ECHOSTAR   **HUGHES**

An EchoStar Company

13 August 2015

<u>Submitted via e-mail to SSSreview@ofcom.org.uk</u>

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Re: Call for Input ("CFI")—Strategic Review of Satellite and Space Science use of Spectrum

I.   Introduction and Background

EchoStar Satellite Operating Corporation ("ESOC"), EchoStar Mobile Limited ("EML"), Hughes Network Systems, LLC ("Hughes"), and EchoStar Technologies L.L.C. ("ETC") (collectively "EchoStar") submit these comments in response to the above-referenced CFI.[1] EchoStar appreciates the opportunity to provide valuable input for Ofcom's strategic review.

EchoStar operates a fleet of 24 geostationary orbit ("GSO") satellites in the Direct Broadcast Satellite ("DBS") Service, the Fixed-Satellite Service ("FSS"), and the Mobile-Satellite Service ("MSS"), making it the fourth largest commercial GSO satellite operator in the world. Notably, EchoStar Corporation is the parent company of ESOC, Hughes, ETC, and EML. Hughes is the world's largest satellite Internet provider with over 1 million users in North America and Europe. And EML, a pan-European MSS operator, is leading the way in bringing pan-European MSS services to entire EU as well as a complimentary ground component. Accordingly, EchoStar has the experience and expertise to assist Ofcom in understanding the current and future spectrum challenges and uses in the satellite sector.

II.   Questions & Responses

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

EchoStar Comment:
EchoStar supports Ofcom's proposed approach.

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[1] Strategic Review of Satellite and Space Science Use of Spectrum, Ofcom, (Jun. 4, 2015).

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)?

EchoStar Comment:

EchoStar generally agrees with Ofcom's list of applications, their definitions, and their relevant use of the relevant ITU radiocommunications service(s), but recommends adding a category for geostationary and non-geostationary orbit satellites for FSS and MSS satellite systems. Significantly, these satellites offer different capabilities and have different spectrum requirements; therefore, they should be viewed separately for the purposes of this proceeding. Finally, there should be category for broadcasting satellite service ("BSS") applications.

3. Do you have any comments on our broad overview of the space science sector? In particular, do you have comments on the completeness of the list of applications, their definitions and their use of the relevant radiocommunications service(s)?

EchoStar comment:

No comment.

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?

EchoStar comment:

EchoStar agrees with Ofcom's representation of the value chain.

For the past 18 years, the Satellite Industry Association conducts an annual study assessing the current state of the satellite industry. In 2014, the study included proprietary surveys, in-depth public information, and independent analysis, which demonstrates that the different players in the value chain experienced significant earnings. [2] The study shows the following for the year 2014: launch providers earned $5.9B in global revenue, largely because of the higher number of European commercial satellites launches.[3] Satellite manufacturers earned $15.9B in global revenue.[4] Due to

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[2] Satellite Industry Association, 2015 State of the Satellite Industry Report, 4, (May 2015), *available at* http://www.sia.org/wp-content/uploads/2015/06/Mktg15-SSIR-2015-FINAL-Compressed.pdf.

[3] *Id.*

significant growth in consumer and network equipment, ground equipment has increased revenue earning $58.3B in global revenue.[5] Not surprisingly, satellite service providers earned the most in global revenue—earning an impressive $122.9B—which reflects the increasing high demand for satellite services.[6] Accordingly, the earnings of the various players in the value chain reflect the vibrant nature of the global satellite industry.

5.   What is the extent of your organizations' role(s) in the value chain? Which satellite applications does your organization use; provide: or help deliver?

EchoStar comment:

EchoStar plays a vital role in numerous sectors in the satellite industry. As one of the world's largest commercial GSO satellite operators, EchoStar operates 24 satellites and has six under construction.[7] EchoStar provides satellite services in a number of areas, including FSS, MSS and BSS, which are incredibly important parts of the value chain from an operator perspective. In addition, along with being the world's largest satellite Internet provider, Hughes develops both network and user satellite equipment. Relatedly, ETC designs, develops, and distributes set-top boxes. Thus, EchoStar is particularly well-suited to understand a broader value chain of the satellite industry than satellite operators who do not have an equipment arm.

In terms of satellite services, EchoStar's services can be broken down as follows:

Direct to Home ("DTH") Satellite Services:

EchoStar leases satellite capacity primarily to DISH Network, and also to DISH Mexico, which is a joint venture with EchoStar as a partner. These networks provide DTH services to approximately 16.5 million customers in North America.[8] In addition, EchoStar provides satellite capacity to satellite TV providers, broadcasters, government service providers, state agencies, and programmers who use its satellites to deliver programming. EchoStar is continuing to expand its DTH fleet and has a number of

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[4] *Id.*

[5] *Id.*

[6] *Id.*

[7] EchoStar's Quarterly Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934 for the Quarterly Period Ended March 31, 2015 filed with the SEC, *available at* http://sats.client.shareholder.com/secfiling.cfm?filingID=1104659-15-34987&CIK=1415404

[8] *Id.*

satellites under construction, including EchoStar XXIII which will be launched in 2017 and expand EchoStar's DTH service to the Brazilian marketplace.[9]

Satellite Broadband Services:

Hughes operates two broadband satellites: SPACEWAY 3 and EchoStar XVII, and utilizes additional satellite capacity from multiple third-party providers, to provide satellite broadband internet access to North American consumers. Today, Hughes provides broadband Internet service to over one million North American consumers. Jupiter 2 (EchoStar XIX), with over 150 Gbps of capacity, will expand Hughes' satellite Internet service in North America and is set to launch in 2016.[10] Hughes also has a distribution agreement with dishNET Satellite Broadband L.L.C., to market, sell, and distribute the Hughes satellite internet service under the dishNET brand. And, as discussed further below, Hughes Europe offers satellite broadband services as part of its managed services throughout Europe including in the United Kingdom.

MSS Services:

EchoStar is the pre-eminent S band MSS operator. EchoStar operates DISH network's two S band MSS satellites over North America, and EML operates W2A today over the European Union. In addition, in 2016, EchoStar will launch a new S band MSS satellite (EchoStar XXI), through which EML will bring MSS services to all EU member states. Indeed, EML will operate a wholesale business model, with a variety of MSS services, including web browsing, audio and video streaming, e-mail, and voice over Internet Protocol ("VoIP"). These MSS services will be complimented with a terrestrial network in the S band, which will enable the most efficient use of the S band. Finally, EchoStar also holds a concession for S band MSS in Brazil and plans to deploy an S band MSS Service in Brazil in the near future.

Managed Services:

Hughes provides satellite network products and services—as well as managed network services and equipment to enterprises and broadband service providers worldwide, including the UK and Europe via Hughes Network Systems Europe. In Latin America, Hughes is the leading supplier of broadband systems and solutions—including high-speed Internet, voice ("VoIP"), and video conferencing to help governments and businesses meet their communication needs. Additionally, Hughes is India's largest

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[9] *Id.*

[10] Press Release, EchoStar, Hughes Showcases Next Generation Broadband Satellite Technology at CommunicAsia 2013 (June 10, 2013).

satellite service operator, providing a comprehensive range of services, such as managed network services, Internet, and interactive distance education.

Significantly, Hughes has pioneered the very small aperture terminal ("VSAT") and is the world's leading provider of enterprise VSAT to major corporations; telecommunications service providers, public service organizations, and governments around the globe. In fact, Hughes holds more than 50% of the cumulative market share in global VSAT business.

Hughes is also expanding the capabilities of private business networks by providing new services and IP-based applications, such as Internet/intranet, multicasting, video, and audio broadcasting, Web caching and messaging. Hughes' global enterprise services are sold in a variety of market segments, including convenience stores, retail petroleum, retailers, automotive, banking and financial institutions, and energy. Moreover, Hughes provides satellite ground segment systems and terminals to mobile system operators, and wireless backhaul systems.

Set Top Box Segment:

ETC's digital set-top boxes give consumers the ability to watch and control their television programming and contain a variety of other capabilities. For instance, EchoStar's high-definition and standard-definition content set-top boxes allow consumers who subscribe to television service from multi-channel video distributors to access encrypted digital video content.[11] ETC also provides internet protocol television ("IPTV") functionality, which supports on-demand services that allow consumers to download television programming, movies, music, applications, and other content.

Furthermore, ETC' set-top boxes contain advanced capabilities and functionalities—including social media, shopping, and digital video recorders.[12] Notably, ETC's technology allows a customer to watch and control digital television content anywhere in the world via broadband Internet connection.[13] ETC also designs and develops related products, such as satellite dishes and remote controls.

6. For each of the satellite applications you use, provide or help delivers, and taking into account your role in the value chain, where applicable please provide:

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[11] *Id.*

[12] *Id.*

[13] *Id.*

i. The spectrum frequency ranges used for each application, distinguishing between the frequencies used for service provision, for the feeder/backhaul links and for TT &C;

ii. The coverage area for services links; or, in the case of TT&C and feeder/backhaul links, the location of the gateway station(s);

iii. The estimated number of users (e.g. MSS terminals, DTH subscribers, FSS earth stations);

iv. 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

v. 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.

EchoStar comment:

A. EchoStar Service Frequencies, Coverage Areas, and Capacity:

Service	Service Frequencies	TT&C (GHz) Note: TT&C operating frequencies are at the Service and Feeder band edges	Feeder Links (if applicable)	Coverage Area	Overall Capacity
DTH	11.7-12.2 GHz, 12.2-12.7 GHz	10, 11, 12, 14, 17	14.0-14.5 GHz, 17.3-17.8 GHz	United States, Canada, Mexico, and Caribbean.	[BEGIN CONFIDENTIAL] ▉▉▉ [END CONFIDENTIAL]

Service	Service Frequencies	TT&C (GHz) Note: TT&C operating frequencies are at the Service and Feeder band edges	Feeder Links (if applicable)	Coverage Area	Overall Capacity
MSS	2000-2010 MHz, 2010-2020 MHz, 2180-2190 MHz, 2190-2200 MHz, 1980-2010 MHz, 2170-2200 MHz	17, 18, 19, 20, 27, 28, 29, 30	10.7-10.95 GHz, 11.2-11.45 GHz, 12.75-1300 GHz, 12.75-13.25 GHz, 13.73-13.753 GHz, 13.7505-13.7525 GHz, 18.55-18.8 GHz, 19.7-20.2 GHz, 29.25-30.0 GHz	North America and the European Union	[BEGIN CONFIDENTIAL] ▮▮▮ [END CONFIDENTIAL]
Broadband	27.85-29.10 GHz, 29.25-30.0 GHz, 18.3-19.3 GHz, 19.7-20.2 GHz	17, 18, 19, 20, 27, 28, 29, 30	17.3-17.8 GHz	United States, Canada, Mexico and Caribbean	Capacity over 100 Gbps
Fixed Satellite Services	11.7-12.2 GHz, 19.7-20.2 GHz	10, 11, 12, 14	14.0-14.5 GHz, 17.3-17.8 GHz, 29.5-30 GHz	United States, Canada, Mexico and Caribbean	[BEGIN CONFIDENTIAL] ▮▮▮ CONFIDENTIAL]

Table 1: EchoStar Service Frequencies, Coverage Areas, and Capacity

B. EchoStar's Gateway Station Locations: EchoStar has over 25 gateway stations in North America today and is constructing several others. In addition, EchoStar is constructing a gateway station in Brazil to support its soon to be deployed services there. In addition, in Europe, EchoStar has gateway locations in France, Germany and Italy.

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).

EchoStar comment:

EchoStar applications provide a variety of satellite services across the UK to a number of different market segments, which generates significant benefits for the UK economy. For nearly a decade, Hughes Europe has been running the retailer communications network for the UK National Lottery operator, Camelot. Camelot utilises a number of technologies, with 85% of the approximately 36,500 sites connected via satellite technology.

Camelot is a highly redundant network offering very high levels of availability due to its satellite technology. As such, the UK Government has been able to maximize the money generated through the lottery by raising more money compared to an identical network based purely on terrestrial connectivity. Accordingly, for the year ending in March 31, 2015, Camelot provided the following benefits:

- £1,796.8 million raised for National Lottery projects;
- £3,915.3 million was paid in prize money;
- £873.3 million went to the Government in Lottery Duty; and
- £333.3 million was earned by retailers in commission.[14]

Access to the Internet has become an essential element of every child's education. But many schools are located in areas where terrestrial based Internet service does not provide adequate quality to enable effective learning. Hughes Europe, however, provides satellite broadband Internet access to schools across the UK that provide essential educational opportunities for children of all ages. Otherwise, children in rural areas would be disadvantaged because they would have less Internet access than children in urban areas.

Relatedly, Hughes Europe offers a wide variety of service plans for its satellite Internet service. These plans are customized for different environments, from high usage schools, to low usage homes. Therefore, access to the wealth of educational content available on-line is available to children both at school and at home—regardless of where they live. This allows for optimum use of allocated spectrum.

The fact that Hughes Europe utilises satellite technology means it can provide services in the UK and Europe during any situation. For instance, satellites are an essential element in implementing diverse last mile connectivity, by providing a completely independent physical path to terrestrial connectivity options. This ensures

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[14] The National Lottery, Where the Money Goes, https://www.national-lottery.co.uk/life-changing/where-the-money-goes (last visited Aug. 12, 2015).

availability for consumers, commercial transporters, petrol retailers, and can be critical for high volume service stations—such as those on motorways, or near ports and airports.

One of the significant benefits of satellite communications is that capacity can be dynamically allocated between locations, changing with demand and ensuring efficient use of spectrum. One of the solutions from Hughes Europe that utilises this capacity to good effect has been deployed within the utility sector to help monitor and safeguard the provision of essential water services. This solution uses satellite connections to backhaul video content from remote and unmanned sites back to the utility's operations centre. This allows for cost-effective full time monitoring of essential sites.

Furthermore, the operations centre can always select which cameras it wishes to view on which sites. The satellite capacity is dynamically allocated to match this demand, being allocated to different sites as needed (in real time), and enabling the operator to choose whether he wants to view any content from that site or from multiple simultaneous camera feeds. Not surprisingly, this is independent of any terrestrial connectivity to the sites, which are often located in remote areas or areas without good terrestrial connections. Thus, this service is critical in maintaining the security of these sites.

Within the utility industry, Hughes Europe has deployed a number of auto-deploy and communications on-the-move satellite systems to help the utility industry deal with emergency and disaster situations. Disaster response vehicles have access to rapid-deploy communications services independent of any terrestrial connectivity, which are often unavailable or inoperable during a disaster. Central situation management centres can get data, audio and video feeds of what is going on in the area of the incident; allowing for efficient and effective coordination of activities.

The ability to quickly deploy satellite solutions has been a key element of Hughes Europe gaining business with major telecommunication carriers in the UK. Its supplied satellite systems are used to provide temporary connectivity to businesses until permanent terrestrial solutions are available. This allows businesses to be able to function within hours or days, instead of waiting months for terrestrial lines, or being unable to operate where terrestrial services are not viable. The construction industry, for example, has benefited extensively from this service because it generally begins operations in green-field sites or remote locations before essential infrastructure can implemented. In addition, satellite solutions are used in transient situations where a workforce may be rapidly moving from site to site but still need high-speed broadband access at each site.

In the provision of service to Camelot, and many other users of Hughes Europe satellite services, Hughes Europe uses a number of installation and maintenance field service partners, from large organizations and down to small family businesses. This generates jobs and profits within these businesses. What is more, Hughes Europe provides communications solutions to the Oil and Gas Industry—both in the UK and across Europe, with involvement in both upstream and downstream sectors.

The upstream Oil and Gas sector typically operates in environments where terrestrial connectivity is not an option and thus satellite communications provide an ideal solution in this environment. Under these circumstances, satellites are extensively used in off-shore production environments, maritime support services, and other associated areas both onshore and offshore.

Hughes Europe uses a blend of technologies to provide connectivity to the Oil and Gas retail sector, connecting service stations across the UK for the front and back office, security monitoring, and Health and Safety applications. These service stations provide essential fuel services for commercial and consumer customers.

Hughes Europe also provides satellite services to numerous businesses in support of the upstream Oil and Gas sector through a reseller model; enabling the resellers to provide important services to their clients by integrating its satellite communications services with their added value services endemic to that industry. This value added reseller ("VAR") model is an excellent way of enabling businesses to provide important services through the integration of satellite communications with the VAR's sector specific expertise and services.

Hughes Europe provides satellite broadcast services across the UK that is perfect for the distribution of video content. Satellite communications are ideal for broadcast applications due to satellites ubiquitous coverage area. In fact, any site with visibility of the satellite can receive the same transmission, resulting in the efficient delivery of content and effective use of spectrum resources, which greatly benefits the consumers of the UK.

Further, Hughes Europe utilises satellite broadcast solutions for the provision of education and training services to the retail industry. Video and text content is delivered to sites where employees can view them at their leisure and provide feedback. These solutions provide essential training material, such as content related to Health and Safety, legal obligations, and regulatory requirements. Content is also sent that helps to educate store staff, improve customer satisfaction, drive profitability, improve employee skill sets, and many other benefits resulting in an overall increase in productivity—which benefits both sellers and consumers.

Of equal importance, EML is offering an S band MSS service today across the
European Union. In 2016, EML will have access to additional MSS capacity utilizing the
soon-to-be launched satellite, EchoStar XXI. EchoStar XXI will enable EML to provide
advanced MSS services throughout the geography of the European Union. In the future,
this MSS service will be complimented by a terrestrial network utilizing the latest 3GPP
standards and technologies.

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

EchoStar comment:

All signs point to a continuation of the increase in consumer demand for the
satellite services EchoStar provides today and the innovative satellite services it will
provide in the future. To meet consumer demand, EchoStar has six satellites under
construction and is continuously planning additional services. Even though EchoStar has
traditionally focused on the North American market, today it operates satellites across
the globe—including Latin American, the mid-Atlantic, and Europe. Moreover, EchoStar
continues to expand its footprint for its services. For instance, Hughes will provide a
broadband service in Brazil in the near term utilising EUTELSAT 65WL—and EchoStar
21—will provide MSS to the entire EU in 2016.[15]

In addition, EchoStar continues to make strategic investments, such as its recent
investment in the satellite operator, OneWeb. OneWeb will operate a global
constellation of non-geostationary satellite orbit ("NGSO") satellites in the Ka and Ku-
band in order to provide Internet broadband on a global basis.[16] NGSO satellites are a
nice compliment to a GSO network because of their lower latency and their ability to
offer service to polar regions.

High-throughput satellites will continue to be constructed and deployed, both in
the civil and military domains, to meet the global increase in demand for high-speed
broadband Internet access.[17] These satellites will provide faster satellite broadband

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[15] Press Release, Eutelsat Concludes Deal with EchoStar's Hughes, Eutelsat, (Apr. 23, 2014); Advanced
Television, EchoStar Mobile to Launch 2016, (May 11, 2015), http://advanced-
television.com/2015/05/11/echostar-mobile-to-launch-2016/.

[16] Press Release, Jun. 25, 2015, EchoStar, Hughes Announces Partnership in OneWeb's Innovative Global
Satellite Broadband Initiative to Close the Digital Divide.

[17] Sarwant Singh, The Space Industry: Seriously Congested, Contested and Poised for Growth, Forbes
Business, (July 2, 2014, 6:40 PM), http://www.forbes.com/sites/sarwantsingh/2014/07/02/space-
industry-mega-trends-seriously-congested-contested-and-an-industry-of-growth-for-the-future/.

speeds; boost rural and remote connectivity, increase capacity for high-definition television in the commercial domain and high-definition video streaming for soldiers.[18]

Digital-natives of today and tomorrow are driving demand for on-board connectivity services.[19] So, in order to ensure safety and efficiency, EchoStar expects airlines to continue to rely on satellite connectivity for automated flight operations and on-board Wi-Fi usage in the future. In addition, innovative consumer-friendly products will be deployed at a much faster rate than it is today. Historically, satellite products in the MSS sector were usually introduced every three to five years.[20] But in the future, EchoStar expects a new product to be introduced every three to five months, which is comparable with the terrestrial industry.[21] Accordingly, the demand for satellite services will continue to grow significantly; therefore, the satellite sector will develop and deploy innovative technologies and services for the foreseeable future.

In addition, S band MSS, with the advent of new high power satellites that have large antennas and spot beam technologies, are able to offer superior services than has previous been in the market. Utilizing the latest technology, EML is particularly well placed to bring to the EU marketplace the latest in MSS services.

Likewise, the evolution in the technology of BSS satellites is enabling the ubiquity of high definition television broadcasting (HDTV) and the increasing availability and distribution of ultra-high-definition video content, known as Ultra HD, or 4K. EchoStar, as a leader in satellite video broadcasting, is at the forefront, designing and launching satellites to promote the ubiquity of such high-quality video content to consumers across the globe.

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

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[18] *Id.*

[19] *Id.*

[20] Anne-Wainscott Sargent, Satellite Industry Visionaries: Innovation, Opportunity and a Broadband Future, Satellite Today, (Feb. 24, 2014), http://www.satellitetoday.com/technology/2015/07/27/norsat-receives-follow-on-order-from-eurasian-defense-contractor/.

[21] *Id.*

EchoStar comment:

<u>FSS (Broadband and other services)</u>

With the growing demand for the fixed-satellite service, including broadband and other data services, the C-, Ku- and Ka-bands are reaching saturation of their capacity. And there is an upcoming FSS spectrum shortage; notwithstanding the satellite industry's utilization of the V-band and the most efficient spectrum technologies. Accordingly, there is not enough FSS spectrum currently available to satisfy future demand.

The FSS industry is expected to have a similar or even a higher growth rate for the next five years than it had the last five years. Table 2 below shows the estimated subscriber growth from now until 2020 for 10%, 15% and 20% growth rates for North America assuming a current subscriber base of around 1.5 million.

Year	Estimated subscribers [million] with 10% growth rate per year	Estimated subscribers [million] with 15% growth rate per year	Estimated subscribers [million] with 20% growth rate per year
2015	1.5	1.5	1.5
2016	1.65	1.73	1.8
2017	1.82	1.98	2.16
2018	2.00	2.28	2.59
2019	2.20	2.62	3.11
2020	2.42	3.02	3.73

Table 2: Estimated FSS Broadband Subscriber Forecast for North America

From Table 2 it can be seen that even in the most conservative forecast using a 10% estimated growth rate, the number of subscribers in 2020 will be approximately 60% higher than in 2015. Using the more aggressive 20% annual growth rate, the subscriber base in 2020 will be around 150% higher than today.

The demand for satellite broadband Internet access is expected to steadily increase in the future. In fact, satellite broadband Internet access is projected to gain 3.8 million net new subscribers by 2021.[22] The MSS market is expected to grow at a global annual rate of 7% in number of terminals.[23] Thus, by 2024, the number of terminals is expected to reach 6.8 million active terminals.[24]

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[22] Northern Sky Research, Broadband Satellite Markets, Report Briefing, 11th ed. (2010).

[23] *Id.*

[24] *Id.*

Furthermore, service and customer premises equipment revenues for the broadband satellite industry are expected to double between 2011 and 2021 with a projection of 4.9 billion net gain.[25] In addition, enterprise VSAT growth is increasing. This growth is the product of social inclusion and classic corporate verticals, and Europe has recently experienced great gains in two-way narrowband VSAT services, which is the product of ATM and lottery networks that are perfect for two-way narrowband VSAT services.[26] This marks a substantial opportunity for Hughes since it is the world's leading provider of VSAT services.

The Internet of Things ("IoT") is helping drive the convergence of satellite and terrestrial services, with MSS and FSS providing a powerful and ubiquitous connectivity overlay to terrestrial services, allowing internet connectivity on a truly global scale. This is a unique discriminator, which underscores the value of satellites services in the telecommunications ecosystem.

Video broadcasting via satellite remains and is expected to continue to be the most effective and economical mechanism for the delivery of video content to large geographical areas, with demand steadily growing.

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.

EchoStar Comment:
EchoStar already uses spectrum efficiently and it provides important innovative services to consumers across the globe. For instance, in order to operate the most spectrum efficient satellite system, EchoStar utilises advanced technologies—such as spot beam technologies and frequency reuse for high-throughput satellites, which use spectrum as efficiently as possible. Notably, these high-throughput satellites bring critical broadband connectivity to rural and remote areas where access to terrestrial and wireless infrastructure is generally unavailable.[27] Despite the use of such technologies, EchoStar needs additional spectrum to meet the rising consumer demand for its services because spectrum is becoming increasingly scarce.

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[25] *Id.*

[26] *Id.*

[27] Brian Witkowski, Bridging the Digital Divide: Improving Broadband Access for Rural Americans, 13 Pub. Int. L. Rep. 170, 174 (2008).

Recent increases in the amount of spectrum allocated to terrestrial services, in particular mobile services, have often come at the expense of spectrum for satellite services.[28] Thus, EchoStar is very concerned about its ability to meet the future demand for its services because of spectrum scarcity. Ku band satellite capacity across the globe is in short supply and Ka band capacity is also very limited.[29] And existing bands, such as the V band, are expected to become heavily utilized in the near future.[30]

EchoStar and the rest of the satellite industry count on the continued long term availability of existing ITU primary or co-primary allocated spectrum so they can continue to develop innovative satellite systems capable of offering a wide range of FSS, MSS, and BSS services. Accordingly, EchoStar is very concerned about the long-term availability of the Ka, Ku, and V-bands, which enables it to meet the important needs of their customers.

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?

EchoStar comment:
The satellite industry has and will continue to develop technology that uses spectrum efficiently, such as multi-spot beams. Multi-spot beam technology reuses the same frequency due to the narrow nature of the beams. This reuse allows for increased capacity due to the wider bandwidth usable for each beam. The more beams a satellite supports—the higher the total satellite capacity.

But there are inherent limitations on how many beams can be supported, due to satellite antenna size, pointing accuracy, and interference isolation between the individual beams. R&D efforts continue in this area; focusing on the most suitable reuse pattern for the most spectrum efficient use. The limits, however, are almost reached. The same can be said for new transmitter and receiver technologies.

DVB-S2X, a new digital satellite television broadcast standard, also provides a more efficient use of spectrum. Standardized as an extension of the DVB-S2, this new standard includes higher modulation schemes, smaller roll-off factors, and tighter filter

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[28] Satellite Spectrum Initiative, http://satellite-spectrum-initiative.com/ (last visited July 30, 2015).

[29] Id.

[30] GN Dkt No. 14-177 et. al., Comments of the Satellite Industry Association, 8-9 (filed Jan 15, 2015).

requirements for smaller carrier spacing. Thus, this new standard will be used in the future, with a 10-20% more efficient use of spectrum on average (51% in rare cases). Significantly, however, the DVB-S2X is already approaching the theoretical limit (Shannon-Hartley theorem).[31]

In addition, satellite networks continue to share spectrum resources with other users. For example, the satellite industry has shared several bands with fixed terrestrial systems for years. We are generally open to sharing with terrestrial applications (including mobile systems) but due to exclusion zones required to protect satellite earth stations, sharing may be impractical.

Moreover, satellite spectrum demand is rapidly growing and thus the expansion of satellite systems has to be taken into account (e.g., additional earth stations) when it comes to future sharing spectrum. For any new sharing scenarios, the cumulative interference from various systems needs to be examined. In sum, even taking into account all of the potential mitigation techniques, EchoStar still needs additional spectrum in order to meet growing customer demands.

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?

EchoStar comment:
No comment.

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 organization to address the challenges it faces?

EchoStar comment:

EchoStar continues to expand its services around the world to keep pace with customer demand. The demand for EchoStar's satellite services is not stagnant; it will be robust for the foreseeable future. Therefore, EchoStar needs additional spectrum and orbital positions to support its future customers, and assurance that its existing spectrum is secure. This will provide spectrum certainty.

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[31] DVB Fact Sheet, DVB-S2X-S2 Extensions, May 2014, www.dvb.org/resources/public/factsheets/dvb-s2x_factsheet.pdf

Spectrum certainty is particularly important to satellite sector because satellites take multiple years to design and build. And after a spacecraft is launched, its design is locked in for the life of the satellite—which can run 15-20 years.[32] Moreover, the total cost from design to launch can easily amount to a half a billion dollars.[33] Thus, since EchoStar has to expand to stay viable, Ofcom must implement regulations that provide spectrum certainty so it can have the confidence to invest in new facilities and technologies.

The need for spectrum certainty is at issue at the 2015 World Radio Communication Conference. There is an agenda item that proposes regulations that will help the satellite sector overcome the FSS spectrum shortage. Specifically, the item proposes additional FSS spectrum—including for both GSO and NGSO orbit use—with Earth-to-space and space-to-Earth direction of transmission in the 32.3-33 GHz frequency band, and for reverse direction operations for gateway earth stations in the 37.5-39.5 GHz frequency band.

At the same time, such regulation must take into account existing services in the band and consider the possibility of sharing with existing uses of the bands. Spectrum certainty is necessary because FSS service supports a number of important public interest initiatives and because demand for FSS service is skyrocketing.

Put simply, EchoStar urges Ofcom to ensure the protection of existing and planned FSS spectrum for the satellite sector. Additionally, Ofcom should make sure there is room for expansion in current satellite bands. To this end, EchoStar is concerned about the impact of proposed future agenda items surrounding the IMT and HAPS that are looking at sharing studies leading to the identification of spectrum for these services in key satellite bands.

Although EchoStar recognizes sharing of spectrum is necessary, it is concerned about spectrum satellite use in these bands being curtailed, which would prevent it from growing to meet consumer demand for satellite services. Moreover, even though EchoStar does support sharing in bands where it operates its gateway stations (with appropriate protections), it is highly unlikely that sharing can be accomplished in bands with two or more widely distributed services operating (e.g., IMT and satellite

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[32] Virgil Labrador, Satellite Communication: *How Satellites Work*, Encyclopedia Britannica, *available at* http://www.britannica.com/EBchecked/topic/524891/satellite-communication/288217/How-satellites-work (last updated Feb. 18, 2015).

[33] The Cost of Building and Launching a Satellite, *available at* http://www.globalcomsatphone.com/hughesnet/satellite/costs.html (last visited Jul. 16, 2015).

broadband services). Therefore, EchoStar urges Ofcom to consider these limitations as it prepares for the upcoming WRC and any future studies.