Introduction

O3b Limited ("O3b") submit their views on this Consultation as a member of the U.K. satellite and telecommunications industry. Since our response to Ofcom's 2014 Call for Input and its 2015 Strategic Review of Satellite and Space Science Spectrum, O3b's customer base has grown exponentially. O3b provides connectivity to emerging markets and to remote and isolated areas for customers such as large enterprises, telcos, mobile network operators, and government users. In fact, the demand for O3b's specialized connectivity (via a non-geostationary, medium-Earth orbit constellation) has risen so rapidly that O3b has already begun the construction of another eight satellites.

O3b would also like to note that we are a member of both the Global VSAT Forum (GVF) and the EMEA Satellite Operators' Association (ESOA), and we support the inputs submitted by those organizations to this consultation as well.

Question 1: How useful is the interactive data that we have provided on our website and why? How can the presentation and interactivity of the data be improved? How frequently would it be useful for us to update the information and why?

O3b firmly support Ofcom's regulatory principle of being "evidence-based, proportionate, consistent, accountable and transparent in both deliberation and outcome."[1] However, O3b have some concerns about the particular interactive tool under consideration and the value of data that appears to be transparent but may potentially be inaccurate or misleading. Once data is public, it will be judged and used by everyone, and applicants and operators need Ofcom to continue in its role as an arbiter and regulator, and not let the public alone judge the value of spectrum use.

Specifically, in the Tab on Earth Stations: This data collection does not account for receive-only or DTH, which are unlicensed. Without this data, the website may give a skewed impression of the extent the spectrum is being used by satellite services.

Re the Tab on Satellite Filings: This data must only be provided in aggregated form: awareness of the plans to use spectrum or orbits is highly strategic from a markets and business point of view, and Ofcom must be careful not to harm its own UK industries by exposing such strategic information in its otherwise-laudable effort to be transparent

Some parts of the graphics need to be clearer. For example, it seems likely that the X axis on the "ITU-R Geostationary satellite filings by status" should be degrees of longitude; however, the axis goes from -200 to +200, which cannot be meant to show 180 degrees in each direction. Also, essential nomenclature such as the ITU convention by which explaining that "G" means "United Kingdom" in ITU filings are not made clear.

Also, on the Tab on Stakeholder Input: stakeholders are not allowed to edit the data after it is up on the site, so at a minimum stakeholders should be allowed to confirm the data before Ofcom shares it, in case there are updates or corrections.

As an aside, O3b note that similar tools have been tried for mobile terrestrial services, such as the "Sitefinder" interactive tool for terrestrial mobile networks that was set up in 2000 and the "mobile

[1] Consultation at 3.15, citing to http://www.ofcom.org.uk/about/what-is-ofcom/statutory-duties-and-regulatory-principles/

services map." The "sitefinder" tool ended up being "incomplete and inaccurate;"[2] although the "mobile services map" has been more successful.[3] Ofcom should approach this latest tool with forethought. An aggregated tool (not identified by operator) that provides comparable information about licenses granted and system build-out, as well as service being deployed for both space-based and terrestrial-based spectrum use (such as FSS, BSS or MSS for satellite; and 2G, 3G or 4G for terrestrial mobile) could well be interesting. However, Ofcom should press at the international level for the same data from other administrations, some of which continue to be quite discreet about the operators behind their filings.

Question 2: Do you agree with the industry and technology trends we have identified for the satellite sector? Are there other trends that could have implications for spectrum use?

O3b launched commercial service on its Ka-band, high-throughput, low-latency, NGSO constellation in September 2014, placing it at the vanguard of many of the innovative trends Ofcom mention in this section. O3b already need substantially more capacity to accommodate the growing demand for its high throughput, high performance connectivity, and has secured a further 460 million dollars in financing to manufacture and launch eight more satellites. At least four other NGSO constellations are in various stages of planning and manufacture, indicating that low latency HTS systems will play a significant role in supporting the ever-increasing demand for broadband capacity via satellite.

Ofcom identifies a transformative innovation in noting the development of flat panel antennas. O3b is one of several satellite operators working directly with manufacturers to deploy such antennas, which will enable delivery of high-throughput satellite capacity in fixed and mobile applications. Antenna innovations are also enabling more flexibility in service delivery. O3b expect to soon deploy an 85 cm terrestrial terminal that can be set up in 90 minutes, enabling video streaming and cloud-based applications that customers can receive in no other way in remote un-fibered locations. The terminal also illustrates the factors driving the increasing use of Ka-band by satellite; this Ka-band terminal is roughly one quarter the size of a traditional C band terminal yet it delivers 10 to 100 times the throughput.

Ka-band in particular offers the highest throughput of available satellite spectrum, which is important as broadband networks rely on cached data and content delivered via satellite, an essential one-to-many content and data distribution mode for consumers.

On the other hand, while "dynamic spectrum access" is a promising technological concept, Ofcom should be wary of claims that it is a panacea. Dynamic sharing is possible when there are a limited number of known users in known locations; dynamic sharing is less likely to be usable for a large number of mobile or ubiquitous users.

Another trends Ofcom must confront is "speed to market." The next generation of satellites will come to market before the next international spectrum conference (WRC-19), and thus it will be good if Ofcom retains the necessary flexibility and discretion to accommodate interim decisions.

Question 3: Do you agree with the application specific trends we have identified for the satellite sector? Are there other trends that could have implications for spectrum use?

O3b agree that Ofcom has identified the most obvious trends for satellite applications, but would like to add that we expect non-geostationary satellite technology to be used for backhaul for current and future terrestrial mobile networks. LEO and MEO satellite networks have a latency similar to

[2] http://stakeholders.ofcom.org.uk/sitefinder/
[3] http://maps.ofcom.org.uk/mobile-services/

fiber, and thus LEO and MEO satellite networks are expected be used by terrestrial mobile networks as part of their backhaul infrastructure both for the current 4G and for the future 5G.

Question 4: Do you agree with the industry and technology trends we have identified for the space science sector? Are there other trends that could have implications for spectrum use?

O3b have no comment on this question.

Question 5: Do you agree with the application specific trends we have identified for the space science sector? Are there other trends that could have implications for spectrum use?

O3b have no comment on this question.

Question 6: Do you agree with the applications we have identified as having particular potential for growth in consumer and citizen benefits?

Terrestrial systems are limited to build-out on land, and are rarely built in remote or thinly-populated areas because of the poor return on investment for the terrestrial operator. Only space-based satellite services can ensure truly geographic universal broadband connectivity in the UK. HTS systems, and particularly systems using Ka-band frequencies, can offer cost-effective service to UK consumers in areas with limited or no terrestrial build-out, and keep UK consumers connected on the move through mobile applications (on board airplanes, ships, and even mobile terminals on land). Satellites can also offer coverage to whole regions immediately upon launch. With these capabilities, satellites are essential to meeting consumer expectations of being able to access broadband connectivity anywhere they go.

Although the UK has committed to provide superfast broadband to 95% of UK homes and businesses by 2017[4], Ofcom's CEO, Sharon White, noted that to serve the last underserved 5% will entail a combination of wireless and satellite, and that encouraging investment in technology is the only way to find an overall solution to universal service.[5]

The mobility market for satellite applications is experiencing rapid growth. Mobile users are demanding the same speed and quality of service they have come to expect from the best fiber-based connections, and satellite is making it possible for airlines, vessels and other mobile platforms to satisfy this demand wherever the consumer goes. O3b connectivity is currently being provided to vessels on a scale not seen before, and we are exploring aeronautical services as well.

Satellites also operate on a business model that typically delivers capacity at the level of large enterprises or governments, which in turn enables and is an input to consumer services, direct-to-user broadband offerings, and mobile connectivity (planes and maritime). Benefits to consumers of satellite services extend beyond end-user services, which seem to be the focus of citizen/consumer benefits explored here. Satellite benefits UK citizens and consumers by providing upstream inputs and infrastructure, as well as mobility applications for citizens and consumers who take for granted that there will be connectivity everywhere.

[4] https://www.gov.uk/government/publications/the-digital-communications-infrastructure-strategy/the-digital-communications-infrastructure-strategy

[5] Evidence of Sharon White before the Commons Select Committee, 14 July 2015, at minute 11:15:52. http://www.parliament.uk/business/committees/committees-a-z/commons-select/culture-media-and-sport-committee/news-parliament-2015/evidence-ofcom-15-16/

Finally, noting that this question is focussed on benefits for consumers and citizens, and that there is no comparable question regarding benefits to UK industry, it would be helpful to know how Ofcom would suggest "industry" make its voice heard. O3b recognize the inherent difficulty of reconciling Ofcom's current remit (which does not include "industry") with the UK government goal of increasing the UK's share of the global space industry. Would it perhaps be appropriate to relay industry concerns to either DCMS or UKSA, and then allow those agencies to relay industry concerns to Ofcom?

Question 7: Do you agree with the three priorities that we have proposed for our strategy? Are there other priorities that are as important, or more important, for citizens and consumers and why?

O3b can support the priorities, with the caveat that exploration of spectrum sharing must ensure that satellite communication remain fully available to meet broadband communications needs.

The benefits to citizens and consumers described above are dependent on certainty of access to spectrum for satellite broadband services. Satellite services have long shared spectrum among operators - using the same spectrum every two degrees along the orbital arc - and with compatible terrestrial services such as fixed point-to-point services. Any additional opportunities for spectrum sharing would be viable only to the extent that new spectrum uses are compatible with and not disruptive of satellite services. Moreover, Ofcom should not limit its thinking about satellite as being only for "hard to reach locations." Satellites can - and do - provide truly global geographic coverage, in densely populated cities as well as the most remote and thinly-populated islands.

Question 8: Are there other areas where spectrum liberalisation could enable better satellite broadband services and what specific actions should we be considering?

O3b are pleased that Ofcom have been supportive of ESOMPs (both for GSO and NGSO satellite systems), and are pro-actively considering the best ways to nurture new NGSO systems while preventing harm to existing systems.. We note Ofcom's awareness of "the international nature of satellite applications," [6] and are pleased that Ofcom intends to "support international bodies undertaking relevant studies that could lead to future international agreements or recommendations" about these technologies.[7]

Question 9: Do you agree that existing bands are likely to provide sufficient capacity for considerable growth in satellite broadband and that we do not need to prioritise the identification of new bands? Do you have any comments on the analysis we have undertaken of supply and demand?

O3b do not agree that existing allocations are sufficient. Satellite operators are already making investments in the newer Q and V bands, and there are multiple studies being undertaken about how to share existing allocations. Agenda Item 1.6 for WRC-19 is opening the band to more growth by working out how to share up front, before new services move to this band. This kind of pro-active spectrum management provides certainty regarding sharing rules.

Ofcom's focus on spectrum sharing is yet another indication that additional spectrum will be needed to continue and expand benefits currently enjoyed by the existing users. The technology developed that allows mobile users to communicate with satellites that weren't designed for mobile users

[6] Consultation at 7.10.
[7] Consultation at 7.11.

(ESOMPs) is a brilliant development, but one born from the need to accommodate more users and additional applications within the FSS spectrum.

It should also be noted that when many of the current allocations for Mobile were first granted, the Mobile service envisioned bore almost no resemblance to the Mobile services being developed today, certainly not in terms of ubiquity and number of users.

Satellite services already share spectrum among operators (GSO operators re-use spectrum every two-degrees on the orbital arc; NGSO and GSO operators use the same spectrum) and with compatible terrestrial services e.g. fixed point-to-point (which has compatible deployment patterns). It is notable that satellite operators can deliver broadband with access to only a very limited amount of exclusive spectrum.

Spectrum liberalisation will be most effective with pro-active spectrum management that ensures optimal use of spectrum by requiring compatibility amongst the various services.

It is not prudent to assume that satellite connectivity requirements will remain static while data demands skyrocket. Satellite's role as a direct broadband competitor, as a broadband enabler, and in the mobility sector will see the same ratcheting up of data requirements as other telecom distribution paths.

Question 10: To what extent does the proliferation of filings for 'paper satellites' create costs or barriers that hinder the provision of satellite services to UK citizens and consumers?

As Ofcom know, the ITU has a methodology in place for handling filings that have not completed coordination (RR 11.41), and O3b credit Ofcom for adopting this approach in its recent update to its "Satellite Filing Procedures." Although Ofcom needs to cover its administrative costs for ITU filings, and will not want to spend scarce human resources on projects that do not come to fruition, it would be short-sighted of Ofcom to assume that any of the many new satellites filings it receives are merely "paper" filings. Innovation and growth stem from new ideas, untested technology, and breaking barriers. If the UK and Ofcom wish to grow the UK's share of the world's space industry, it must maintain a medium-to-long-term view of this industry. In the case of ITU satellite filings, that means Ofcom should work closely with the applicants to ensure that new projects come to fruition.

In particular, O3b appreciate Ofcom's pro-active support of O3b and the newer NGSO systems. Because there are myriad ways to be "non" geostationary, it will be difficult to find a single set of regulations that can cover all potential architectures and situations. The ITU regulations have handled this situation well, by being strict about interference with existing systems, while allowing leeway with the multitude of other variables. O3b believe Ofcom will continue to negotiate the best path between encouraging growth and restricting warehousing of spectrum.

Question 11: Are there other actions we should be considering that could enable greater benefits from satellite broadband?

O3b again thank Ofcom for its strong lead at CEPT and WRC-15 to protect the 28 GHz band for broadband satellites (such as O3b). By taking a more international approach to satellite spectrum, the UK is helping to gain the economies of scale needed to maintain successful services. Unfortunately, there are other countries still considering the 28 GHz band, which could have serious repercussions for the UK's own citizens and consumers. Thus, O3b respectfully ask Ofcom to remain aware of this threat, and to pro-actively speak to other administrations about the importance of this band for things such as the backhaul of 4G and 5G, IOT, and M2M.

Question 12: Do you agree that existing bands are likely to provide sufficient capacity for considerable growth in earth observation data downlink and that we do not need to prioritise the identification of new bands? Do you have any comments on the analysis we have undertaken of supply and demand scenarios?

O3b have no comment on this question.

Question 13: What other specific actions should we be considering to facilitate earth observation data downlink?

O3b have no comment on this question.

Question 14: To what extent will access to suitable spectrum for TT&C enable greater use of small satellites and why? Do you agree with the specific actions we have identified and what else should we be considering?

O3b have no comment on this question.

Question 15: What other actions should we be considering to support long term predictability of access to sensing bands?

O3b have no comment on this question.

Question 16: Are there other actions we should be considering that could enable greater benefits from earth observation?

O3b have no comment on this question.

Question 17: Are there any improvements we should consider in how we enable existing benefits to continue, whilst exploring sharing / new uses?

O3b support Ofcom's intentions to provide certainty to our industry, and we a grateful for Ofcom's understanding of the international nature of satellite services, and of the long lead times for build-out of a satellite system. FSS operators need predictability, particularly with regard to access to spectrum. O3b and other FSS operators are writing code, fabricating chips, and designing and ordering even newer generations of satellites, earth stations, air interfaces, traffic optimization software and other system elements. The innovations and applications mentioned above will support the evolution and growth of their services five, ten and twenty months from today. This development must be supported by a predictable regulatory environment, especially in the Ka-band, to ensure the long-term availability of the benefits of broadband connectivity to UK citizens and consumers at any locations.

O3b commend Ofcom for beginning to hold more stakeholder meetings, and we would encourage Ofcom to continue this trend, with a particular emphasis on having the meetings before Ofcom has made its decision. (Otherwise the “stakeholder” meeting is really just a press conference announcing the result; it’s not an interactive exchange of ideas.)

Question 18: Do you agree that the applications we identify do not need to be a particular focus for regulatory action in the short to medium term?

O3b commend Ofcom for its "light touch" approach to regulation, and for showing restraint in imposing unnecessary and potentially inhibiting regulations. Having the flexibility and discretion to respond quickly to innovation and unforeseeable new developments is Ofcom's best chance of keeping abreast of technological changes.

To aid with this need for quick and informed responses to growth, O3b encourage Ofcom to bolster its technical staff. Although Ofcom is well-suited for economic and competition analyses, Ofcom's growing responsibilities as an ITU filing administration for innovative new satellite systems requires its spectrum engineers be experienced in as broad a range of services as possible, from all the industries that use spectrum. The expected introduction of additional NGSO systems, as well as the study of introduction of various terrestrial services in bands allocated to satellite services, will place new demands on Ofcom's expertise in the satellite and space science industries, to enable Ofcom to make informed decisions about what is best for these industries.