ESOA Responses to Ofcom's Consultation on "*Space Spectrum Strategy*"

10 May 2016

Introduction

ESOA welcomes the opportunity to respond to Ofcom's consultation on "Space Spectrum Strategy", published on 1 March 2016.

The position of ESOA represents the view of EMEA satellite operators. This consultation is very important in order give assurance that spectrum required by the space industry is actually available for the continuation and growth of services that are essential to the UK economics and citizens.

ESOA commends Ofcom for its efforts to provide a thorough and future proof analysis of trends in the space and satellite sector in order to best evaluate our spectrum needs. Following our extensive comments on Ofcom's strategic spectrum review in 2015, we respectfully provide these additional comments.

About ESOA

ESOA (EMEA Satellite Operators Association) is a non-profit organisation established with the objective of serving and promoting the common interests of satellite operators from Europe, the Middle East, Africa and CIS. The Association today represents the interests of 21 satellite operators who deliver information communication services around the globe.

Together ESOA Members provide invaluable communication services to the whole world including television broadcast and distribution, broadband connectivity, emergency communication, newsgathering, maritime and aero communication, secure services for governments, 24-7 monitoring of industrial processes such as energy plants and a whole range of other communications capabilities that society has come to rely on.

ESOA's Response

Ofcom previously published a Call for Input in 2014 and received 42 responses.[1] This present document summarises the findings from that proceeding in defining strategy for future satellite communications and space sciences. ESOA represents the operators of satellite communications systems only and therefore responds below only on those questions that are within the ESOA mandate. Hence, the responses below represent ESOA views on the topics raised in the consultation questions for questions 1-3, 6-11 and 17-18.

As a reminder, the Space Innovation and Growth Strategy (IGS) 2014-2030 asked that "*Ofcom should prioritise the interests of UK satellite operator companies creating wealth, employment and taxes in the UK, in matters related to access to international satellite spectrum allocated by the International Telecommunication Union (ITU), treatment of satellite network filings by the UK to the ITU and to framing of international satellite regulations at the ITU*". [2]

In its response, the Government agreed that "*Ofcom will continue to develop its approach to satellite and spectrum issues in close consultation with the UK space industry*". [3]We therefore encourage Ofcom to ensure sustainable protection for existing and planned satellite services spectrum and spectrum use policies and to avoid fundamentally jeopardising the viability of existing and future use of ITU satellite service allocations within the UK.

In section 1 of the consultation document, Ofcom discusses the benefits to UK citizens and consumers. Ofcom has identified such benefits that arise from the use of satellite services such as satellite TV and satellite navigation. It is important also to consider the benefit to UK citizens and consumers that arise to the UK from a successful space industry that serves not only the UK but, generally speaking, the global market. The UK has a thriving space and satellite community which itself benefits UK citizens. The space sector contributes £11.3 billion a year to the UK economy and has been growing at about 7% each year throughout the recession, according to the UK Space Innovation and Growth Strategy (IGS), initiated in 2010 and refreshed in 2014. The same IGS is targeting a fourfold growth in the sector by 2030, or 8.5% CAGR over those two decades. ("A Space Innovation and Growth Strategy 2010 to 2030", UK Space, 2010).

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.

The global availability of spectrum for satellite services is vital for almost all aspects of the UK space industry as it serves consumers in a global market along with those in the UK. Hence the actions taken by Ofcom in the international regulatory fora on behalf of the UK have a

[1] http://stakeholders.ofcom.org.uk/consultations/space-science-cfi/

[2] http://www.parliamentaryspacecommittee.com/media/publications/Space%20IGS%20Main%20Report.pdf

[3] http://www.parliamentaryspacecommittee.com/media/publications/Space%20IGS%20Main%20Report.pdf

major influence on the capabilities of the UK space industry to meet its growth objectives. The Space Spectrum Advisory Committee was established with the aim of ensuring that Ofcom's decision making takes into account the high importance that the international regulatory framework has for the UK space industry, even when serving non-UK customers. This body should continue to influence Ofcom's decision making process.

Question 1: How useful is the interactive data 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?

ESOA applauds Ofcom for the open and transparent mechanisms it has used to gather the data and provide with an interactive database. It is indeed critical to acknowledge that satellites and space science provides a wide range of important services to customers including commercial businesses, governments, military users, public safety organisations, and individual users, consequently providing direct and indirect benefits to UK citizens and consumers. These services encompass: television broadcast and distribution, broadband connectivity, emergency communication, newsgathering, maritime and aero communication, secure services for governments, 24-7 monitoring of industrial processes such as energy plants and a whole range of other communications capabilities that society has come to rely on.

The Ofcom interactive database provides an important insight into the use of space spectrum by companies licensed in the UK. As explained in Ofcom's document, information and charts are interactive and the users can enable the filtering and downloading of the information easily. Although it is UK only information, it is still very useful and may trigger other countries to act with the same transparency.

However, it is unclear what Ofcom's intention is in inviting users of the database to manipulate and possibly modify the existing data, e.g. for future scenarios on Broadband or TV. Is Ofcom inviting stakeholders to send further inputs? We have not found clarification from the consultation document or from the website that only explains how filtering information will work in practice ("How to use the interactive dashboard" from: http://stakeholders.ofcom.org.uk/consultations/space-spectrum-strategy/interactive-data/).

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?

Ofcom has identified certain envisaged technology trends in the satellite and space science sectors that it believes have the most significant impact on spectrum use in the future.

Among the identified trends is the increasing use of Ka-band for broadband applications alongside existing and future Ku-band applications and improved satellite antenna technologies that help to introduce High Throughput Satellite (HTS) technologies for better capacity in satellite usage.

ESOA appreciates the inclusion of HTS in this consultation. HTS enables the provision of between 2 and 20 times the total throughput of classical FSS satellites for the same amount of allocated orbital spectrum, thus drastically reducing cost per bit. ESOA confirms that HTS at Ku-band are on the roadmap for some operators and it should be noted that some operators (e.g. Intelsat with Epic) are already using HTS in Ku-band or C-band. HTS in both bands will naturally bring a high capacity along with reduced cost per bit rate.

A specific trend to be recognized by Ofcom is the evolution of C-band and Ku-band satellites from traditional bent-pipe design to completely digitized, highly flexible multi-spot technology. The incorporation of high-capacity digital switching allows for unprecedented flexibility in allocation of resources to target high-demand areas. Such developments allow C-band and Ku-band satellite to offer services that are especially suited for broadband services to maritime and aero-mobility.

When considering trends and future hybrid systems, Ofcom should also take notice of a renewed interest in non-geostationary (NGSO) satellite systems. While NGSOs are not new, the explosive demand for connectivity coupled with big leaps made in space technology have made NGSO systems technically and economically viable.

Some of the technology trends identified by Ofcom, e.g. flexible payloads and flat panel, phased-array and steerable antennas will also support the introduction of new services and applications at lower cost. Recent developments in user terminal antennas with the use of dynamic, high accuracy pointing mechanisms has allowed for the introduction of mobile broadband to ships and aircraft. Further technology developments can be anticipated that will reduce the size and lower the cost of such terminals, including flat panel antennas.

ESOA believes that the space segment innovation (e.g. electric propulsion and mass optimization, digital processing on board satellites) should also be taken into account to evaluate further optimisation in satellite transmission throughput and spectrum use.

Finally, ESOA notes the reference to dynamic spectrum access technologies and the need for spectrum management techniques (exclusive licenses, LSA, shared access) to be better investigated to allow more efficient use of spectrum. While such sharing techniques are generally feasible when considering sharing with FSS gateway earth stations, which are relatively few in number and deployed at fixed, known locations, the situation is different for mobile or ubiquitously deployed terminals.

In order to make sure new advanced spectrum sharing mechanisms continue providing sufficient regulatory predictability and certainty, a prerequisite is to actually implement these mechanisms, based on proven technical means and reliable deployment conditions, with evidence that harmful interference is precisely identified and carefully avoided.

Satellite operators are also moving towards spectrum usage in Q and V bands (around 37-51 GHz). Technology developments are making equipment and components for these bands more affordable and the need for ever increasing bandwidths is also creating a demand. Some satellite test and development payloads are currently in operation. These bands are allocated to other services and some parts are already in use by terrestrial systems. These bands are also within the scope of several WRC-19 agenda items which could impact on the long-term availability of spectrum for the FSS. It is likely therefore that these frequency bands will need to become an area of increased focus by Ofcom in the future, to ensure that a stable and effective regulatory environment exists for satellite communications.

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?

Ofcom has focussed on the 4 most dominant applications: broadcasting TV, broadband connectivity, satellite positioning services as well as IoT issues. All of them are significantly important applications in terms of satellite usage and the consultation clearly highlights the role of satellite in each case.

ESOA agrees with Ofcom's remarks by highlighting that satellite's role in connecting devices in locations not easily served by terrestrial networks will be significant. This will be especially important for development of connected devices, because this number is expected to increase to 20-50 billion by 2020 (as predicted by several analysts including Cisco).

However, as satellite and antenna technology advances, especially with mobile and hybrid applications, as noted in this response, satellite services should not be considered purely as a service for remote and rural connectivity but part of a hybrid mix of connectivity solutions for delivering level services across wide regions.

It is also to be emphasized that the VSAT market, as part of fixed broadband connectivity, remains an essential component of satellite communications notably for corporations (especially oil & gas including off-shore platforms (UK)), governmental institutions/bodies, NGOs and UN agencies, especially for international communications needs.

ESOA further considers that other applications are worthy of special consideration: Hybrid Broadcasting-Broadband (BC-BB) as well as hybrid terrestrial-satellite networks providing full connectivity should also be taken into account. It is important to insist that video-centric content will be a key driver of demands on the capabilities of next generation networks (NGNs), including 5G.[4] All possible network technologies (cellular, satellite, fiber) should be seamlessly integrated into an overall 5G solution in order to be able to deal with these demands. Hybrid terrestrial-satellite network architecture should combine satellite's wide coverage areas, ubiquitous access, and broadcast-ability with intelligent routing, caching, and popularity metrics together with terrestrial "return channel." This approach has already taken form through the widespread HbbTV standard in Europe.

We finally confirm that the IoT is likely to be a significant driver of growth in satellite spectrum use. The IoT is a very wide field with many facets - in certain cases, satellite are the ideal mode of communication. One clear example is the connected car where providing software updates to millions of cars around the globe can only be efficiently achieved via satellite. It may be noted that that satellite systems already provide IoT with M2M services notably for SCADA applications e.g. oil & gas; electricity generation & distribution; or petrol stations and ATMs outside urban areas. As technology develops further, ESOA sees IoT as a driver for increased spectrum use by satellites, also in the Military, Transportation (e.g. Dispatch, Fuel, Emergency, Geo-positioning) & Cargo (Freight by all transport means) areas.

Questions 4-5:

No answer.

[4] More than 80% of all IP traffic will be made up of videos according to CISCO.

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

Ofcom has identified the following services as applications with the greatest potential for growth in consumer and citizen benefits:

- Broadcasting
- Broadband access (Fixed)
- Broadband access (Mobile)
- Navigation and positioning
- Earth observation

ESOA further believes that IoT/M2M applications, which are highlighted in section 6, also have potential to provide significant growth in consumer and citizen benefits. As explained above, predictions for very high growth in M2M/IoT generally, even if only partly realised, will increase demand for satellite based M2M/IoT in order to ensure ubiquitous coverage. For example, innovation in satellite mobility services and antennas will open the way for connected car applications, which can impact UK consumers via improved safety, reliability and efficiency across the entire region and not simply in remote areas.

While these services may have the greatest potential for growth in consumer and citizen benefits, there are other services which provide high consumer and citizen benefits but, as they are more mature services, may not have the same high potential for growth. For example safety related communication services for ships, off-shore platforms and aircraft rely on satellite communications. New broadcast technologies will also impact UK consumers as well as benefitting UK broadcast companies for the delivery of news and culture broadcasts abroad.

Ofcom also clearly indicates how satellite can be involved for all these applications. However, these applications are very UK-specific. Weight of each application is very country oriented in terms of consumers' usage. Companies licensed in the UK in many cases, however, provide service far beyond the countries' borders while bringing home revenue, cultural and economic advantages. Hence, Ofcom should take a wider view of those services, for example to be used for cellular backhaul, trunking and international connectivity.

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?

The three priorities are the following:

- growth in broadband communications provided via satellite to otherwise difficult to reach locations, on land, off-shore platforms, ships and aircraft

- growth in quality and quantity of earth observations data collected by satellites

- continuation of the benefits that citizens and consumers enjoy presently while exploiting opportunities of spectrum sharing in the spectrum bands currently used by the space sector and new uses in the adjacent bands

ESOA concurs that the first of these items are important, and ESOA supports that Ofcom prioritises this issue.

Regarding the third priority, spectrum sharing ought to be treated with caution - it will not be a panacea for meeting future spectrum demands. ESOA submitted extensive views to Ofcom on its spectrum sharing consultation in 2015.[5] We recognise that spectrum sharing fits into Ofcom's general strategy. Some of the bands used by satellite services in the UK are also used by terrestrial services, and some applications are able to share with no major drawbacks. For example gateway earth stations which are few in number can typically share with coordinated point-to-point terrestrial links, which is evidenced by the number of satellite gateway earth stations already licensed by Ofcom within the UK. However, for other applications, particularly those which require ubiquitous deployment of earth stations or terrestrial systems, the scope for sharing is very limited.

When considering potential new sharing opportunities, whether in the same bands used by satellite applications or in adjacent bands, it is important that Ofcom continues to ensure that satellite applications are adequately protected against interference. This coexistence issue is going to become particularly acute if Ofcom is planning to increase the usage of satellite C-band by terrestrial applications.

Moreover, Ofcom should add the following as potential additional priority:

- Role of satellite in contributing to the deployment of 5G networks & solutions: It is extremely important that 5G systems take account of the contribution of all technologies in future connectivity ecosystems (for 2020 and beyond), in order to address increased capacity requirements as well as full coverage & inclusiveness. ESOA expects that FSS using C-band, Ku-band and Ka-band will contribute to this overall evolution in connectivity needs especially as regards IoT, M2M, communications on the move, Mobile backhaul and media & entertainment.
- Facilitating the growth of satellite services in all areas: Ofcom is uniquely positioned to play an active role in shaping the regulatory framework in the ITU and other regulatory bodies in a manner that embraces its base policy of adding flexibility to serve new segments, especially ones that impact UK citizens.

Finally, while focussing on specific priorities, it is important not to overlook the more day-to-day spectrum management activities which are important to maintain a continuing sound regulatory environment for all satellite systems in all frequency bands. Ofcom should aim to ensure that the regulatory environment does not lead to unacceptable interference to satellite systems, and to ensure that satellite systems have a fair opportunity for access to spectrum resources. This means, for example, continuing to work within the international regulatory fora (in particular the ITU and CEPT) to ensure that the regulations related to sharing and compatibility for satellite and terrestrial applications are adequate.

[5] http://stakeholders.ofcom.org.uk/consultations/space-science-cfi/?showResponses=true&pageNum=2#responses

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

Ofcom essentially expects to "provide greater flexibility for the deployment of new technologies by liberalizing spectrum use" in order to facilitate nGSO networks & ESIMS.

ESOA is pleased to note that Ofcom has supported changes to regulations to enable new technology developments such as ESIMs and the use of complementary ground components (CGCs) in S-band. Regarding ESIMs, while the UK and European regulations are well developed, further work may be needed in the future, particularly in the context of WRC-19 agenda item 1.5, as identified by Ofcom.

Regarding the use of CGCs, we understand that Ofcom is currently consulting on the potential use of CGCs to provide aeronautical services and is planning to consult on the operation of the related aircraft terminals. Aside from this activity, we are not currently aware of any further requirements for CGCs.

ESOA also calls for flexibility in using spectrum (e.g. to enable mobility in the FSS), notably in developing standards that would allow mobile terminals the flexibility to operate. For example, there is a need for the development of new technical standards for electronically steerable antennas. The existing ITU recommendation and CEPT documents are all based on parabolic antennas. Including new antenna technology in formulating standards and recommendations would have a wide implication on the adoption of new services such as the connected car. Industry will look to Ofcom to support efforts to advance such discussions in the relevant fora.

ESOA therefore expects Ofcom to play an active role at the ITU and CEPT in developing a regulatory environment that would facilitate the growth of new services such as IoT and mobility in the FSS.

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?

The C- and Ku-band are heavily used and face congestion. However, based on the assumption that C-band will remain available for the FSS in the future (taking into account the outcome of WRC-15 agenda item 1.1), and based on the additional Ku-band made available after the WRC-15 decisions on agenda item 1.6, the allocations in these bands could be considered adequate for the time being.

Nevertheless, it should be kept in mind that most of the bands allocated for satellite communication purposes are also allocated to other services, usually the fixed service (FS) and mobile service (MS). Hence the existence of adequate frequency allocations in the ITU Radio Regulations is not necessarily an indication that all is well.

In Ka-band for example, one of the potential issues is that while at first glance there is 2x2.5 GHz available for commercial satellite communication systems (17.7-20.2 GHz and 27.5-30 GHz), much of that spectrum is also used for terrestrial systems. In the downlink direction, the band 17.7-19.7 GHz, or 80% of the FSS band, is widely used for fixed links in the UK and elsewhere, placing a major constraint on its use for FSS applications. In the uplink direction, Ofcom has issued "Spectrum Access 28 GHz Licences" for the bands 27.8285-28.4445 and 28.8365-29.4525 GHz, or 49% of the FSS band, placing a major constraint on its use for FSS applications.

With these constraints in mind, there will very likely be insufficient spectrum in the Ka-band for the envisaged satellite applications in the near future. In Annex 5, Ofcom has included a supply and demand analysis for fixed and mobile broadband which suggests that future HTS satellites will be able to meet demand for fixed and mobile broadband in the UK. However this has assumed the availability of 2 GHz spectrum in the return link direction for user terminals. As indicated above, currently only 51% of the band (1.3 GHz) is realistically available for user terminals in the return link direction under the current regulatory regime, even if all HTS feeder links were to move to Q/V band. In the forward link direction, the available spectrum that is unconstrained by FS use is only 0.5 GHz – much less than the 2 GHz assumed by Ofcom. Therefore Ofcom's analysis appears to support action in Ka-band to provide for greater spectrum access than is currently the case.

Work has been undertaken at the CEPT level to define the frequency plans by which parts the so-called non-exclusive band (17.7-19.7 GHz and 27.5-29.5 GHz) can be used for ubiquitous FSS user terminals (HDFSS). In this respect we must take particular care to avoid deployment of any IMT in these frequencies as this would undermine the CEPT work by precluding use of ubiquitous FSS user terminals in these frequencies.

The Q-band and V-band are beginning to be used/planned for satellite communication services, notably for gateways in order to free more of the Ka-band for user terminals, in order to support for future generations of HTS payloads. WRC-19 agenda item 1.9 / issue 9.1.9 is seeking a possible additional allocation at Q/V-band with the aim of rationalising the existing uplink and downlink allocations. Therefore the need for future gateway link spectrum is very important and should be supported by Ofcom.

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?

Inefficiencies in the ITU satellite coordination processes are a hindrance for all satellite operators whether serving users in the UK or abroad.

ESOA fully supports efforts to improve the current processes, taking into account also the need to assure the regulatory certainty that current and future satellite investment depends on. Improvements to the current rules must be agreed internationally and applied fairly and consistently in a manner which respects the many complex balances developed through decades of consensus at progressive ITU Radio Conferences. In this respect, to apply more stringent regulations nationally would harm those operators which file through the UK and at

the same time benefit those operators which file through other national administrations. Such an approach would provide no benefit to UK citizens and consumers.

More specifically, ESOA feels that some of the recent changes to Ofcom's Procedures for the Management of Satellite Filings require far more details to be provided than the ITU-R does and may thereby, if being implemented strictly, hinder the provision of satellite services to UK citizens and consumers by having a negative effect on investment in the UK satellite industry.

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

There is a need to be continually alert to threats to satellite operators serving the UK. One specific example is the threat posed to the Ka-band uplink spectrum by proponents of the same band for terrestrial 5G networks. Although the Ka-band uplink spectrum was discussed as a potential band for 5G at WRC-15 and rejected, a handful of administrations (outside of Europe) are still considering that band. This runs a high risk of causing interference to satellite operations in the same band, which could cause interference to the signals received from UK users and would in any case reduce the overall efficiency with which the Ka-band can be used, thereby increasing costs for all operators and users. (Please also see our comments to Question 10 concerning the precluding of any use of ubiquitous FSS user terminals in frequencies where IMT is deployed).

In general it is important that Ofcom remains ready to address this and similar threats that occur from time-to-time in all frequency bands. A well-regulated international regime is vital for the satellite industry as a whole, which is critical to support the benefits for UK citizens and consumers that satellite technology provides. Consequently, Ofcom should maintain its leading role in the development of international regulations related to satellite communications.

Question 12-16:

No answer.

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

Ofcom has listed some factors that would permit existing users to obtain a reasonable return on investment considering the lifetime of satellites as between 10-20 years. Small satellite lifetime is even shorter as small satellites may last 6 months to 2 years according to Ofcom consultation. The lifespan of new generations of terrestrial technology averages every 8-10 years as shown by evolution of GSM, 3G or 4G (up to 2020). ESOA supports Ofcom's effort to take into account the time that satellite operators must include in their business planning. Amongst considerations about spectrum sharing, one can note the following:

- Any sharing regime should allow for future growth and expansion of existing satellite services and avoid the freezing of certain bands or preventing the introduction of new satellite services.

- On spectrum sharing, the consequences and implications first need to be carefully evaluated in terms of new regulatory conditions including new pfd limits (constraints), etc. Currently, there is no detail of possible new spectrum sharing proposals in Ofcom's consultation, and we will evaluate when the detail is provided.

Ofcom has identified a number of actions that may be taken to address the protection of satellite services from interference. However one aspect which is missing is the regulatory decision making at the international level (principally ITU and CEPT), where decisions on the allocation of frequency bands and many of the technical sharing conditions or procedures to avoid interference are agreed. It is partly because of this international regulatory framework that interference cases to satellite services are generally manageable. It is therefore important to satellite operators that Ofcom and other regulators continue to operate actively at the international level to maintain an international regulatory framework that meets changing requirements.

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?

The applications that Ofcom refers to here are HD broadcast TV content, satellite navigation and positioning, machine-to-machine communications & the "Internet of things", and safety-related communications. ESOA agrees that these require no particular focus for the time being, but should be monitored.