1. Response to Questions

Q1: Do you have any comments on our approach to this review?

The particular focus on UK citizens and consumers seems particularly narrow in scope. We represent companies in the UK satellite services and ground equipment industry that provide employment in the UK, pay UK taxes, and thus contribute to the UK economy - directly benefiting the UK citizen and consumer. The approach therefore should have explicitly identified UK industry that benefits the UK citizen and consumer.

Q2: 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)?

The list of applications and their definitions seems complete.

Q4: 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?

The value chain as shown in the document is far too simplistic. For instance, the Equipment Manufacturers shown at the start of the chain feeding into the Launch Providers are not in the same sectors as the Equipment Manufacturers who support each of the other parts of the value chain.

Industry revenues cannot be considered just at the UK level – this data is not easily measurable as by its very nature the satellite industry does not operate on a national basis. Global industry revenues are most easily obtained from specialist consultancy firms such as Northern Sky Research, who produce regular reports on different facets of the satellite industry.

Q5: 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.

Table 1 summarizes the applications and usage by our members:

Table 1 - Applications and corresponding involvement of our members

End-user applications	**APTN**	**Reuters**	**SIS**	**Solo**	**7E**
Direct-to-Home Broadcast TV	**U**	**U**	**U**	**U**	
Broadband internet access	**U**	**U**	**U**	**U**	**HTD**
Machine-to-Machine (M2M)			**U**		
Commercial Mobility (MSS)	**U**	**U**	**U**	**U**	**HTD**
Corporate Networks	**U**	**U**	**P/HTD/U**		**P/HTD**
Navigation (location based)	**U**	**U**	**U**	**U**	**U**
Other applications					
Distribution	**P/HTD/U**	**P/HTD/U**	**P/HTD/U**	**U/HTD**	
Contribution and OU TV	**P/HTD/U**	**P/HTD/U**	**P/HTD/U**	**P/HTD/U**	**HTD**
Legacy telephony and carrier					**P/HTD**

Key: U – Use P – Provide HTD – Help to Deliver

Some of our members provide SNG services directly to broadcasters. Table 2 illustrates how specific applications are used for this.

Table 2 - SNG Usage of Applications

Application	**Usage**
Navigation (GPS)	To aid getting to site; For automated antenna control systems used to locate the target satellite
DTH	When on site the DTH broadcast signal is normally monitored by the SNG terminal to see TV channel output and monitor when "on-air"
Commercial Mobility	May be used in remote locations as an alternative to mobile cellular to keep in touch with newsroom and also to contribute content
Broadband internet access	May be used in remote locations as an alternative to mobile cellular to keep in touch with newsroom and also to contribute content
Corporate Networks	Newsroom computer systems
M2M	SIS LIVE uses a central system to automate and directly remote control access to the satellite by a significant number of their SNG units

Q6: ***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:***

Q6a: ***- 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***

Because of the range of services used and provided by our members, it is not possible to provide exact frequency usage. Services are also not necessarily continuous (e.g. OU contribution traffic), but it is possible to specify the sub-bands used within each band:

C-band 3.6 - 4.2GHz; 5.9 - 6.8GHz
Ku-band 10.75 - 12.75GHz; 13.75 - 14.5GHz
Ka-band 19.5 – 20GHz; 29.5 - 30GHz

Q6b: - the coverage area for services links; or, in the case of TT&C and feeder / backhaul links, the location of the gateway station(s);

Gateways stations owned or used by our members are not only in the UK but also in various locations across Europe and beyond. Some of our members own their gateway stations; others make use of broadcasters own gateway stations, or use third party gateway station operators. Because of the ubiquity of fibre, it is no longer necessary for gateway stations to be in the country of final service delivery.

Q6c: - the estimated number of users (e.g. MSS terminals, DTH subscribers, FSS earth stations);

This information is commercially sensitive, and our members are not willing to divulge such detail in this consultation. However, it can be said that on any given day, most of the world's population sees content produced by our two TV news agency members through both TV and online. For our other members involved in TV contribution, a significant amount of the live location content seen on UK-originated TV channels (and to varying degrees, on foreign TV channels) is provided by them on a daily basis, including major sporting events and breaking news stories.

One of our members provides several branded and encrypted TV channels for exclusive viewing in betting shops both in the UK and in other parts of Europe. The audiences for these services can be measured in the millions.

Q6d: - an estimate of the average use by end user (for those applications for which the demand for spectrum is driven by end user traffic);

This is not possible to quantify.

Q6e: - 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).

The advent of HD has had some effect on spectrum demand, although this has been mitigated by dramatic improvements in compression, modulation and coding technologies. But particularly for the coverage of breaking news stories, in which all our members are involved with, the demand for spectrum capacity is driven by the news agenda. This demand is for the direct provision of "live" content, as in the case of conventional TV and radio contribution services.

However, what might not be apparent is that MSS band is also used for this purpose; 7E Communications provides MSS terminals on sale/ hire basis for a range of print and TV clients, and also provides the associated airtime capacity on a reseller basis.

Ofcom should include Digital Cinema Distribution as a driver for spectrum. It is a sub-set of Distribution, but it is an application which requires fairly high-throughput speeds (typically 140 Mbps) for live events. Even for non-real-time transport, the file sizes are typically 150GB or more, currently taking several hours to deliver. According to Eutelsat [1], there are 1300 cinemas across Europe equipped to receive films distributed by satellite.

Q7: For each of the satellite applications you provide, please could 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).

UK consumers and citizens benefit in that both live events and breaking news is delivered by our clients either directly or indirectly for BBC, ITV and BskyB, as well as regional UK broadcasters. It is not possible to quantify the benefit easily, but what is very clear is that UK broadcasters rely significantly on services provided by our members to deliver content to UK consumers and citizens.

[1] http://www.eutelsat.com/en/services/broadcast/digital-cinema.html

Q8: From your perspective, what high level trends will affect the satellite sector in the coming years?

The use of High Throughput Satellites, the expansion in use of Ka-band (although often spoken of together, the two are not the same), and the uptake of UHD TV.

Q9: Question 9: For each of the satellite applications you use, provide or help deliver what do you see as the:
Q9a: current demand trends
Q9b: underlying current and likely future drivers of demand for the satellite application(s) your organisation uses or provides?

Current demand trends
There is a demand for more satellite capacity across a number of applications – but in particular for OU and DTH services. However, the efficiency of use of spectrum has meant that, for instance, HDTV contribution signals can be transmitted in much narrower bandwidths than was the case three years ago. This is due to the spread of MPEG-4 H.264 technology combined with the use of DVB-S2 modulation.

As an example of the bandwidth saving, a few years ago it was necessary to use a full 36MHz transponder to transmit MPEG-2/DVB-S HD signals for HDTV contribution. This has now generally halved to 18MHz, or even less particularly for TV news contribution, by using MPEG-4 H.264 in combination with DVB-S2.

Future demand trends for DTT, Contribution, and OU
Demand for 4K UHD TV (and beyond that possibly 8K UHD TV) is a global trend as the consumer device manufacturers pushes the roll-out of UHD televisions and other UHD capable devices. Existing HD pictures (1920 x 1080 pixels) are composed of just over 2 million pixels, while a 4K (3840 x 2160) signal is comprised of just over 8 million pixels. As a result, an important issue quickly becomes apparent: 4K has four times the resolution, and subsequently requires four times the amount of data to transmit the video over the satellite, which quadruples the amount of bandwidth required to transmit when compared with existing HD.

Looking even further out, 8K UHD (32 million pixels – sixteen times standard HD) is a growing development in the Japanese market which may eventually spread to the rest of the world including Europe. NHK, the Japanese broadcaster, began research and development on 8K television back in 1995. Since then they have spent well over $1 billion on its research and development. Called Super Hi-Vision, Japan plans 8K test broadcasts in 2016 (note that NHK ran tests on 8K from Wimbledon 2015). Regular broadcasting of 8K signals by NHK could begin in 2018, and its goal is to broadcast the entire 2020 Olympics in Tokyo at 8K resolution.

However, the likely application outside Japan may be limited to Digital Cinema Distribution only. The use of the H.265 (HEVC) compression standard along with DVB-S2X modulation/coding technology is designed to handle the high data rates for 4K – typically 50 Mbps for contribution and even 25Mbps to the home. The spectrum demands for 8K using current technologies exceed this by a factor of 2, and so there is little doubt that greater channel capacity will have to be found for both Contribution and Distribution of 8K UHD TV

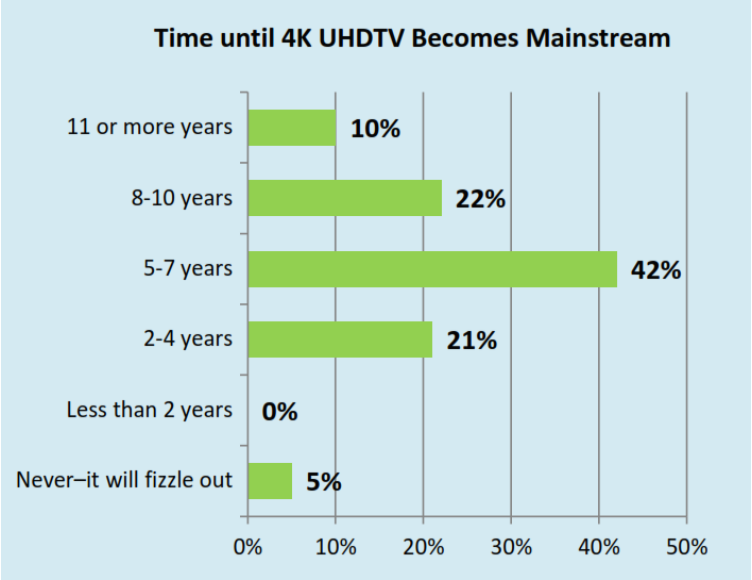
More than one of our members is already working on the contribution of 4K UHD TV, and Digital Cinema Distribution.

Q10: 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.

The challenge in the rise in demand for 4K and 8K UHD TV is the broadcaster investment required. This consumer manufacturer-driven demand is dictated by consumer take-up and demand and

supply of content. After the hype and then failure of 3D TV to take off in Europe, with several fledgling channels ceasing transmission, there is cautiousness in the rate and amount of investment that should be allocated to 4K, and to a greater extent, 8K.

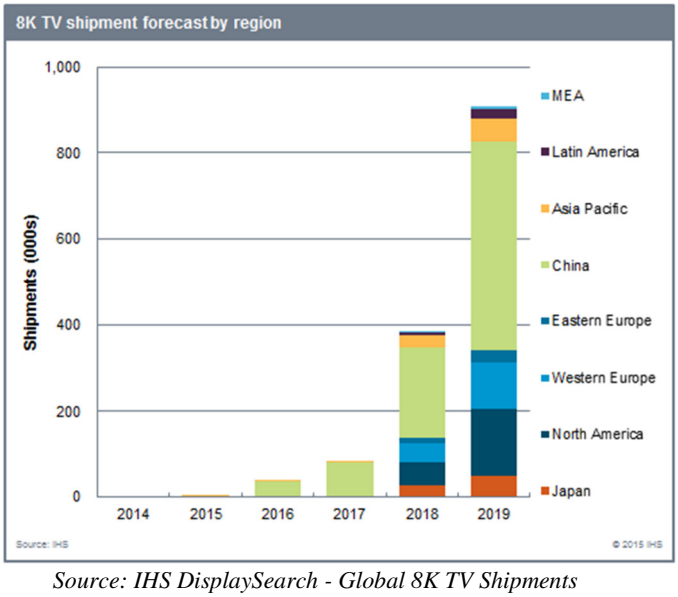
From a survey carried out by Intelsat in 2014, it was found that 63% of media executives globally see 4K as being mainstream by 2021 and the de facto norm by 2024 [2]. In addition, it found that while technical professionals believed most widely that Digital Cinema will be the first segment to gain momentum for 4K, non-technical respondents most widely believe that DTH services will be the first segment to adopt the technology.



Source: Intelsat Global Media Executive Survey 2014

Satellite is expected to play a significant role as a 4K UHDTV delivery medium for traditional television (43% of respondents) and Occasional Use (42%).

The uptake of 8K is more uncertain; IHS DisplaySearch published a study in June 2015 looking at the consumer sales of 8K displays [3] showing a dramatic global increase in 8K displays sold over the next four years. The operating costs for 8K TV channels will be substantially more than current HD channels, and the data throughput required seems, by current measures, eye-wateringly high.



Source: IHS DisplaySearch - Global 8K TV Shipments

[2] Intelsat - *Global Survey of Media Executives Forecasts 4K UltraHigh Definition TV Adoption and Business Models*

[3] IHS DisplaySearch - *Global 8K TV Shipments to Approach One Million Units in 2019*

As can be seen, Europe is on a par with North America in terms of anticipated growth, though lagging behind China, Japan and the Asia Pacific region. The subject of 8K and its use is now a 'hot' topic amongst many of the world's leading broadcasters. With a 36MHz transponder fully utilized needed to transport just one 4K TV channel, step-changing technologies will be required to enable satellite delivery of 8K.

Q11: 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?

Frequency re-use through the utilisation of multiple smaller beam antennas on High Throughput Satellites is already happening, and will continue as the current generation satellites are replaced.

The use of more satellites through increased co-location in existing orbital slots does not appear to be a development that is gaining widespread acceptance. The issues relating to ITU co-ordination, frequency re-use at the same position, and different operators occupying the same orbital slot, appear to be barriers.

Reducing orbital separation, which would require even tighter tolerance earth station antennas, does not appear to be attractive to satellite operators. The current nominal 2° spacing limit appears to cause significant difficulties for some satellite operators to approve the use of existing high power/small aperture terminals as used for SNG. While for low power VSAT traffic reducing orbital separation may well be viable, the costs associated with developing SNG antennas to meet the required technical criteria - and therefore the high purchase price - maybe a significant deterrent. HTS may mitigate this in the long term as more OU traffic is transitioned onto HTS capacity.

Q12: 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?

We cannot see any other mitigations at this time.

Q13: 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?

None currently foreseen.