GSO networks, such as the equivalent power flux density (EPFD) limits in Article 22 for the Ku and Ka band frequencies or Nos. 22.5L and 22.5M in the Q/V band frequencies. In other situations, in frequency bands where No. 9.11A or No. 9.12 applies, the ITU Radio Regulations apply coordination between NGSO and GSO systems on a first come, first serve basis. And finally, in BSS or FSS frequency bands, the ITU framework (No. 22.2) relies on NGSO systems to avoid causing unacceptable interference to GSO systems. The UK could rely on

this ITU approach in accommodating NGSO systems in additional frequency bands.

28. Specifically, OneWeb agrees that the Earth station network license be amended to enable NGSO ship/aircraft earth stations to use the same parts of Ku and Ka band spectrum that are currently available for GSO use (as well as the corresponding changes to the Ship and Aircraft Radio licenses themselves).

<u>NGSO systems sharing with NGSO:</u>

Improving the International Framework for NGSO systems:

29. The ITU framework provides a well-established, and globally understood and accepted process for dealing with interference issues - specifically, that the NGSO system with the later filing should be operated in a manner not to cause harmful interference to earlier systems which operate in accordance with the provisions of the Radio Regulations. This basic and core principle should continue to be the primary means for handling NGSO-NGSO coordination and any instances of unacceptable interference.

30. Ofcom state in Para 6.37, that the "principles of the current ITU framework remain important". OneWeb would like to stress that the current ITU framework remains essential to ensure the efficient sharing of spectrum and avoid the risk of disruption to users. Whilst appreciating Ofcom's intention to mitigate the risks identified, the principle that operators need to coordinate with earlier filed systems - and that this is a two-way process involving good faith negotiations - needs to be upheld in any proposed changes to the framework that Ofcom advocate.

Regarding Ofcom's specific proposals that it plans to:

Create guidance on how much interference NGSO systems should be prepared to accept from one another:

31. As mentioned above, OneWeb supports the work of the ITU's Working Party 4A (WP4A). Again, it is essential that international consensus is reached on protection criteria before being implemented, otherwise there is a risk that national rules/guidance will create a patchwork of inconsistent approaches between countries to the detriment of the satellite industry and consumer.

Increase certainty around changes to NGSO systems may need to undertake during lifetime:

32. OneWeb urges Ofcom to take into account the need for operators to maintain some separation between orbital planes in order to safely fly the satellites within their system in considering how to quantify how much the orbital characteristics of NGSO system can deviate from what was recorded at ITU.

33. It is critical that an NGSO system be able to modify its system without affecting its coordination status and relative date of priority within a reasonable framework. UK operators have performed such modifications previously.

34. With respect to ensuring recorded satellite numbers remain up-to-date through the lifetime of an NGSO system, OneWeb urges Ofcom to gain experience with application of the new milestone regime for WRC-19 before jumping into another complicated set of provisions. The 10-year milestones for most systems will not occur until after WRC-27, so the international community still has time to assess how the new milestones work before adopting another layer of regulatory complexity for NGSO systems.

<u>Handling of NGSO-NGSO interference</u>

Updates to NGSO licensing framework – bands and pricing:

35. To ensure consistency and simplicity for operators (and the regulator), OneWeb agrees that the new licensing regime for NGSO earth stations be extended to any additional bands that are opened up for NGSO access.

36. OneWeb would welcome any future discussion with Ofcom on proposals to change the licensing fees for NGSO gateway earth station. However, to ensure that the UK remains competitive with respect to hosting earth stations, it will be critical to ensure any new fee scheme is not prohibitive. One possible approach would be to maintain the nominal fee for an operator's first ground station, and then have a "sliding scale" after that to reflect the increasing restrictions and reductions in suitable sites that would result from an operator(s) licensing increasing numbers of ground stations within the UK.

37. Moreover, spectrum pricing policy on service links has a critical role to play on adoption of emerging technology such as the LEO satellites: affordability of spectrum used for NGSO systems directly impacts the consumer price and business case of bringing service into rural and remote areas, and so realising the socio-economic benefits of inclusive connectivity.

<u>NGSO systems sharing with GSO</u>

New licensing terms to put conditions on downlinks

38. As mentioned in paragraph 24 above, any change in licensing conditions would need to consider the business model of those involved in providing NGSO services so that the appropriate entity can be responsible for compliance (e.g. the satellite operator), whilst not preventing other entities (e.g. distribution partners) from providing a service to consumers. Further, as mentioned in paragraph 27, the ITU Radio Regulations include a detailed sharing regime between NGSO systems and GSO networks – which Ofcom should reflect when considering any new licensing conditions on downlinks.

Developing our capabilities for handling NGSO to GSO interference:

39. Any approach to measure potential NGSO-GSO interference must involve input from the NGSO system operator(s) to ensure a credible and accurate investigation.

International regulations on NGSO-GSO sharing:

40. OneWeb agrees that the methodology used by the ITU to assess interference to GSO systems from NGSO systems contained in Recommendation ITU-R S.1503 can result in unnecessary constraints on NGSO systems when the methodology does not accurately model the systems involved and would therefore support any efforts by Ofcom to improve it. OneWeb is appreciative of Ofcom's support of such initiatives to date in WP 4A. OneWeb urges Ofcom to continue these efforts and to recognize the need to regularly update this Recommendation as NGSO systems are currently being built and launched at an unprecedented pace. It is inevitable that the ITU will need to update this Recommendation on potentially a yearly basis, in order to allow agreed changes to the Recommendation to go forward while other, newer matters continue to be investigated, refined and ultimately reach consensus for inclusion in the Recommendation at a later meeting. OneWeb urges Ofcom to continue to focus on ways to enable more accurate modelling of NGSO FSS systems, including newer technologies such as flat panel, electronically steered antenna arrays; the use of steerable beams on satellites; and the use of beam hopping to avoid over-estimating the interference GSO systems will receive in practice. Over-estimating the interference results in unnecessary constraints on NGSO systems.

NGSO systems sharing with Radio Astronomy

41. OneWeb supports the protection of Radio Astronomy, and our system deliberately manages its frequency usage and emissions in order to protect the bands allocated to radio astronomy. OneWeb works closely with radio astronomers concerning the protection of radio astronomy sites, and we would be happy to work with

	Ofcom and the radio astronomy community to continue to identify flexible, dynamic ways to co-exist. NGSO systems sharing with terrestrial services *Mobile* 42. Any new approach to licensing Q/V bands will need to ensure that satellite earth stations are adequately protected from any 5G terrestrial mobile service bands that may overlap, and that satellite gateway earth stations continue to have access to the full available satellite allocations in a meaningful way. *Adjacent Band Users* 43. OneWeb agrees with Ofcom's position that it will not act on interference resulting from the poor performance of the receiver, and that it is the responsibility of the user to ensure receivers are effectively able to filter our signals from any neighbouring bands. However, as stated above, this obligation should fall equally on all users of spectrum, and not disproportionately upon users of space spectrum. However, it is important to realize that placing high power terrestrial transmitters in bands adjacent to those used to receive weak signals from space could result in interference scenarios that may be difficult for receiver filtering to entirely address.
Question 7: Do you have any evidence on whether specific actions relating to NGSO communication systems should be a high priority?	44. A key capability/use-case of NGSO communication systems is disaster responses and recovery given their ability to provide rapid connectivity at short notice to areas where communications infrastructure has been lost. This capability is of growing importance given the increasing frequency of natural disasters due to climate change, as well as the impacts on countries and regions because of geopolitical uncertainty and conflict. Any actions identified that would help facilitate NGSO's critical role in global disaster response and recovery should be considered as a priority in Ofcom's strategic approach to space spectrum.
Question 8: Do you have any other comments relating to NGSO systems?	Role of the ITU Regulations 45. As stated in the consultation document, the "obligation to coordinate under the ITU Radio Regulations" is central to ensuring efficient sharing of spectrum and avoid the risk of disruption to users. Following current ITU framework and Coordination Procedures, 99.95% of spectrum[1] assigned to satellite networks was free from reported harmful interference. It is therefore essential that Ofcom's proposals and focus of work regarding NGSO systems

[1] https://www.itu.int/bestofwrs20/wp-content/uploads/sites/4/2021/05/WRS-20-Orbit-Spectrum-Internatio_nal-Regulatory-Framework.pdf

	(both domestically and internationally) continue to support and promote the ITU coordination requirements. Any new or additional processes should not replace, supersede, or negate the ITU core coordination requirement that later filed NGSO operators must coordinate with earlier filed systems – as per the provisions of Article 9 of the ITU Radio Regulations - in any way. **May 2022**