Ofcom Consultation:

A Framework For Spectrum Sharing

September 2015

The EMEA Satellite Operators Association (ESOA) and the Global VSAT Forum (GVF) have the honour of replying to Ofcom's Consultation for A Framework For Spectrum Sharing.

ESOA is a CEO-driven association representing satellite operators in Europe, the Middle East, and Africa; the GVF is a non-profit organisation headquartered in the United Kingdom with 200+ members from every major region of the world, representing every sector of the satellite industry. Together, they are the leading voices of the international satellite community.

More information about the associations is available from: **www.esoa.net** and **www.gvf.org**

ESOA and the GVF welcome Ofcom's Consultation and respectfully provide the following responses to Ofcom's questions.

Introduction

In this spectrum sharing consultation, ESOA / GVF highlight the satellite industry response to new opportunities and needs for viable access to spectrum for satellite services. We further emphasize how our industry manages spectrum sharing in order to meet the growing and competing demand of FSS/BSS/MSS satellite services. Finally, we set out our thinking about Ofcom framework's for assessing spectrum sharing options.

Our response identifies the barriers to increased sharing and how they apply on the satellite case. ESOA / GVF hope Ofcom will be able to use this response to better define how the satellite industry utilises spectrum so that Ofcom can most effectively meet new demands, whether for our industry or for other players.

Satellite players count on the continued long term availability of existing ITU primary allocated or co-primary allocated spectrum to MSS, FSS and BSS in L-, S-, C-, X-, Ku-, Ka- and Q/V-bands to enable the continued development of innovative satellite systems capable of offering a wide range of advanced services to businesses and consumers.

Ofcom's principal spectrum duty is to secure the optimal use of spectrum, and to achieve this, where appropriate, shared access to spectrum is authorised. Exploring sharing within the satellite bands can however create regulatory uncertainty which in turn sets up a negative environment for investment and may affect sustainable growth in such spectrum bands.

It is critical that Ofcom respects the rights of existing licence holders whilst considering sharing approaches, in order to avoid causing undue and harmful interference to legitimate services that UK citizens depend upon or services that are critical to the country's benefits. In many instances, sharing approaches might not be possible to access spectrum already licensed. Of course, giving effect to this general observation in specific cases requires a detailed consideration to determine whether sharing is technically feasible or not.

Today satellite services are already using some bands where spectrum is also used by fixed services. It is also well acknowledged that satellite contributes to the establishment and resilient provision of critical and unique communication links. It should be a priority that when trying to meet the spectrum demand for new services and applications, existing services that are considered critical are assured the appropriate spectrum is available to address demand and future growth needs. It is all the more vital to ensure service continuity, especially when the service cannot be replaced, or at costs and with spectrum amounts that are far higher than by satellite.

ESOA / GVF believe that viable and sustainable spectrum access should be assured for satellite FSS/MSS/BSS systems in order to enable the continued delivery of essential services delivered by the satellite industry not just in the UK but also outside the UK.

Question 1: Do you have any comments on the barriers to increased sharing that we have identified above? Which are the most significant and why? Are there others we should take into account?

Broadly speaking, commercial satellite data communications contribute to the establishment and resilient provision of critical and unique communication links that meet the UK government policy objectives in the 21st century, e.g. cost effective and sustainable broadband for all, vital international links to other continents, global maritime and aviation communications, 2G/3G/4G mobile backhaul (and future 5G), humanitarian and disaster relief communications, etc. Although essential, these services are not easily measured in purely economic terms.

Typically, sharing is not feasible when earth stations of satellite systems are deployed ubiquitously, or when terminals are mobile. In this situation, it is generally not possible for other services to avoid causing or receiving harmful interference. In bands for which the operation of earth stations is licence exempt, the location of earth stations is unknown, and this further restricts any possibility of sharing. Therefore any suggestion of forcing sharing would create unnecessary regulatory uncertainty and severely impact the current network and service operations.

Ofcom has identified four tools and enablers that could have potential to facilitate or enable further sharing: Information, Market, Technology and Authorisation Conditions. ESOA / GVF discuss each of these below.

Availability of information:

Several individual satellite operators as well as the GVF/ ESOA provided detailed responses to the Ofcom consultation on a CFI for the satellite spectrum strategic review use, in the summer 2015.[1] Ofcom is encouraged to study these inputs to have a complete overview of the level of spectrum utilisation by the satellite industry today and the future growth in the coming years. Such inputs should already help Ofcom to establish whether there is an opportunity for sharing or not.

It is also vital that in undertaking this analysis, Ofcom follows high level criteria which go beyond the value for individual UK consumers and citizens and supports the UK space sector in terms of its global outlook and economic or strategic benefits to the UK, as well as the criticality and uniqueness of the communications which depend on satellite.

Risk of erecting market barriers:

There are valid risks and concerns to a licensee in allowing other firms to share the spectrum it uses. One risk is that the arrangement may not allow the licensee sufficient flexibility to adapt its business model in the future, e.g. by expanding its network to new locations. Another risk is that facilitating sharing could lead to the market entry of a disruptive technology which would cause interference that goes beyond Ofcom's management control.

As an illustration, the widespread deployment and use of broadband is considered vital to the UK Government to help achieving growth and productivity gains in the UK's economy and maximising

[1] Ofcom, Strategic review of satellite and space science use of spectrum - Call for input (6 Apr. 2015), *available at* http://stakeholders.ofcom.org.uk/consultations/space-science-cfi/

the gains to society from e-Health, e-Government, e-Education and other essential electronic services, and hence these risks have to be very carefully evaluated and mitigated.

- The UK has already made public investment of £1.7billion in broadband networks (primarily BT's) yet the 95% UK coverage by 2017 still remains a challenge
- The goal is to offer national service with affordable, high quality, high speed services
- Satellite operators' (Avanti, Eutelsat, Inmarsat, and SES) Ka-band satellites are designed to provide 100% UK national broadband coverage for high-quality, affordable services

Such an objective can only be achieved under safe market conditions. In limiting prospects for growth and introducing interference conditions, the resulting uncertainty would discourage licensees from pursuing appropriate investments.

Technological challenges:

It is to be reminded that all global satellite operators have shared spectrum with fixed terrestrial systems in several different bands for years, based on appropriate coordination. As noted recently by the UK Spectrum Policy Forum, globally, even though space services have primary allocations totalling 30% of all sub-3GHz spectrum, 65% of spectrum between 1GHz and 10GHz, and 82% of spectrum between 1GHz and 100GHz, only 3% is available on an exclusive basis for space/satellite services; and between 3GHz and 10GHz, no spectrum is allocated on an exclusive basis. Most commonly, allocations are shared with fixed and/or mobile terrestrial services.[2]

Although the vast majority of bands allocated to satellite services are also allocated to other services, co-allocation does not indicate that sharing is always feasible with the other allocated services. It is necessary for regulators to consider the current and planned use and applications of a particular band of both the satellite service and the other allocated services to assess whether sharing is practically feasible. For example many bands allocated to the FSS are also allocated to the mobile service. However, the shared used of the band by FSS earth stations and cellular mobile systems is not practical due to the earth station's high sensitivity to interference and the ubiquitous coverage required for cellular mobile.

The C- and Ku-bands are the most extensively utilised for commercial FSS services, while the Ka-band is seeing rapid uptake and hefty new investments because the technological advances have helped the industry to unleash the full potential of available large bandwidths for high capacity systems.

As C- and Ku-band continue to become more saturated, most new broadband and other satellites will deploy Ka-band technology in the coming years. Therefore it is vital that a sustainable future growth for both GEO and non-GEO satellite systems in Ka-band is ensured.

Satellite operators already share these frequencies amongst themselves by entering into carefully assessed coordination agreements; employing precise orbital spacing; coordination; and using directional antennas to avoid creating interference into each other. Satellite operators have developed a complex and functional framework to effectively utilise the same frequencies covering the globe.

[2] UK Spectrum Policy Forum, *UK Spectrum Usage & Demand: First Edition* (26 Mar. 2015) *available at* https://www.techuk.org/insights/reports/item/3773-uk-spectrum-usage-demand-first-edition.

Sharing or coexistence possibilities with mobile services have been explored in several bands used for satellite communications. High density mobile service (2G, 3G, 4G, and theoretically 5G) involving ubiquitous deployment of mobile terminals and base stations has put significant constraints on sharing with *any* other services. ESOA / GVF are not aware of any successful spectrum sharing on a sustainable basis between this mobile service and the satellite service.[3]

In C-band, for instance, the newly adopted ITU-R Report S.2368 states that "[s]haring studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15"[4] have again concluded that FSS and IMT are not compatible. The entirety of this ITU report—including assumptions, modelling, results, etc.—was not only agreed by all the JTG participants but also by Study Group 5, the ITU expert group on terrestrial services, in November 2014.[5]

In Ka-band, the CEPT has studied the possibility of using the 27.5-29.5 GHz spectrum for ubiquitous FSS terminals using satellite communications to facilitate further deployment of FSS services in this bandwidth the adoption of the Ka-band report on "*The Use of the Frequency Bands 27.5-30.0 GHz and 17.3-20.2 GHz by Satellite Networks*".[6] Again, it has been made clear that sharing spectrum for a mass market of users in the Ka-band uplink spectrum would practically be not feasible. In the downlink spectrum, in particular in the band 17.7-19.7 GHz, this report identifies a need to improve access to this band for satellite services, recognising the heavy FS use of this band in many CEPT countries. This led to ECC Report 232 that examined possibility for making better use of this band for FSS systems, including potential technological enablers. Research into the possible introduction of such techniques is still ongoing.

Authorisation conditions:

Satellite services are generally authorised through one of two methods:

- Authorisation for a specific earth station location
- Authorisation for multiple fixed or mobile earth stations operating anywhere within the UK

The first of these approaches has the potential to allow shared use of the band by some terrestrial applications. For example, this has allowed C-band spectrum (uplink and downlink) to be used by

[3] The case/situation is different when the mobile service is a Complementary Ground Component ("CGC") that is treated as an integral component of MSS under the full control of a same and single operator.

[4] International Telecommunications Union, *Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15* (2015) available at http://www.itu.int/pub/R-REP-S.2368

[5] EMEA Satellite Operators Association, *Frontier Economic Studies: Fiction vs Reality of C-band Reallocation Impacts*, available at http://www.esoa.net/upload/files/publications/C%20Band%20rebuttal.pdf

[6] Electronic Communications Committee, *The Use of the Frequency Bands 27.5-30.0 GHz and 17.3-20.2 GHz by Satellite Networks*, Report 152 (Sept. 2010), available at http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep152.pdf

point-to-point FS links. This authorisation approach facilitates shared used on a geographic basis by applications for which such geographical constraints are tolerable.

The second of these approaches recognises that when earth stations are ubiquitously deployed or are mobile, it is technically not possible to share the band. Consequently, such authorisation is not a real constraint since shared use of the band is in any case not possible.

It is therefore the case that neither of these authorisation approaches represents a real constraint on spectrum sharing.

Another important consideration is that the authorisation to use radio spectrum, and the rights attached thereto, at best can only reflect the market and technology realities and limits. ESOA / GVF believe that license conditions cannot improve all sharing constraints. Even good intentions and purposes will not help licensing sharing arrangements (e.g. Licensed Shared Access (LSA)) modifying emission power characteristics or interference caused by close geographical proximity. (See our response to Q7 below).

Question 2: Have you experienced or are you experiencing the effects of these barriers? If so, in what circumstances and with what impact?

No response.

Question 3: Are the categories of information set out in paragraph 5.5 the right ones? Are there any areas here that you think we should prioritise? Are there other types of information that we should be improving?

The information provided in section 5.5 are highlighted in the table below with comments from GVF/ ESOA:

Ofcom Information	GVF/ ESOA feedback
Increased information on public sector spectrum use;	It is important to gather from all industry players and an assessment should be made not only on utilisation within the UK, but also globally.
Information on actual use, not just what is authorised;	Often not easy to identify in most cases, e.g. for license exempt use for millions of TVROs.
Real-time usage information from licensees on which frequencies are in use in which locations and characteristics of use (e.g. power levels, transmitter heights);	Satellite operators often do not know the precise locations of the earth stations. It is also important to recognise that the frequencies and other technical characteristics may change periodically, due to operational constraints and the need for sharing between satellite networks.
Forward looking information on use from licensees (could help address insecurity of tenure for opportunistic users) to mitigate the secondary nature of sharers' rights relative to	Requiring satellite licensees to provide continually updated technical parameters would be cumbersome, expensive, raises confidentiality and security concerns, and may

incumbents, whether for opportunistic users or sharers with more notice to quit;	not even be technically possible with current systems. This is not possible to apply to satellite services that are licence exempt, such as receive-only earth stations. Registration or licensing of receive-only earth stations and other similar services creates an increased administrative (time and cost) burden on Ofcom; is difficult to apply to devices already deployed; places an unnecessary burden on satellite consumers and end users; and could increase consumer costs.
Information on actual interference to manage the interfaces between users better	The identification of actual interference is a real challenge. While the identification of specific interference cases does occur, it may not be possible to definitively identify interference is all cases, particularly when the interference is temporal. The identification is also very time and resource consuming. Where interference does occur, the party suspected of causing it will be contacted, whether through regulators or directly. It unclear that any change in approach would provide any benefits. Constraints on services expressed in terms of the interference caused to other services are not necessarily enforceable and require action after the damage has occurred.
Information on spectrum demand both from existing users and potential users.	See satellite stakeholders' responses to Ofcom's 2015 CFI on the Strategic Review on Spectrum.

Question 4: Do you think the information about spectrum characteristics described in paragraph 5.9 would be useful? What information would need to be included as a minimum to make it useful?

ESOA / GVF note that the information identified by Ofcom in section 5.9 is essentially focused on looking for spectrum data to the services provided by a particular sector.

A concern that GVF / ESOA members have is the difficultly to share highly commercial sensitive information and data to the level of detail that Ofcom seems to be requesting. Not only this information is sometimes not available to satellite operators, but often our commercial contracts prevent such sensitive information from being disclosed. The characteristics Ofcom suggests might be provided seem to be too general to be of real use, and GVF / ESOA does not see any significant benefit from the provision of such simple spectrum characteristics.

Question 5: Have we identified the relevant market enablers, or are there others we should take into account? For each one, what is the potential for it to facilitate sharing and what are the downsides? Are there any that you think would be particularly effective or problematic?

The Space sector contributes £11.3 billion a year to the UK economy and has been growing at rate of about 7% each year throughout the recession.[7] The same UK Space Innovation and Growth Strategy is targeting a fourfold growth in the sector by 2030, or 8.5% CAGR over those two decades.[8]

The sector also supports thousands of jobs as a direct result of its activities, with employee productivity more than four times the national average. It consequently contributes some £145,000 per worker to UK GDP. Significantly, both manufacturing and operations are capital intensive and require highly skilled people resulting in graduates filling nearly two-thirds of all jobs.

Satellite DTH coverage in the UK is in excess of 99% according to the Digital satellite Coverage Study Group from 2000 and the trial undertook by BSkyB at the same time.[9] Cleary, satellite enables delivery of TV to virtually all households in the country or elsewhere in Europe and the rest of the world.

Commercial Mobility: This application allows UK citizens to stay connected to their work and family when travelling for leisure or when working at sea (e.g. cargo vessels) and on aircraft. Recent developments of this application in the satellite industry has allowed for broadband type experience for travellers where previously no broadband communications was possible.

Corporate Networks: This allows UK companies (e.g. BP) to operate worldwide and remain connected to retail sites (e.g. gas station) as well as remote offices. Satellite communications is essential to the oil, gas, and mining industries, in which UK companies play key roles.

Distribution and Contribution: Satellite distribution and contribution of TV is essential to the operations of the BBC, and has allowed the BBC to provide worldwide news and entertainment services, being able to keep citizens informed throughout the entire world.

Military and Government: Satellite applications allow tactical coverage of conflict zones. Also, satellite links provide for much needed welfare for British troops that are stationed overseas, allowing them to stay connected to their families—and allows them to follow, for example, their national sports team like the rest of the UK population can back home.

The same applies with satellite broadband services which are, or can be, delivered in all locations over Europe, Africa or Middle East, including the most remote rural areas or islands.

In addition, satellite has enabled the availability of a multiplicity of HDTV channels all over Europe, including in the UK, due to high capacity throughput dedicated to broadcasting services. Satellite is

[7] UK Space Innovation and Growth Strategy (IGS), initiated in 2010 and refreshed in 2014.

[8] *A Space Innovation and Growth Strategy 2010 to 2030*, UK Space, 2010; *Government response to the space growth action plan*. https://www.gov.uk/government/publications/government-response-space-growth-action-plan

[9] *See* ITC Consultation on Progress Towards Digital Switchover, Response by BSkyB, at 3 fn.2 (Rutherford Study) available at http://www.ofcom.org.uk/static/archive/itc/uploads/BSkyB.doc

now pioneering the delivery of Ultra-HD video content that requires extensive capacity and more spectrum.

The services highlighted above are very sensitive to interference by other services. This sensitivity makes some types of sharing, such as with IMT, a risky proposition for consumers of satellite services.

Question 6: Have we identified the relevant technology enablers, or are there others we should take into account? For each one, what is the potential for it to facilitate sharing and what are the downsides? Are there any that you think would be particularly effective or problematic? What, if any, role should Ofcom play in helping to develop them?

New small-beam satellite technology allows for the same frequencies to be reused multiple times on the same satellite. This creates a significant increase in the overall spectrum efficiency. This is one example of where satellite manufacturers and operators have made major investments in new technology to maximize the efficiency with which satellite spectrum is used and shared within the industry. Further technological improvements can be expected, which should dramatically reduce the cost per MHz, cost per bit, and equipment costs. Technological improvements are unlikely to diminish the demand for viable access to the spectrum used by such satellites and will instead translate to increased demand from consumers for additional, new applications provided by satellite services. Any constraint to this innovation will harm consumers, the satellite industry, and hinder the same premise that Ofcom is trying to advocate—efficient spectrum sharing.

The satellite industry is maximising its spectrum usage and investing to improve spectrum efficiency. Spectrum reuse via spot beam architecture expands available capacity and reduces the transmission and equipment costs. Early satellites systems employed wide downlink beams, which provided global or hemispherical coverage. By employing frequency reuse, satellites (using either linear or circular polarisation discrimination) can utilise the full bandwidth twice. Furthermore, geostationary satellites may be spaced every few degrees around the arc, each providing service to the same geographic area with the same frequencies.

More specifically, on the technology enablers identified by Ofcom:

1. **Protocols for accessing shared spectrum**

Satellite bands are already shared among satellite operators through careful coordination agreements.

Due to the architecture of satellite networks and its services, the protocols for accessing shared spectrum mentioned in points 5.22 to 5.26 would not apply to terrestrial services wishing to operate in bands used by satellite services.

For receiving satellite earth stations, the wanted signal is transmitted from a satellite in geostationary or non-geostationary orbit. It is not practical for other devices to detect the wanted signal or to determine where it is being received.

When the satellite is receiving, the wanted signal is transmitted from an earth station which may be on the other side of the earth. It is not possible for the terrestrial service to detect such a signal.

2. Geolocation database technologies

Identification of satellite service end-users may not be possible even for the satellite operators (e.g. in the case of TVROs), so the creation of geolocation databases would be extremely challenging. Furthermore, even if all the station locations are identified, assessing the interference potential from other services and enforcing interference limits would still remain the key concerns.

3. Sensing

Sensing is similar to the "detect and avoid" technique, on which we comment above (see section "Protocols for accessing shared spectrum"). Sensing would not be applicable to satellite networks due to their network structures.

One additional concern with some sensing methods is that the system may not be fail-safe, in that if the sensing mechanism fails or is disabled, the terrestrial transmitter may falsely believe that it can transmit without causing interference. Therefore the assurance of correct operation of sensing mechanisms becomes an important and challenging issue.

4. Automatic reporting of interference

The accurate detection of the source and level of interference is often difficult, in particular the ability to identify definitively the source of interference. Where it is possible to detect the source, such identification generally happens after the interference has occurred.

5. Frequency and band agile equipment

Satellite services are already restricted to a limited portion of spectrum, which is shared between other satellite operators and often other service. The frequency bands used by the satellites cannot be changed after the satellite is launched, and satellites are currently expected to operate for 15-20 years. Earth stations typically may operate on any frequency within a defined band (e.g. C-band). However the large frequency separations between different satellite bands (C-, Ka-, and Ka-band) mean that terminals operating in multiple bands are not practical. Also, for an earth station to operate in multiple frequency bands requires a corresponding satellite covering multiple bands, which must be successfully coordinated for all bands. This is also acts as an additional practical limitation.

As the frequency bands have difference propagation characteristics, different applications tend to prefer specific bands. For example, high availability links—such as broadcasting—might require use of C-band whereas applications requiring small antennas but lower availability might use Ka-band. The difference characteristics of the frequency bands also limit the extent to which switching from band to another could be useful.

Overall, we don't see this approach as being usefully applied to satellite services.

Question 7: Do you have any comments on the authorisation tools that we have identified above? Are there others we should take into account? For each one, what is the potential for it to facilitate sharing and what are the downsides? Are there any that you think would be particularly effective or problematic?

Ofcom raises the issue of "tiered access". This could be a useful way of categorising services or applications, or giving one service priority over another. It does not however address the technical feasibility of one service sharing with another.

Ofcom also highlights LSA as an instrument to facilitate efficient use of spectrum.

GVF / ESOA understand that, in order to determine the scope of LSA in the context of this definition, it is considered that a sharing arrangement falls within the framework of LSA if:

1) A band is primarily *used or intended to be used* for a given radiocommunication service by one or more incumbent users.
2) There are sharing *possibilities* for a limited number of licensed alternative users of the band.
3) Alternative users should *not* interfere with the primary use of the band.

It is therefore expected that any implementation of LSA:

- Fully complies with the licensing regime as defined in the EU Regulatory Framework on Electronic Communications (Telecoms Package);
- Is only relevant in spectrum where incumbent users are individually licensed (i.e. not license exempted);
- Is aimed at providing some kind of *legal* security for spectrum sharing but does not prejudge on technical or technological constraints that, in some cases, makes sharing just *not* feasible.

These sharing rules are considered necessary to provide a certain level of quality of service (QoS) for all users in the band.

GVF / ESOA are highly concerned that the promotion of flexibility in spectrum use may lead to deteriorate the conditions under which critical services are provided. As such, we fundamentally subscribe to the point that LSA should in no way compromise the incumbent QoS.

On the other hand, LSA licences should not, in the long term, limit potential innovation by the incumbent service in accordance with its spectrum rights of use. Indeed, LSA is defined as an instrument to permit *viable coexistence* between different users in a same band. GVF / ESOA therefore consider that LSA should in no way be foreseen as a tool to re-allocate spectrum.

Finally, ESOA / GVF consider that, in evaluating the opportunity of introducing LSA in a specific frequency band, a thorough evaluation is made of both benefits *and* risks associated with the presence of newcomers. In particular, alongside QoS, other considerations (e.g. resilience, coverage,

security, safety, contribution to culture, and access to international communications) are critical to measure the value of some services to society. There will undoubtedly be several cases where the cost of sharing will demonstrably be too high based on these parameters.

ESOA / GVF add that spectrum pricing is currently applied to some classes of earth station, for example licence fees for permanent earth stations are set following AIP principles. These are already strong incentives to use spectrum is an ever more efficient manner. Spectrum trading, leasing, and auctions have not previously been applied to satellite services and remain inappropriate for satellite services, for numerous reasons, including the need for stable, long-term spectrum policy to accommodate the multi-decade time span of satellite projects, as well as the inherently international nature of satellite policy, which precludes unilateral changes.[10]

Question 8: Are the characteristics of use we have identified sensible and sufficient to provide a high level indication of sharing potential? Are there other factors that we should expect to take into account? Are there any factors that you consider to be particularly significant? Are there any which we should attach less weight to?

Assessing sharing potential between satellite and other services should also include the following considerations:

System tolerance to interference:

Satellite systems are optimized for the reception of very weak signals, which makes them particularly vulnerable to interference. Large-scale deployment of another service in the same or adjacent band can results in aggregate interference, which raises the general noise floor and thereby disturbs or even prevents satellite signal reception.

Possibilities for future network growth:

Studies such as those in the new Report ITU-R S.2368 have concluded that geographic sharing between satellite and terrestrial broadband networks will result in large sterilized areas, where future satellite network deployment will not be possible. This will limit the satellite industry's growth and innovation and reduce the value to end-users.

Introducing a new satellite station to an area already geographically allocated to terrestrial broadband would be practically very complex and require terrestrial operators to scale back networks in areas where investment has already been made.

Impact of protection areas in case of sharing by geographical separation:

Assessment of potential sharing opportunities should include any available interference studies done in the field. For instance, studies considering sharing between satellite and terrestrial broadband networks in Report ITU-R S.2368 indicate that protection distances between the satellite

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Satellite Industry Association, *The Satellite Industry is Opposed to Non-Cost-Based U.S. Spectrum Fees and Auctions for Satellites* (10 Apr. 2013) available at http://www.sia.org/wp-content/uploads/2013/07/SIA_Spectrum_Fee_and_Auction_Position_Paper_2013_FINAL.pdf

and terrestrial services can reach up to 525 km. It should therefore be considered whether the existing satellite network allows deployment of the newcomer's network in any useable way.