Your response

Question	Your response
Question 1: Do you have comments on the overall approach to the review?	Intelsat welcomes Ofcom's strategic spectrum management objectives and would like to highlight the importance of a mix of networks, including satellite networks, to achieve them. Satellite networks play an important role in improving wireless communications wherever, as they extend the reach of terrestrial networks in all geographical areas and can effectively provide connectivity to moving platforms, such as airplanes cars and vessels. Intelsat, together with other satellite operators, is making a continuous efforts to ensure that satellite connectivity will be part of the future releases 17 and 18 of the 3GPP standard with respect to the integration of satellite access network solutions into 5G system TSG RAN which is currently being developed with specifications on the solutions for 5G New Radio (NR) to support non-terrestrial networks (NTN) as we believe 5G and satellite communications platforms will be increasingly able to operate and interface seamlessly with terrestrial 5G systems. Ever since the decision of WRC-15, Intelsat has made huge investments by launching several next generation high-throughput satellites (HTS)[1], which utilize spot beam technology to increase the throughput while benefitting from large geographical coverage using Ku and C-band. While acknowledging the Ofcom strategic spectrum management objective to support flexible spectrum use, Intelsat considers that continued assurance for spectrum access should apply also to the existing users. While Intelsat agrees with Ofcom that spectrum sharing should be promoted as means to maximise efficient use of spectrum, Intelsat considers that spectrum sharing should be done in a manner that safeguards the current and future usage of the bands by the existing users. An opportunity to one industry stakeholder should not be made at the expense creating regulatory uncertainty or unnecessary restrictions to others. For Intelsat Ofcom's decision to allow shared mobile use in the frequency band 3 800-4 200 MHz will jeopardize return of these massive investments. While Intelsat acknowledges that promoting spectrum sharing is one of the strategic themes for Ofcom, this should be done in a manner that complies with ITU Resolutions and international standards, to ensure regulatory certainty for all industries.

[1] IS-29e, IS-33e, IS-35e, IS-37e, Intelsat 31, Horizon-3e

	In fact, even if Ofcom does seem to recognize the importance of international framework, decision for 3 800-4 200 MHz band has been made with no existing standardization for terrestrial equipment that would be able to operate under conditions set by Ofcom for the access to the band, and even under secondary mobile allocation in the ITU-R Radio Regulations. Due to difference in power levels of mobile and satellite communications, such decision will effectively halt any possibility for Intelsat to utilize the massive investments by extending its customer base or service offering within UK e.g. through integration into the 5G. While some Ofcom decisions – such as the one for the band 3 800-4 200 MHz – are rigorously driven by the strategic theme of promoting spectrum sharing, in some other cases there seems to be resistance to allow additional use on bands that are only very sparsely used by current incumbents. One area where Intelsat has been involved directly with Ofcom on is the frequency band 14.25-14.5 GHz where an opportunity to increase the efficiency of spectrum use by allowing satellite technology to provide aircraft earth stations (AES) services to share the spectrum with fixed service to provide service to various UK based airlines. Allowing the shared use of this 250 MHz spectrum band eases the rapidly increasing need for in-flight connectivity. This is directly in line with the UK's strategic objective to promote IFC services due to the UK being home to the busiest airport in Europe but also a country with a large amount of aviation industry. Intelsat, among other satellite operators, has been requesting Ofcom to open the full frequency range 14.0-14.5 GHz for additional use by satellites to improve connectivity not only in airplanes, but also in trains and vehicles. Decision to open the full range 14-14.5 GHz for satellite use to improve connectivity to moving platforms would not only support more efficient use of spectrum and innovation, but also improve wireless communications to people in UK wherever they are. Such spectrum use would also be in accordance to ITU Radio Regulations, ECC harmonized framework and ETSI standardization. Intelsat would very much welcome Ofcom to drive a strategy to allow the deployment of these standardized ubiquitously deployed in-motion satellite terminals in UK, in a similar pro-active manner Ofcom has done in case of other frequency ranges.
Question 2: Have we captured the major trends that are likely to impact spectrum management over the next ten years?	Intelsat concurs with Ofcom that as a consequence of people working from home during the COVID-19 pandemic the need for reliable and more dispersed connectivity has increased. Intelsat appreciates that Ofcom "*take[s] a leading international role in relation to satellite communications, including new satellite services that can help deliver improved*

	broadband services to people in locations that are hard to serve with other networks" and would very much welcome that Ofcom would support Intelsat, among other satellite stakeholders, in their efforts in defining the role of satellites in contributing to acceleration and extension of 5G networks, e.g. in 3GPP release 17 and beyond in release 18, 5G-PPP and NTN. Satellite networks play an important role in fostering the 5G service roll out in urban, suburban and these unserved or underserved areas. They can also reinforce 5G service reliability by providing service continuity to users and reduce power consumption, by scaling 5G networks through the provision of efficient multicast/broadcast resources for data delivery towards the network edges, or directly to the user equipment. Additionally, satellite networks are vital during natural disasters and other emergencies, as they enable establishing rapid and reliable communications. Once launched, satellites are essentially carbon neutral as they rely on solar power. However, when spectrum availability is reduced, such as in C-band, additional satellites are needed to maintain the same capacity levels. Therefore, the most environmentally friendly option is to allow the launched satellites to utilize the frequency ranges of the designed payload to the extent possible for the entirety of their life span. This functional life span of satellites can even be further extended with the new technology of Mission Extension Vehicle (MEV) which was first successfully docked into an Intelsat satellite in May 2020. The expansion of satellite functional life span is an important milestone towards even more environmentally friendly connectivity through satellite communications, as well as reduced space debris. Intelsat commends Ofcom for its extensive recognition of the importance of the ITU Radio Regulations and would like to also emphasize the importance of harmonisation work achieved by the CEPT and by ETSI on spectrum usage and standards. Due to the size of satellite footprint, harmonisation of conditions on spectrum use, licensing regimes and equipment usage across the region is critical for satellite services. While undeniably national administrations have flexibility to adopt similar stance to bands against formal decisions of ITU and CEPT, implications of such ad hoc harmonisation to all industries in an increasingly difficult coexistence environment should be carefully considered. It is especially important that the UK keeps participating to the telecommunications standardisation efforts conducted in ETSI, CEN and CENELEC post-Brexit, considering the trade flows between the UK and the rest of Europe.

	Intelsat notes that Ofcom intends to "*continue to be active in promoting 3.4-3.8 GHz, 26 GHz, 40 GHz (40.5-43.5 GHz) and 66-71 GHz as 5G bands in CEPT and in ITU*" but can only remind of the necessity of adapting the approach to the realities and needs of the regional level. Frequency range 3 600-3 800 MHz band is extensively used by FSS in several parts of the world, especially in Africa. While this frequency range is again in the agenda of WRC-23, already past studies have shown that sharing between mobile and satellite services in this frequency range is not practicable or even feasible. Even if WRC-15 made a political decision to allow 5G deployment in the frequency range 3 400-3 600 MHz with conditions that protect FSS usage in the neighbouring countries, this should not become the norm of ITU-R activities. The task of ITU-R is to conduct studies to determine whether sharing is feasible between two services, not make administrations choose between one or the other service on a national basis. Such precedence could permanently jeopardize protection of FSS earth stations, as well as terrestrial services such as FS links. With regards to the 40 GHz frequency range, Intelsat would like to remind Ofcom that the split of the 40 GHz band is reversed in ITU Region 2 - with 5G IMT to use the lower part of the band (37.5-40.5 GHz). Intelsat, amongst some other satellite operators, are currently in the process of constructing their next generation satellites utilizing Q/V bands. This is a time-consuming process requiring massive investments from satellite operators and it is important that conditions for 5G usage in Europe in 40.5-43.5 GHz band will allow satellite use in the band below 40.5 GHz with long term regulatory certainty. While these new satellites concur with the trend identified by Ofcom of communications moving to higher frequencies, similarly as in terrestrial networks, satellite networks have different use cases for different frequency ranges. While the satellite industry is exploring new opportunities in the Q/V-band, as Ofcom also stated, high frequencies are not suitable for all applications. More traditional L-, C-, Ku- and Ka-band frequency resources will remain vital to satellite communications for the foreseeable future. Satellite networks are crucial in connecting people in places that are unreachable through terrestrial networks, including airplanes and vessels. COVID-19 pandemic has only increased the trend of people relying on technology and connectivity. Even if travel restrictions and difficulties of aeronautical industry due to pandemic have delayed some of the plans for inflight connectivity (IFC), there is no indication that connectivity needs of people would be declining in long-term.

	According to NSR's Aeronautical Satcom Markets, 8th Edition report it projects a viable long-term In-flight Connectivity (IFC) market, despite significant near-term challenges due to COVID-19. Coming off a challenging 2018 and 2019, 2020 has already seriously disrupted the IFC market, with air traffic down by at least 80% in most regions. However, longer-term opportunities remain – once air travel resumes, planes will still require ever more connectivity, yielding a market opportunity more than 2x larger than 2019, with $5B in annual retail revenues by 2029. Therefore as mentioned above, there is a pressing and growing need for Ku-band spectrum to be available in the UK to meet the increasing demand for connectivity by UK consumers of broadband services on Aircraft-mounted Earth stations (AES) and other in-motion satellite terminals, something that Ofcom identifies in the Space Spectrum Strategy. This growing demand has placed tremendous strain on the available spectrum for satellite services utilising the entire 14.0-14.50 GHz frequency band ("Ku-band"), including the upper half of this band i.e., the frequency range 14.25-14.50 GHz. We hope that Ofcom is considering opening up this band for further consultation via a Call for Input (CFI), envisaged back in 2019, which we very much welcomed. However Intelsat would also appreciate if Ofcom could confirm whether they have indeed adopted a strategy to allow the deployment of ubiquitously deployed AES and other in-motion satellite terminals within the candidate bands in order to allow satellite operators to meet the pressing demand for spectrum to support relevant services, ensure the efficient use of spectrum and promote new opportunities for growth in the UK at the earliest possible opportunity.
Question 3: Could any of the future technologies we have identified in Annex 6, or any others, have disruptive implications for how spectrum is managed in the future? When might those implications emerge?	Intelsat recognises that the respective performances of wireless transmitters and receivers can notably help improving co-existence amongst radio systems. New antenna technology introduced on the satellite ground segment indeed move us towards better resilience against interference. However, satellite earth station need receive very weak signals from geostationary orbit and there is a limit to which extent interference from high-power systems, such as 5G IMT, can be mitigated. Therefore prior to allowing terrestrial mobile services in any segment of the 3400-4200 MHz band range, it is necessary that technical rules are adopted to ensure C-band FSS operations are protected. Even if new equipment technologies or advanced technics to manage spectrum can alleviate interference risks to a certain extent, sharing between FSS and 5G IMT will remain dependent on power limits or/and geographical separation. The specific mitigation techniques required will be based on various

	factors, including the extent to which C-band earth stations are deployed in a country or region, whether the earth station locations are known or not known, and the operational parameters of the mobile service and its planned deployment.
Question 4: Do you agree that there is likely to be greater demand for local access to spectrum in the future? Do you agree with our proposal to consider further options for localised spectrum access when authorising new access to spectrum?	Intelsat considers that the discussion on local vs national access to spectrum is more relevant in the context of mobile networks than satellite connectivity. Satellite broadband connectivity already today can be based either on local licensing (fixed satellite terminals) or they can operate on terminals anywhere in the UK (mobile satellite terminals). In both cases, systems are typically using bands which are available nationally and are typically not shared with terrestrial use. However, in both cases several different satellite operators may be licensed to use the same frequency bands within UK. Terrestrial local licencing has a significant impact in bands shared between FSS earth stations and terrestrial use. Ofcom decided to introduce this concept in the 3 800-4 200 MHz band, which is heavily used by receiving earth stations in the UK. In this case, it will be important that local terrestrial licences are limited geographically and perhaps limited to indoor use so that a practical sharing framework with earth stations is established. Even in this case, these local terrestrial licences will permanently prevent deployment of new FSS earth stations in the same and nearby areas. Increased amount of such local mobile licences become a significant constraint to the deployment of new earth stations. Assessing the value of satellite use in the 3 800-4 200 MHz band to the UK requires an appreciation of how these links form part of international communications networks. These bands are used as downlinks for associated uplinks in spectrum between 5.8-6.4 GHz, and services carried are downlinked outside the UK, as well as within the UK. While this policy is developed from a domestic perspective, it is important to understand a wider impact on UK interest in this spectrum outside the UK. Similarly, there are parts of Ku-band, Ka-band and Q/V bands that are used or expected to be used for gateway earth stations where sharing with terrestrial systems on a geographically limited basis is feasible. Especially in the case of fixed service, highly directional antennas and link-to-link based authorisation make sharing and coordination with FSS earth stations more feasible while allowing new earth stations to be established. It may be possible to extend this approach to mobile local area licences, but the impact to more sensitive satellite usage in the band needs careful examination. In particular, it needs to be ensured that there is always the potential for deployment of new satellite earth stations in a range of loca-

	tions – urban and rural – by limiting local licensing geographically. Furthermore, it needs to be ensured that such local area licences are actually used, to avoid the unnecessary blocking of alternative uses of the same spectrum. As a last note, Intelsat would strongly advice against promoting a policy developed for a national context, such as the one for 3 800-4 200 MHz, as an option outside the UK without careful consideration on the impact that may have on UK stakeholders.
Question 5: Do you agree with the actual and perceived barriers identified for innovation in new wireless technologies, and our proposed ways of tackling those?	-
Question 6: Do you agree with Ofcom's proposals to improve our outreach and reporting activities, and spectrum information tools? • **Are there additional ways that Ofcom could better engage with existing and future users and providers of wireless communications?** • **Please explain any specific areas where you believe more or better provision of information could provide value to stakeholders**	Intelsat very much welcomes the commitment from Ofcom to consider interests and engage with the UK space and satellite industries in the development of UK positions. Intelsat looks forward to working together with Ofcom to co-operate and form mutual understanding on both UK domestic and international connectivity goals and we are pleased to see the UK and Australia have signed a new 'Space Bridge' partnership to increase knowledge exchange and investment across the two countries' space sector to help advance innovative space businesses and universities to collaborate and share best practice more effectively than ever.
Question 7: Do you agree that it is important to make more spectrum available for innovation before its long-term use is certain? Do you have any comments about our proposed approach to doing this?	In principle Intelsat agrees with the concept of making spectrum available for innovation before its long-term use is certain. Innovation is important to the satellite sector and it usually takes place in the frequency bands with allocation to satellite services and within the agreed transmission characteristics. However, introducing innovation in a manner that may impact the conditions and long-term operations of other existing services in the band, would require careful consideration and studies. Therefore, Intelsat would discourage Ofcom from supporting innovation in frequency ranges or under conditions that are against international standards and decisions, or ITU Radio Regulations. Innovation

	should not be supported at the expense of regulatory certainty and continuity of existing services.
Question 8: Do you agree that it is important to encourage spectrum users to be 'good neighbours' to ensure more efficient use of the spectrum? Do you agree with our proposals to: **a) increase realism in coexistence analysis at a national and international level?** **b) encourage spectrum users to be more resilient to interference?** **c) ensure an efficient balance between the level of interference protection given to one service and the flexibility for others to transmit?** **Do you have any comments on which of these will be the most important?**	Intelsat agrees that it is important to encourage spectrum users to be good neighbours and satellite operators already face considerable incentives to do so since the available spectrum is limited and most bands are shared among different satellite operators and other users. Regarding the three specific proposals in the question, Intelsat provides the following comments: *a) increase realism in coexistence analysis at a national and international level* Intelsat agrees that coexistence analysis should be as realistic as possible. One way to improve realism is to make the extent of deployment of existing systems publicly available. Another aspect are accurate radio propagation models, development of which Ofcom has often supported with its own measurement campaigns to develop and improve standard propagation models used internationally. We encourage Ofcom to continue to invest in this area. *b) Encourage users to be more resilient to interference.* Ofcom notes that improvement in receiving equipment is sometimes key to introducing new spectrum users. Ofcom lists examples where it has been suggested that equipment receivers are sensitive to signals on the adjacent frequencies. Where Ofcom does identify a need for receivers with improved selectivity, spectrum users should be entitled to use that equipment for a reasonable time period to implement the transition. Financial incentives to encourage replacement of equipment outlined by Ofcom seem to purely based penalising users of old equipment with increased fees. Ofcom should also consider direct subsidy of the cost of replacement equipment, if the benefits provided by the new spectrum user outweigh the costs of upgrading receivers. Ofcom also raises a requirement of spectrum users to accept higher levels of interference, which has been evident also in the manner on which Ofcom continues to challenge the interference criteria used for studies related to satellite protection in the ITU. These points from Ofcom seem to be targeted to one service whereas protection requirements of other systems has not been questioned. Ofcom policy in this regard would benefit from some general conditions to ensure that it is applied fairly, balanced and consistently across all technologies. With regard to the possibility for satellite systems to tolerate higher interference levels, it is important to take account of the practical and real-world considerations. The available

	power on the satellite is limited since satellites are solar powered and have a strictly limited power budget which cannot be increased once the satellite is launched. As an example, an increase of 1 dB in the downlink power to compensate for increased interference would require a 26% reduction to the usable satellite bandwidth to maintain the overall EIRP budget. An increase of 1 dB in the downlink EIRP on one satellite network would also result in a 1 dB increase in interference to the neighbouring satellite network due to small orbital separations. Intelsat would welcome consideration of the costs associated as well as the practical limitations from Ofcom. *c) ensure an efficient balance between the level of interference protection given to one service and the flexibility for others to transmit?* While Intelsat agrees with a concept of balancing between protection of services and allowing flexibility in transmissions, both transmitter and receiver have a role in any compatibility issue. The important role of transmitter performance and out-of-band emissions should not be overlooked by Ofcom. For example in the case of 5G terrestrial equipment designed for the mmWave bands, the equipment being developed and deployed are less able to coexist with other services in the same bands and in adjacent bands than more traditional mobile technology. Intelsat would like to emphasize the importance of examining the transmitter requirements as well as the receiver requirements. Also as stated already in point b), for practical reasons a small tweak of parameters illustrated in the Figure 7 of Ofcom consultation may not be as simple for systems.
Question 9: Are there any other issues or potential future challenges that should be considered as part of this strategy?	With regards to Ofcom plans to implement broadband Universal Service Obligation (USO), Intelsat would like to highlight that satellites today play an important role in meeting the requirements for the broadband USO in the UK. Satellite technology is one of the most quick and cost-efficient ways to reach rural and remote areas. Intelsat believes that a mix of technologies is necessary to meet the broadband USO requirements, including both low earth orbit (LEO), medium earth orbits (MEO) satellites for providing low latency and geostationary (GEO) satellite solutions for providing wide coverage in an affordable manner for less time-sensitive applications.
Question 10: Do you agree that continued use of our existing spectrum management tools (as set out in sections 4-7) will	-

be relevant and important for promoting our objectives in the future, in light of future trends?	
Question 11: Is there anything else we should be considering doing, or doing differently, to promote our objectives?	One of the focus areas identified by Ofcom is to create innovate and future-looking regulatory solutions to respond to fast-changing and highly innovative markets. Intelsat welcomes the focus area as defined by Ofcom and acknowledges Ofcom's role in the past as one of forerunners of spectrum sharing solutions. **Innovation in antenna technology:** As satellite communication terminals continue to become cheaper, smaller and more power efficient, a wide variety of technology is already available and is being made available such as the innovation in flat panel antenna technology for satellite communications. These 'phased array' antennas have no mechanical components, relying on software and electronics for steering and making them more suitable for mobile platforms such as IFC as well as connectivity for trains and other vehicles.