OFCOM SPECTRUM REVIEW
13 August 2015

Introduction

SES is pleased to submit this response to this Ofcom's Spectrum Review consultation. As a satellite service provider offering significant services to U.K. customers, SES S.A. on behalf of its various UK interests including wholly-owned subsidiaries SES ASTRA GB Ltd., SES Satellites (Gibraltar) Ltd. and SES Satellite Leasing Ltd. (collectively, "SES"), very much appreciates the opportunity to participate in this consultation and to contribute to Ofcom's review of spectrum used for point-to-point and other services. SES also holds an approximately forty-five percent (45%) interest in O3b Limited, a non-geostationary Ka-band satellite operator located in Jersey, Channel Islands.

Before addressing the specific questions related to this Spectrum Review, SES would first like to comment on the fundamental importance of satellite services to the UK. Satellite services play an integral role in the smooth operation of the UK economy and an important part in the daily life of the UK citizen offering many essential services. Despite this fact and because satellite operators are largely wholesalers that do not have high profile "brand-names" or direct relationships with consumers, the extent of the importance that satellites play and the advanced and wide range of services they offer can be too easily overlooked.

The steady growth of the European commercial satellite sector indicates UK and broader European dependence on satellite services. European market data clearly indicates that the commercial satellite sector has experienced continuous, long-term expansion, as explained in answer to Ofcom's questions.

This same type of growth is driving expansion of the UK satellite services market. In fact, satellite is the leading source for television programming in the UK. With service to more than 12 million UK households, satellite provides service to more homes than terrestrial (8.84 million), cable (4.34 million) or IPTV (2.00 million) and is the leading provider of digital infrastructure in the country.[1] It is also important to note that cable relies on satellite for distribution of signals to UK cable head-ends. Simply stated, satellite is critical to the distribution and delivery of video services in the UK. Further, several media companies based in London use satellite to distribute to CEE (Central & Eastern European) states and Russia. Most notable is Discovery Communications Europe.

In addition, satellites play an essential role in corporate and government networks in the UK. Very-Small-Aperture Terminals ("VSAT") enable high-speed, encrypted data-communications using small antennas. VSAT technology enables the provision of vital corporate and government communications such as connecting home and field-offices, off-shore drilling platforms, embassies and other agencies. Such connectivity is used for inventory management, data transfers, and Internet-connectivity.

[1] SES Satellite Monitor 2014

Commercial users include banks, car manufacturers, oil companies, food and beverage manufacturers, and much more.

It is also not unusual for satellite, at the time of an emergency or disaster, to be the only or best available communications technology. Satellite services can be quickly deployed to provide reliable, quality communications at a time when few if any other services may be available. Satellites can maintain or quickly restore broadcast, critical commercial and governmental services, and enable emergency workers, and affected citizens to communicate. This is the case at international level with the platform *emergency.lu* operated by the Luxembourg government and SES. As a result, VSAT plays an integral and growing role in emergency situations, disaster-recovery and in mission critical security and defense functions. The UK and other European governments use VSATs to link agencies, military and operational centers, in particular, where there is inadequate terrestrial infrastructure or where security, redundancy and reliability are essential. The British troops stationed abroad, for instance, rely on SES through our customer *SSVC*, a registered charity set up to entertain and inform Britain's Armed Forces around the world.

Given these emergency response capabilities along with the benefit of public safety, national security and defense-related satellite services, in the end, during an emergency or disaster, satellites may be the only or best available means of communication.

Similarly, broadband service by satellite is one of the areas where the most significant innovation has taken place in recent years in both satellite technology and the ground segment. Today, satellite broadband services are delivered at speeds and prices comparable to terrestrial wirelines. The resulting increased demand from corporations, institutions as well as from consumers who cannot benefit from quality terrestrial connectivity at home is evidence of the importance of satellite's role in this market. The role of satellite in the provision of broadband connectivity is fundamental for prompt and universal delivery of broadband coverage in the UK.

Finally, satellites bring critical connectivity to UK citizens including, importantly, to rural, remote and underserved areas. This can be critical for countries with a large territorial countryside and multiple islands such as the Great Britain. For instance, our UK customer *Satellite Internet*, a specialist satellite a ISP serving homes and businesses in rural and hard to-reach areas all over the UK and Eire, has worked successfully to contribute to ensure Broadband For All. This means that satellite-based services such as television (DTH and cable distribution), corporate networks, broadband, telemedicine, e-government applications and education connects the otherwise unconnected or under-connected and provides the services that help keep the UK economy moving.

Question 1: Do you have any comments on our approach to this review?

SES has already provided comprehensive information and data on its business to the UK Ofcom, either as part of a spectrum review conducted in 2012, or as part of an informal call for information made earlier this year (February 2015). SES would very much appreciate if Ofcom could let us know what has been done with this information, and what will be done with the new / updated information that we are providing in response to the new consultation.

Question 2: Do you have any comments on our broad overview of the satellite sector set out in this section? In particular, do you have comments on the completeness of the list of applications, their definitions and their use of the relevant ITU radiocommunications service(s)?

SES is broadly satisfied with the list of applications which Ofcom has defined, although some seem to be missing. SES is in line with ESOA comments as explained hereunder.

Ofcom has listed the following satcoms applications:

- DTH
- BB Internet Access
- M2M
- Commercial mobility (ships, aircrafts, land mobile)
- Corporate VSAT
- Disaster relief
- Emergency
- Navigation (GNSS)
- Distribution of broadcast content
- Contribution and Occasional Use (including SNG)
- Legacy telephony and carrier
- UAVs
- Feeder links / TT&C

Other applications identified by ESOA include:

- Backhaul for terrestrial mobile networks, e.g. 3G, 4G and 5G in the future
- Governmental / institutional closed-user groups (CUGs)
- Oil & Gas services at fixed locations
- Distance learning, telemedicine
- VoIP

Question 4: Do you have any comments on our representation of the value chain for the satellite sector? How do you think industry revenues are broken down between players at different positions in the chain?

SES subscribes to ESOA comments: UK's interests are to be driven by all components of the chain, considering that through Ofcom no less than 22 satellite operators have registered filings and the UK is the home country to multiple actors of the chain.

Question 5: What is the extent of your organisations' role(s) in the value chain? Which satellite applications (as summarised in Table 1 in section 3) does your organisation:

- ***use;***
- ***provide: or***
- ***help to deliver?***

Please list all applications that apply and your role in each in your response.

SES is a provider of Fixed-Satellite service ("FSS") and Broadcast-Satellite service ("BSS") in Europe, the Middle East, the Americas, Asia and Africa. The services that are provided range from direct-to-home ("DTH") to satellite news gathering ("SNG"), private networks, broadband services, maritime and aeronautical services. SES uses all of the frequency bands it has available to it (C-, Ku- and Ka-band), and the choice for a certain frequency band for a certain service depends on a great number of factors.

C-band is ideally suited for coverage of large areas that are required for long-distance or regional communications (backhaul, international links, point-to-multipoint, broadcast distribution). C-band beams can easily cover almost one third of the Earth with a single beam, and this band is the band of choice for services requiring the highest and largest levels of availability due to its robustness against rain fade and size of geographical beams.

Ku- and Ka-band provide better consumer, as well as enterprises or government, solutions than C-band for DTH or broadband services relying on small antennas. The Ka-band is also the expansion band that satellite operators have started to use now for growth beyond the already congested Ku-band.

Several SES satellites are located in UK orbital positions,[2] many are launched and/or operated pursuant to UK authority,[3] many have UK manufactured satellite components, and many are insured by UK entities. SES is a provider of a wide variety of important satellite services to customers in the UK including for direct-to-home ("DTH") services, satellite news gathering, private networks, broadband services, and more. For more than a decade, SES has been an important provider of satellite capacity in the UK market.

SES provides or helps to delivers virtually all applications that are listed in response to Q2, be it in the UK or elsewhere in the world.

[2] For example, SES's AMC-18, AMC-21 and NSS-11 satellites operate at UK orbital positions filed with the ITU at the request of the Gibraltar Regulatory Authority on behalf of SES Satellites (Gibraltar) Ltd.

[3] These include satellites launched and/or operated pursuant to space activities licences issued by the UK Space Agency and the Gibraltar Regulatory Authority pursuant to the Outer Space Act 1986 (UK) and the Outer Space Act 1986 (Gibraltar) Order 1996.

Question 6: For each of the satellite applications you use, provide or help deliver (as identified in Question 5), and taking into account your role in the value chain, where applicable please provide:

- ***the specific spectrum frequency ranges used for each application, distinguishing between the frequencies used for service provision, for the feeder / backhaul links and for TT&C ;***
- ***the coverage area for services links; or, in the case of TT&C and feeder / backhaul links, the location of the gateway station(s);***
- ***the estimated number of users (e.g. MSS terminals, DTH subscribers, FSS earth stations);***
- ***an estimate of the average use by end user (for those applications for which the demand for spectrum is driven by end user traffic);***
  and
- ***for applications for which the demand for spectrum is driven by other factors, please state what the factor is and the scale of the factor (e.g. for DTH TV the number of TV channels broadcast by format).***

Please provide your response with respect to the UK, the rest of Europe, and other parts of the world where this may be relevant to UK use.

This table lists all frequency bands SES relies and the corresponding applications.

Band	Uplink	Downlink	Applications provided or enabled by SES
C-band	5850-6425 MHz	3625-4200 MHz	Used for intercontinental links and links with high reliability requirements (including broadcast distribution, backhaul, corporate VSAT, Gov CUGs, emergency, disaster relief, distance learning & telemedicine, Oil & Gas, TT&C)
C-band	6725-7025 MHz	4500-4800 MHz	
Ku-band	13.75-14.50 GHz	10.95-11.20 GHz 11.45-11.70 GHz 11.70-12.20 GHz (R2) 12.20-12.50 GHz (R3) 12.50-12.75 GHz (R1 + R3)	DTH TV, corporate VSAT, broadband services, contribution & occasional use, broadcast distribution, commercial mobility

Ku-band	12.75-13.25 GHz	10.70-10.95 GHz 11.20-11.45 GHz	
Ku-band	14.5-14.8 GHz 17.3-18.1 GHz	11.70-12.50 GHz	
Ku-band	17.3-17.8 GHz	12.20-12.70 GHz	
Ku-band	14.5-14.8 GHz 17.3-18.1 GHz	11.70-12.20 GHz	
Ka-band	27.5-30.0 GHz	17.70-20.20 GHz	Broadband Internet connectivity for fixed and mobile terminals, Feeder links for BSS
Ka-band	24.75-24.25 GHz	17.30-17.80 GHz	
Ka-band		21.40-22.00 GHz	

The table below specifies the number of satellites that are deployed in Europe and covers the UK, as well as the main frequency bands that are being commercialized. This table shows that C- and Ku-band services are provided throughout the world, and that the number of satellites deploying Ka-band is increasing.

Europe (ITU Region 1)					
Satellite	**Location**	**C-band**	**Ku-band**	**Ka-band**	**Comment**
NSS-806	47.5°W	X			
SES-6	40.5°W	X	X		
NSS-10	37.5°W	X			
SES-4	22°W	X	X		
NSS-7	20°W	X	X		
SES-5	5°E	X	X		
ASTRA 4A	5°E		X	X	
ASTRA 1KR	19.2°E		X		
ASTRA 1L	19.2°E		X	X	
ASTRA 1M	19.2°E		X		
ASTRA 1N	19.2°E		X		
ASTRA 3B	23.5°E		X	X	

Europe (ITU Region 1)					
Satellite	**Location**	**C-band**	**Ku-band**	**Ka-band**	**Comment**
ASTRA 2E	28.2°E/28.5°E		X	X	
ASTRA 2F	28.2°E/28.5°E		X	X	
ASTRA 2G	28.2°E/28.5°E		X	X	
NSS-12	57°E	X	X		

The coverage area of these satellites is available from:
http://www.ses.com/fleet-coverage

DTH business

During the past decade, the number of video channels transmitted via SES satellites in Europe has increased from 1,037 to 2,547 (SES Channel Count based on Lyngsat)

During the past decade, the number of video channels transmitted via SES satellites @ 28.2E for the UK/Ireland has increased from 337 to 733 (SES Channel Count based on Lyngsat)

During the last 10 years, the satellite bandwidth used for digital transmissions on SES satellites in Europe has grown from 5.7 GHz to 9.4 GHz.

Today 154 million European homes receive television from SES satellites: 64 million via DTH, 65 million indirectly via cable and 25 million indirectly via IPTV (SES Satellite Monitor Year End 2014),

Today 18.5 million UK homes receive television from SES satellites: 12.1 million via DTH, 4.3 million indirectly via cable and 2 million indirectly via IPTV (SES Satellite Monitor Year End 2014).

Occasional use services

SES has dedicated a significant amount of its capacity for occasional use (OU) types of services from/to the United Kingdom. This capacity is reserved from some of the major SES orbital locations, such as 28.2°E, 23.5°E and 5°E. This capacity is used for various purposes, of which the most notable ones are major sporting events.

For international/transatlantic distribution, separate capacity is dedicated for OU services from the orbital position of 22°W.

Satellite broadband

SES is also providing broadband services into the United Kingdom in both Ku- and Ka-band, where services are provided to thousands of customers. We rely on three customers to distribute the service over the UK and Ireland:

- Satellite Internet (www.satelliteinternet.co.uk)
- Satellite Solutions (www.satellitesolutionsworldwide.com)
- Broadband Everywhere (www.broadbandeverywhere.co.uk)

SES notably works with Satellite Internet (ex-BeyonDSL): Our AstraConnect solution was selected to connect Devon and Somerset and carry out the pilot project for the DCMS/BDUK Innovation Fund, as part of the British government Ultra-fast Broadband programme launched in 2010.

More information is available from: https://www.youtube.com/watch?v=GSl9Avvf7AA

Mobile, Data and DTH usage

Currently SES is operating 700-750 MHz of spectrum for mobile and data customers in the UK. For DTH service, SES is operating 1.8 GHz of spectrum.

SCADA (M2M)

SES subsidiary TechCom offers satellite services that use spectrum covered by this review for Smart Grid applications. For example, we already serve Supervisory Control and Data Acquisition ("SCADA") pilot sites. SES estimates that between 5,000 and 20,000 satellite links are used today to monitor oil, gas and power facilities in the UK.

Oil&Gas, maritime and int'l links (Africa)

A table of our UK customers using C Band capacity is in Annex 1. This information is to be treated as confidential. They almost all use this spectrum for links with other countries abroad, notably the Middle East, Africa and the North Sea (oil/gas industry).

As an interesting illustration, NSSL, a maritime & government VSAT company, relies on flyaway portable terminals that enable to provide connectivity anywhere on land and sea. For more information: https://www.youtube.com/watch?v=PP2YyC-Rc6s

Several of the teleports / companies using SES satellites are not our direct customers anymore due to mergers & acquisitions, but they are increasingly using our capacity. SES has limited visibility on the exact amount of spectrum that is used, but this ranges from a few MHz to over 300 MHz (for Arqiva).

Some of our users in these sectors do consider C Band as an essential spectrum for future high throughput operations (HTS) precisely because of the unique wide beams they benefit from.

Question 7: For each of the satellite applications you provide, please could you indicate how UK consumers and citizens benefit from their use? Where possible please also provide an indication of the scale of the benefits (either qualitatively or quantitatively).

Response to this question is covered by our introduction to this document and our response to the other questions. One can only repeat how satellites communications are sometimes critical and unique in connecting everyone over all geographical points (whether for DTH video delivery or broadband consumer services).

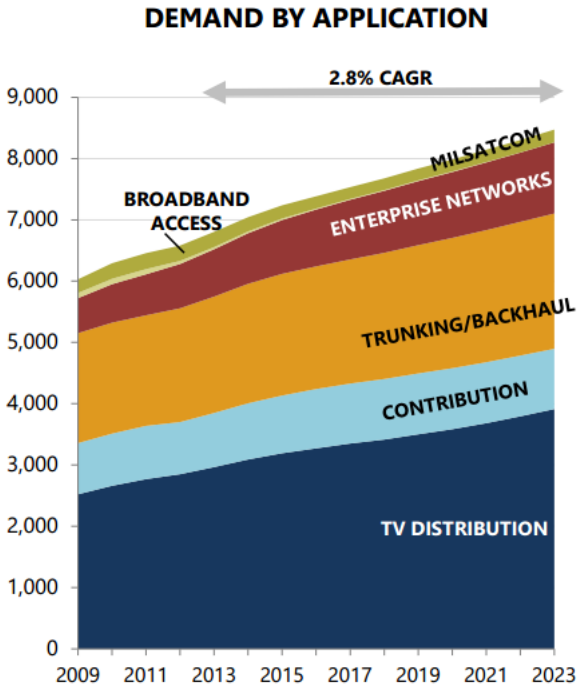
Their resilience and immunity to natural disasters make them ideal to guarantee a 24 hour connectivity on any point of the planet, as well illustrated by the public-private partnership emergency.lu.[4]

Question 8: From your perspective, what high level trends will affect the satellite sector in the coming years?

Our association ESOA has provided a lot of important information about the future of our sector.

In terms of global trends, most recent studies conducted by Euroconsult have demonstrated that demand for satellite capacity is foreseen to grow in the years to come.

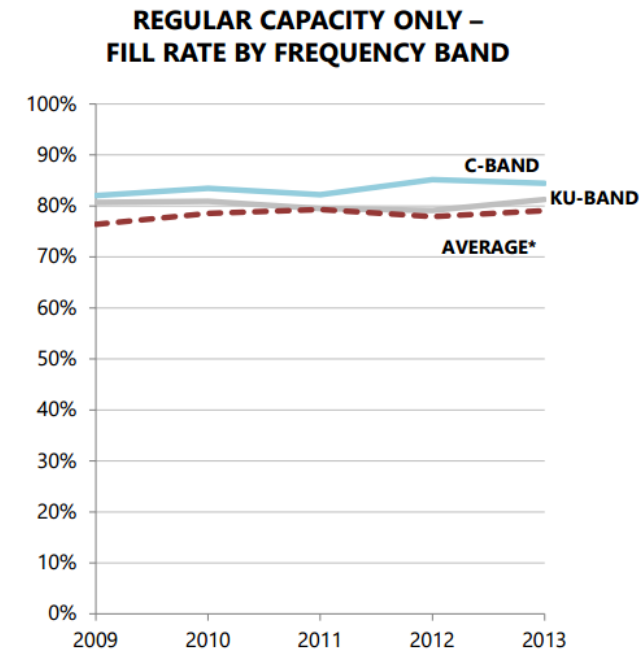
1. *Regular capacity – Demand forecast (2009-2023, in TPE) (Source: Euroconsult)*



2. *Regular capacity – Trends in frequency bands (2009-2023, in TPEs) (Source: Euroconsult)*

Fill rate by frequency band

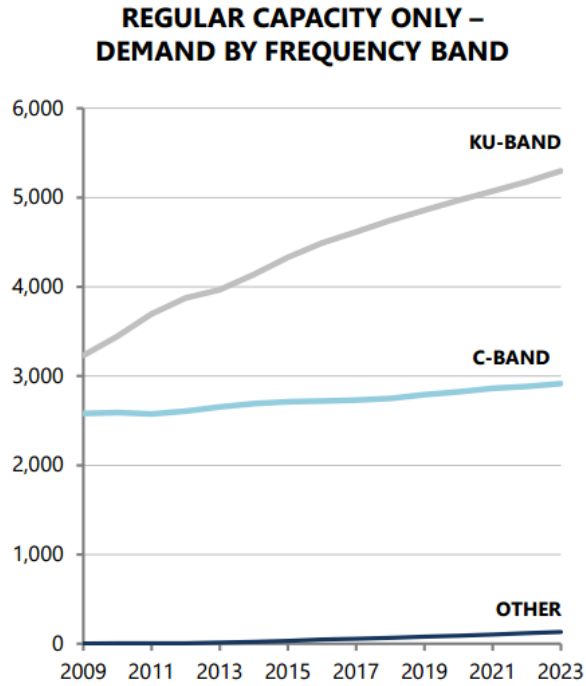
[4] See http://www.emergency.lu and https://www.youtube.com/watch?v=z7fatvZmirU



*The average fill rate considers TPEs in all frequency bands (C, Extended C, Ku, Ka, L, S, X) excluding HTS capacity.

3. *Regular capacity – Trends in frequency bands (2009-2023, in TPEs) (source: Euroconsult)*

Demand by frequency band



Question 9: For each of the satellite applications you use, provide or help deliver what do you see as the a) current demand trends; and b) underlying current and likely future drivers of demand for the satellite application(s) your organisation uses or provides?

Please include in your response for both a) and b) above:

- ***the scale and future impact of the trends/drivers on demand;***
- ***any variations in the type and scale of trends/drivers by geography (i.e. in the UK, the rest of Europe, and other parts of the world where this may be relevant to UK use) and why;***
- ***whether future demand is expected to be temporary or intermittent, and the reasons for this.***

In your response, please provide any evidence which supports your position on the drivers of demand (e.g. forecasts, studies and statistics).

There are several factors which will influence spectrum demand for satellite services over the next 5-10 years. These factors are both technical and commercial. For example, the digital television in the UK and Europe, and the digital media segment more broadly has grown dramatically over the last 20 years. The key drivers for this growth are an increase in the types of delivery channels and the rapid change in consumer behaviour. Highly diverse and high quality digital content, substantial increases in number of TV channels and in high definition ("HD") television have been major growth drivers in all delivery segments, including satellites. We believe that this trend is going to continue with the development of Ultra-HD programs and technologies. Without even including the growth of mobile users, delivering such high volume to fixed users requires powerful distribution pipes that satellites provide.

Criticality of Ku-band

To satisfy the current digital broadcast demand, SES uses a substantial amount of capacity for video distribution in the UK. Specifically, more than 100 transponders of 26 MHz or 33 MHz are used for DTH distribution (and cable feed-in) in the UK (ASTRA 2E, 2F, 2G). In fact, given the increasing scarcity of Ku spectrum, Eutelsat is leasing additional transponders from SES to satisfy their own video distribution demand in the UK market.

In total, SES is using 2984 MHz of satellite capacity for UK digital transmissions plus 250MHz operated by Eutelsat on 28.2/28.5E on hosted payload on SES satellites. All downlinks are made using the BSS and FSS bands between the 10.7 and 12.75 GHz. All uplinks are made by our well-established customers from the UK (Sky, ITV, BBC, Channel 4, Arqiva, Globecast and others), using the 12.75-13.25 & 13.75-14.5 & 17.3-18.1 GHz bands.

Broadcast satellites today, with their continental reach, directly deliver 1 Zettabyte yearly of information and edutainment to 1.7 billion people in 480 million households. This is 50 times more traffic than all cellular networks combined.

Satellites also feed cable and IPTV head-ends serving another 500 million households. The penetration of high definition television ("HD") and the advent of Ultra-HD (UHD) will multiply this data volume by an order of magnitude over the decade to come.

In sum, use of Ku-band spectrum to broadcast satellite signals - despite using much less favorable "higher" bands - is currently 25 times better used than mobile spectrum when considering actual per MHz global spectral efficiency.

It is worth noting as well that Agenda Item 1.6 of the WRC-15 looks at the potential for more Ku-band spectrum for the Fixed-Satellite Service. This agenda item was agreed as it was recognized that the currently the Ku-band as used by the Fixed-satellite service has become congested, and that due to an imbalance in spectrum allocations in uplink- and downlink spectrum, as well when comparing the various ITU region, satellite service cannot always be provided in the most efficient manner. The satellite industry has been very active in performing the necessary compatibility studies with respect to incumbent allocations, which shows its dedication in obtaining these needed additional allocations.

Relying on Ka-band

SES has an ambitious programme to further develop its fleet of satellites with appropriate capacity to address various customers' service needs including, but not limited to, provision of broadband services, satellite news gathering ("SNG"). This includes Ka-band links between gateway in Europe and satellite, and Ka-band links between satellite and end-users in Europe), data services to businesses and governments (Ka-band links between gateway in Europe and satellite, Ku-band links between satellite and end-user in or outside Europe), DTH (including enhanced and interactive services), as well as Internet and wireless backhaul, and contribution links for other networks (*e.g.* broadcast or cable television networks). For SES, the main potential for growth in satellite demand will ***not*** necessarily be driven by consumer broadband terminals.

It is important to highlight that the principal driver for the satellite sector's move towards use of the Ka-band is congestion in the Ku-band in Europe. This has led satellite operators to increasingly use and rely on the Ka-band to accommodate growth and advanced services. For example DirecTV one of the largest DTH services providers in the US already uses the Ka-band extensively for video distribution. In addition, SES has customers in the UK that have already invested millions of British Pounds in Ka-band SNG equipment and trucks.

Today, due to the large number of satellites serving Europe using a minimum of two degree spacing, it is generally very difficult to add additional satellites at new Ku-band orbital positions capable of serving the UK or Europe. This is due to the constraints imposed by coordination requirements associated with two degree spacing and the likely interference that such additional satellites would cause into neighboring satellites. Due to the fact that Ku-band satellite capacity at existing orbital positions is fully utilized satellite operators have had to include Ka-band in their growth plans resulting in newly launched satellites for the expansion of satellite services and the introduction of new services.

Continued global C-band need

SES uses C-band spectrum in the UK for teleports and domestic and international services. Today, the UK represents the largest share of SES C-band downlink spectrum used in Europe (roughly 400 out of 950 MHz). We anticipate that this business will grow steadily**.**

With respect to C-band in particular it is important to note that around 180 satellites with C-band payloads operate in the geostationary orbit today, and more than 55 satellites with C-band payloads operate over Europe, with several under procurement.

In Europe in particular, the C-band supports critical services such as aviation (AMS(R)S), emergency services (emergency.lu, UNHCR), navigation (GDDN), maritime (GMDSS), meteorology (WMO) and public (e.g. EBU) services. The BBC World Service Group relies on C Band satellite capacity for contribution (i.e., the collection and transmission of programing to studios and transmission facilities) as well as distribution and monitoring from Europe to the Rest of the World. Similarly, the Services Sound and Vision Corporation (SSVC), a registered charity, also relies son our C Band satellites to entertain and inform Britain's Armed Forces around the world which mission is to be the preferred provider of entertainment and information to military service personnel and their families worldwide.

Delivery of TV programmes to Latin American or Asian expatriates living in Europe also rely on satellite C-band. There are around 30 C-band satellites covering Europe capable of providing TV reception for people using a 1.8 metre dish. Distribution to cable head-ends (DTC) or feeds for terrestrial re-distribution (DTT) are also possible thanks to these satellites.

In neighboring Africa & Russia, as part of ITU Region 1, C Band is even more intensively used. Africa relies on links with Europe and FSS Earth stations located in Europe for services such as civil aviation (ASECNA), TV contribution & distribution links, backhaul to terrestrial wireless systems and other data links. Recent studies by Euroconsult highlight the importance of C-band in Africa;[5] in particular, one study indicates that in 10 countries examined in this continent, C-band is extensively used for communication networks, with a large impact for the country's economy, social development and the efficiency of government actions. It is noteworthy that GSM backhaul is an important application for which C-band is used. Several of these applications depend on hubs / gateways located in the UK and elsewhere in Europe.

C-band users therefore include a large number of public and private organizations, with C-band often being used to connect multiple locations spread around the country, as well as to provide direct or backup international connectivity.

[5] See http://www.euroconsult-ec.com/shop/home/65-prospects-for-satellite-communications-and-broadcasting-in-africa.html and http://satellite-spectrum-initiative.com/files/C-band%20usage%20in%20African%20countries%20-%20Final%20Report%2022%2009%202014.pdf

C-band is also used for major sports distribution from or to the UK. The latest example of this are the broadcasts that SES made during the Africa Cup of Nations, where SES has been working with major international broadcasters and local partners. The Africa Cup of Nations is the largest football competition in Africa, and is held every two years. This 30th edition took place from 17 January to 8 February 2015 in Equatorial Guinea.

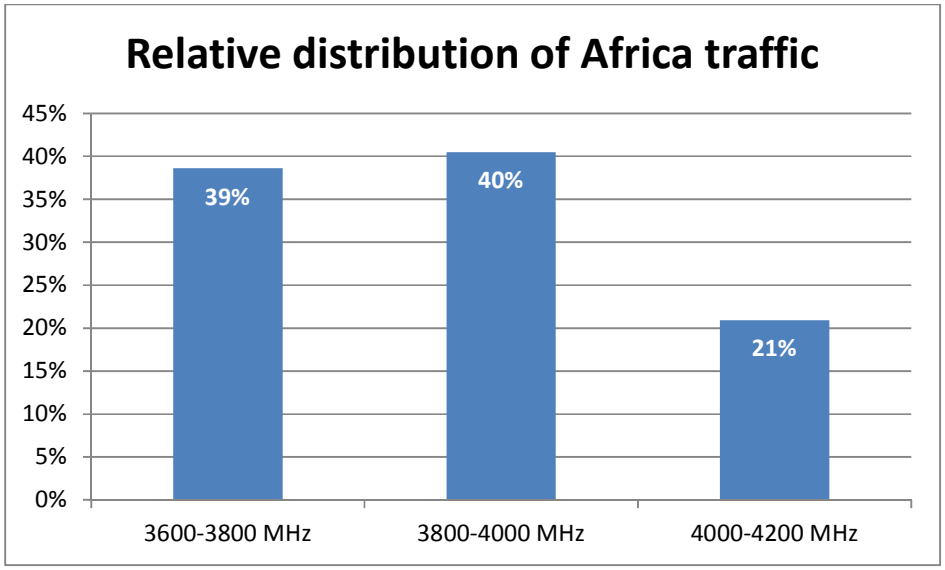
According to CAG (Confederation of African Football) the event is the third largest world football competition in terms of its cumulative TV audience, coming after the FIFA World Cup and the European Nations Championship. The satellites SES-4, NSS-7 and NSS-806 were the prime carriers to beam this event live to audiences around the world.

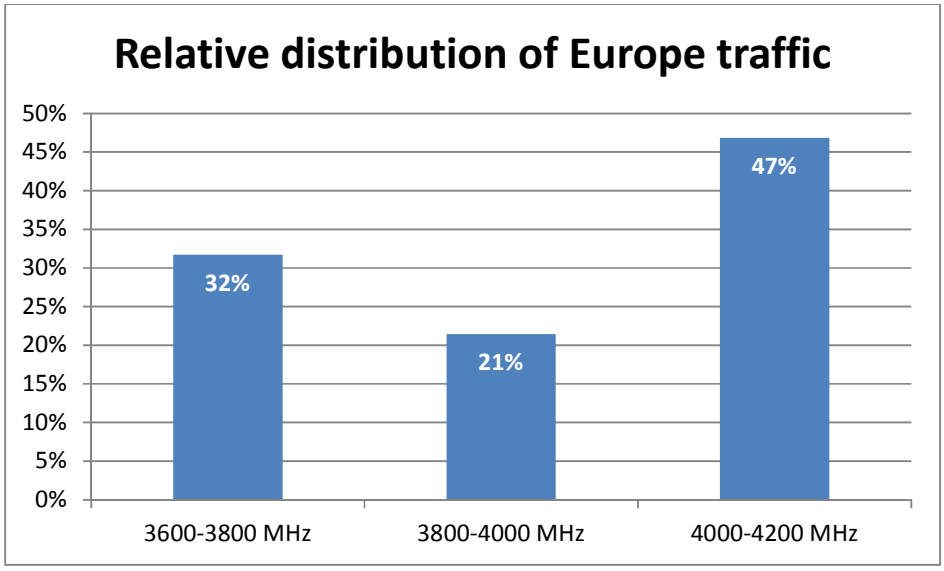
Due to the special characteristics of the C=band, such as low rain fade and high availability, most of these services cannot be migrated to higher frequency bands.

More information and documentation can be found at: http://www.bit.ly/CBandSATCOMSinfo

Role of UK as data hub for C-band services

SES has made an analysis of its own C-band traffic over Africa and Europe in the frequency band 3600-4200 MHz. The graphs below indicate the distribution of the traffic over the various sub-frequency bands.





It is important to note from these overviews that the frequency band 3600-3800 MHz is used as intensely as the other frequency band. The amount of traffic in this band is such that it is no option for SES fleet to migrate this traffic to the higher frequency bands.

Further, it is worthwhile to note that, of all the traffic in C-band that is received in Europe, roughly 40% is received by Earth Stations in the United Kingdom. Further there is a significant amount of C-band traffic being received by mobile terminals in C-band (e.g. vessels) that are registered with UK customers. Overall, the largest amount of C-band traffic in Region 1 in the SES fleet is between Europe and Africa, which means that the United Kingdom serves as a major hub for enabling services in Africa.

Question 10: Taking into account the drivers you have identified in your response to Question 9 above, what (if any) challenges is your organisation concerned about in meeting potential future demand? Please provide the information by application and band, along with any supporting evidence, if available.

1. Allocate appropriate spectrum to 5G mobile systems above 31 GHz

SES commends Ofcom for its identification of spectrum bands to be made available to 5G mobile systems.

Identification of additional spectrum for new radio services such as 5G / IMT should not result in detrimental effects on existing radio services including space services / satellite services. Any IMT / 5G terrestrial use of the spectrum where satellite operates would inevitably disrupt not only critical incumbent TV services across Britain but also existing and future VSAT services in the C band and Ku Band for both fixed and mobility applications, thus jeopardizing the billions of pounds in investments and revenues from these investments. Similarly, the entry of IMT / 5G terrestrial use into Ka-band would likely disrupt critical incumbent Ka-band satellite services within the 27.5 – 31.0 / 17.3 – 22.0 GHz bands, also jeopardizing sunk investments and, perhaps more importantly, harming the UK space sector by diminishing the regulatory certainty currently in place for Ka-band satellite systems.

The position communicated by Ofcom to the CEPT in April 2015 recognizes these important points, and SES expects that the UK will not change its position but, on the contrary, lead the CEPT efforts towards identification of appropriate frequency bands above 31 GHz at WRC-15 (Agenda item 10).

2. Maintain our access to a variety of frequency bands

As explained above, not all satellite spectrum bands are the same – their different technical characteristics make them more or less suited to different communications applications. It is important to remember that it is usually not possible to simply relocate services from one band used by satellite to another, not only because of the unique technical characteristics of each frequency band, but also due to the high cost of any migration for the users, and the risk of simply losing the provision of unique services.

Preferences for use of one frequency over another are determined by a variety of factors. In some cases, large coverage areas are required for long-distance or regional communications (*e.g.,* backhaul, international links). C-band is ideally suited for this. SES' UK customers use C-band to provide services into Asia, Africa and Latin America, particularly into equatorial regions. C-band also enables coverage of almost one third of the Earth with a single beam. A customer with sites all over Africa can use one broadcast outbound carrier to cover all sites, reducing costs of having to uplink onto multiple beams as may be required in the Ku and Ka-bands.

Weather may also play a determining factor in whether or not to choose a certain band. For example, customers serving areas of high rain or snow fall demand C-band as it is more resilient to interruptions due to precipitation than higher frequency bands such as the Ku and Ka-bands.

SES insists towards Ofcom that, not only the existing FSS earth stations registered in the UK operating in the 3600-4200 MHz range need to be protected, but a mechanism to allow for the deployment of new satellite earth stations without risk of interference should be put in place. It should also be well noted that IMT / Mobile services deployed in the band 3400-3800 MHz may not only cause harmful interference to other existing services in the same band but also may affect (and can cause harmful interference to) services operating in the adjacent bands, specifically satellite services above 3800 MHz.

Where service areas are smaller (*i.e.,* spot beams for DTH services) or size of terrestrial antennas must be smaller, Ku and Ka-bands provide better solutions than C-band (*e.g.,* SNG, DTH, broadband, VSAT, and mobile applications). The Ka-band is the expansion band that satellite operators are using for growth beyond the already congested Ku-band.

It should be a priority for the UK, as for every other national administration, to ensure that satellite users are guaranteed access to the Ka-band frequencies designated by the ITU for satellite services, such as in the 27.5-29.5 GHz band. SES also expects that the UK government will fully subscribe to any harmonisation effort within Europe to set up a regime of exemption from individual licensing could be developed in appropriate sub-bands within the 17.7-19.7 GHz band.

It is critical that, in the regulation of the shared portions of spectrum in both 18 and 28 GHz bands, the UK ensure that big satellite earth stations still have the possibility to access the entirety of the shared spectrum, as identified by the ITU, on the basis of individual coordination.

3. Ensure the regulatory framework remains stable over time

Once a spacecraft is operational, it cannot be physically altered. As a result, it is important for the successful roll-out of satellite-based networks that the regulatory framework under which the satellites and the ground stations are authorized to operate remains stable and transparent in the long run. Without this certainty, UK consumers could lose essential access to critical communications services and the investments of satellite operators could become stranded.

Question 11: Do you have any comments on the list of potential mitigations we have identified? What likely impact would each of the mitigations have on spectrum demand? E.g. what order of magnitude increase in frequency re-use might be achieved? To what extent do you believe that these mitigations apply only to certain applications?

ESOA in its response has specified the types of mitigations risks and opportunities that apply to our sector in general.

SES would like to repeat that satellite operators always look to maximize the spectrum that they can use from an orbital location. Frequency re-use is applied to the maximum extent possible. Re-use from a single orbital slot can be achieved by re-use of polarisations (e.g. Vertical vs. Horizontal linear polarization) or by geographical reuse. Furthermore, all of the frequencies can be reused from an orbital location which is about 2 degrees separated for the closest adjacent satellite due to the receive antenna discrimination. These factors make it possible that a certain frequency band over a certain region is re-used many times.

Question 12: What other mitigation opportunities do you foresee that we should consider? For what applications are these likely to be applicable and what scale of improvement are they likely to deliver?

No answer

Question 13: Beyond the activities already initiated and planned for the satellite sector (e.g. as part of WRC-15), do you think there is a need for additional regulatory action that may, for example, help your organisation to address the challenges it faces?
In your response, please indicate what type of action you consider may be needed and why, including any evidence to support your view.

No answer