



Avanti Response to UK Ofcom Space Spectrum Strategy Consultation - 10 May 2016

About Avanti:

Avanti Communications (Avanti) is a UK Headquartered and listed satellite operator. Avanti is the first mover in high throughput Ka-band satellite data communications in EMEA. The Group has invested \$1.2bn in a network that incorporates Ka-Band satellites, ground stations, datacentres and a fibre ring. Avanti has three Ka-Band satellites in orbit and a further two fully funded Ka-band satellites under construction for launch in 2017. Avanti covers an end market of over 1.7bn people.

Avanti Communications was awarded 'The Queen's Award for Enterprise,' the UK's highest accolade for business success, in recognition of outstanding achievement in delivering growth in exports.

More Information: www.Avantiplc.com

Introduction:

Avanti welcomes Ofcom's public consultation setting out Ofcom's proposed Space Spectrum Strategy which covers the use of spectrum by the satellite and space science sectors.

We acknowledge and agree with Ofcom that these sectors and in particular the satellite communications sector already deliver important benefits to UK citizens and consumers, such as broadcast TV, global positioning, broadband communications and connectivity to ships, off-shore platforms, cars and aircraft. However, there is potential for greater benefits in the future. More broadly speaking, commercial satellite data communications contributes to the establishment and resilient provision of critical and unique communication links that enable to fulfill the UK government policy objectives in the 21st century, e.g. cost effect and sustainable broadband for all, vital international links to other continents, global maritime and aviation communications, 2G/3G/4G mobile backhaul (and future 5G), humanitarian and disaster relief communications, SNG, etc. Although essential, these services are immeasurable in purely economic terms.

Satellites are an established and important technology for delivering telecommunications, broadband and media services. Satellite communications support economic development, social objectives, and national and regional integration. As the industry has matured so has its use of advanced technology. Whilst Avanti welcomes Ofcom's efforts to better understand the satellite industry's spectrum landscape, future demand and technology trends and the resulting implications for spectrum. However we believe that in undertaking this review, Ofcom should also explicitly take into account the interests of the global opportunities for UK industry as a priority alongside UK consumer and citizen interests, since most satellite services by nature provide coverage on a global basis including the UK.



The UK space sector is a valuable one supporting thousands of jobs as a direct result of its activities, with employee productivity more than four times the national average. Significantly, both manufacturing and operations are capital intensive and require highly skilled people resulting in graduates filling nearly two-thirds of all jobs. Today only 3% of satellite spectrum is available on an exclusive basis for satellite services, most commonly, there is sharing co-existence with fixed terrestrial services.

The satellite industry count on the continued long term availability of existing ITU primary allocated or co-primary allocated satellite spectrum to MSS, FSS and BSS in L, S, C, X, Ku, Ka and future Q/V bands to enable the continued development of new innovative satellite systems capable of offering a wide range of advanced MSS / FSS / BSS services. Therefore any suggestion of sharing within the existing allocation bands would create unnecessary regulatory uncertainty which will severely impact the current coexistence in spectrum allocation

Question 1: How useful is the interactive data that we have provided on our website and why? How can the presentation and interactivity of the data be improved? How frequently would it be useful for us to update the information and why?

Avanti very much welcomes Ofcom's new mechanisms to gather data in an interactive portal for the public to review the applications used by satellite technology in an open and interactive database.

However, in order for this database to be as effective as possible for Ofcom in managing use of the radio spectrum, it is important to have an up-to-date and thorough understanding of the trends influencing spectrum use, particularly given the increasing and competing demands for spectrum from different sectors. This is not an easy process to keep updating the database as the input would be required from numerous stakeholders. Currently Ofcom does not have a mechanism for such an update process other than an ongoing call for input. We are in particular impressed with the satellite allocations from the UK Frequency Allocation Table (FAT) providing details of products available in the UK for authorising spectrum use by satellite and space science applications in an interactive and visual format. Using the search filter can also provide stakeholders with a clearer view of how spectrum is used by the satellite sectors and how it can be used in the future.

One point to perhaps improve the spectrum allocation tab within the interactive portal is to include a clear reference to VSAT stations within the "spectrum use by application or license" tab, as currently the reference to Earth Station is not a universal terminology whereas VSAT is a terminology that is recognised globally.

It is also not clear why Ka-band is not fully mentioned within the summary of stakeholders input for satellite applications. Each square shows the role of specific organisations using a particular band for a particular application, yet Ka-band is not fully represented in various value chains (e.g. commercial mobility vis-à-vis Earth Station Operator or Broadband vis-à-vis User). Whilst the data included is extensive, as such the chart does not fully provide a comprehensive view of the satellite sector in the UK as it is only based on one call for input. We are also of the view that



it is not clear what the intention of this interactive map of the UK sector and what mechanism would exist to continue updating this database.

Question 2: Do you agree with the industry and technology trends we have identified for the satellite sector? Are there other trends that could have implications for spectrum use?

In overall terms, the UK satellite and space economy has been growing at a compound rate of 8.6 % since 2008 and is forecast to grow to £ 40 billion by 2030¹. UK satellite operators provide a variety of services to address many different market segments, including 2G/3G/4G mobile satellite services to land, maritime and aeronautical users, including safety services; and fixed satellite services that include applications such as broadband to both fixed and mobile users. These services are provided from satellites operating in the C, L, S, Ku-band and Ka-band spectrum.

Avanti can identify the following non-exhaustive list of service trends:

- Universal delivery of TV services in digital and HD formats;
- Development of IP satellite video and hybrid broadcast – broadband standards based on a mix of satellite and terrestrial services (e.g. Sat>IP, Sat-LNB, HbbTV);
- Increased utilisation of HTS technology to provide mobile backhaul services via Ka-band satellite systems, providing a primary connectivity for terrestrial base stations in poorly served or under-served areas;
- Development of High-Throughput Satellite (HTS) services (50+ Mbps two-way connectivity);
- Increasing reliance of governments & institutions on satellite communications for reliable, secure and resilient services;
- Continued and increasing connectivity needs for backhaul services & corporate VSATs.

The continued sustainable growth in these services and applications would be severely affected if regulatory uncertainty is created within the spectrum used by satellite services. Another trend which Avanti is witnessing is that the C and Ku-bands are the most extensively utilised for commercial FSS services, while the Ka-band is seeing rapid uptake and hefty new investments because technological advances have helped the industry to unleash the full potential of available large bandwidths for high capacity systems. Increased use of these key bands is expected to continue, with this growth being particularly rapid in the Ka spectrum. An important trend will be the convergence of BSS, FSS and MSS services in all these bands.

Avanti would further add that with current advancement in satellite technology, there are now new clever technologies that will lead to an increase of frequency re-use to achieve even higher efficient use of satellite spectrum such as:

- Early satellites systems had wide downlink beams giving global or hemispherical coverage. By employing frequency reuse through transmissions in opposite

¹https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298362/igs-action-plan.pdf



polarisations using either linear or circular polarisation discrimination, a satellite can utilise up to the full 500MHz of traditional satellite bandwidth twice, giving a maximum capacity of 1GHz in a beam;

- Spectrum re-use via spot beam architecture will expand available capacity and reduce the transmission and equipment costs. New small beam technology allows for the same frequencies to be used multiple times on the same satellite, giving a significant increase in the overall spectrum efficiency. This is one example of where satellite manufacturers and operators have made major investments in new technology to maximize the efficiency with which satellite spectrum is used. While further technology improvements can be expected, this approach will dramatically reduce the cost per MHz (and inherently the cost per bit) while also reducing equipment cost. This cost decrease will translate to more demand from consumers of different applications that can be serviced by satellite which will increase the demand for viable access to the spectrum used by satellite systems.

The continued sustainable growth in these services and applications would be severely affected if regulatory uncertainty is created within the spectrum used by satellite services.

It is to be reminded that all global satellite operators have shared spectrum with fixed terrestrial systems in several different bands for years, based on appropriate coordination. Most commonly, allocations to satellite communication services are shared with fixed and/or mobile terrestrial services. (UK spectrum usage and demand, March 2015 – UK Spectrum Policy Forum²). However, regulators have to manage potential sharing situations carefully, so as to avoid interference between satellite services and other services.

Satellite players count on the continued long term availability of existing ITU primary or co-primary allocated satellite spectrum to MSS, FSS and BSS in L, S, C, X, Ku, Ka-band to enable the continued development of new innovative satellite systems capable of offering a wide range of advanced MSS / FSS / BSS services. Any suggestion of sharing studies within these bands by Ofcom would create regulatory uncertainty which in turn would create a negative environment for investment and would severely affect the continued sustainable growth in such spectrum bands.

Question 3: Do you agree with the application specific trends we have identified for the satellite sector? Are there other trends that could have implications for spectrum use?

We agree with the list of Ofcom's applications (i.e. broadcasting TV, broadcasting connectivity, satellite positioning services as well as IoT issues) which are significantly important applications in terms of satellite usage to the UK consumers. Satellite technology today plays a major role in each case and this has been highlighted by Ofcom's consultation document.

² Available from: <https://www.techuk.org/insights/reports/item/3773-uk-spectrum-usage-demand-first-edition>



But it is also important to note that the take up of Ka-band is accelerating, and the UK operators are deploying regional and global systems to meet the demand for broadband, DTH and other applications throughout the world. The collective investments made so far by the UK based operators (e.g. Inmarsat and Avanti) in Ka-band satellite systems alone amounts to around £3.4 billion. Such large investment will continue to grow, provided Ofcom does not create uncertainty in terms of regulations and policy that could severely affect the continued sustainable growth in such trends. Such regulatory uncertainty is created, for example, when the possibility of changes within the spectrum allocation to Ka-band is made for future terrestrial services. Considering the huge investment already made in Ka-band and the UK position in the world in regards to this investment, Avanti strongly encourages Ofcom to continue to promote and support this positive growth trend in the industry by maintaining a stable regulatory environment in the UK and abroad.

Avanti would also like to add the following trends that are not clearly highlighted where satellite will play a key role in the future:

- **High Throughput Satellites (HTS).** HTS satellite systems provide higher data throughput using spectral efficiency that allow them to carry large data capacity with lower cost/MB produced relative to competing offerings. HTS satellites can today deliver data rate services (> 100 Mbits/s – 1 Gbit/s) in ‘broadcast / multi-cast’ mode to small radio access points. By 2020 - 2025, Ka-Band HTS satellite systems can deliver (>1 – 10 Gbit/s) services and will require sustainable and viable spectrum access to deliver existing and planned services. Current HTS customer segments are as follows:
 - Broadband: Enterprises / consumers where fast terrestrial broadband is not available, including mobile platforms;
 - Carrier Services: Primarily connecting mobile phone base stations to core networks;
 - Enterprise: High bandwidth broadband connections to link remote offices or businesses with machine-to-machine data communications needs; and
 - Government: Defence and security, schools, healthcare and regional government office.

- **5G Hybrid Systems.** As noted earlier, HTS satellite systems can deliver very high data rate services (> 100 Mbit/s to 10 Gbit/s) in ‘Broadcast / Multi-cast’ mode to small, compact outdoor radio access points for:
 - Direct delivery of linear, non-linear TV and IPTV services to in-building ‘fixed’ customer;
 - Interconnect via 3G/4G/ RLAN wireless access networks (for in-home, in-building distribution) for service delivery to ‘in-building mobile’ users.

- **Internet of Things (IoT).** Ofcom states in 6.23 that IoT is unlikely to be a significant driver of growth in satellite spectrum use. However, IoT is a very wide field with many facets and in certain cases, satellite can be the ideal mode of communication. One clear example is the connected car where providing software updates to millions of cars around the globe can



only be efficiently achieved via satellite. As technology develops further, we do see IoT as a key driver to increased spectrum use by satellites.

Question 4: Do you agree with the industry and technology trends we have identified for the space science sector? Are there other trends that could have implications for spectrum use?

Avanti has no comments

Question 5: Do you agree with the application specific trends we have identified for the space science sector? Are there other trends that could have implications for spectrum use?

Avanti has no comments

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

Internet of Things (IoT) and M2M applications (highlighted in section 6) are also going to have a potential to provide significant growth in consumer and UK citizen benefits. IoT/M2M applications have been a growing market within satellite communications for many years. There are predictions for very high growth in M2M/IoT generally, which even if only partly realised, will increase demand for satellite based M2M/IoT in order to ensure ubiquitous coverage.

In addition to the growth in satellite Ka-band broadband subscriptions, new wireless innovations on the horizon offer further opportunities, but often require extra bandwidth capacity. IoT, for example, offers the potential to transform our daily lives by making a dynamic ecosystem of connected devices possible. With the IoT, interconnected devices promise to revolutionize everything from energy efficiency, connected cars, healthcare, and industrial operations, to everyday personal tasks. Although these types of innovative developments present a new and exciting frontier of wireless technology, they will require 100% coverage availability. The potential for IoT applications is still growing, but could be limited by coverage signal strength and bandwidth capacity. This is why the satellite sector and in particular Ka-band FSS services is investing in new antenna technology, satellites and satellite services that will compliment other technologies to provide and roll out IoT.

Question 7: Do you agree with the three priorities that we have proposed for our strategy? Are there other priorities that are as important, or more important, for citizens and consumers and why?

Avanti provides its response to each of the three priorities in order.



- **Enable growth in broadband communications provided via satellite to hard to reach locations, on land, ships and aircraft.**

Avanti agrees that it is important and we support Ofcom priority in this area. The widespread deployment and use of broadband is vital to Government to help achieve growth and productivity gains in the British economy and maximise the gains to society from e-Health, e-Government, e-education and much, much more. The following factors are pertinent:

- The UK has already made public investment of £1.7 billion in broadband networks (primarily BT's) yet the 95% UK coverage by 2017 still remains a challenge;
- Satellite is designed to provide 100% UK national broadband coverage;
- Satellite can offer national service with affordable, high quality, high speed services, today, with a range of consumer and enterprise packages and wholesale models;
- As satellite and antenna technology advances, especially with mobile and hybrid applications, as noted in this Response, satellite services should not be considered purely as a fall-back service for remote and rural connectivity but rather part of a compelling and viable alternative in suburban areas for mobile connectivity and as part of the hybrid solution for delivering level services across wide regions.

- **Enable growth in the quality and quantity of earth observation data collected by satellites, which are used to provide benefits to UK citizens and consumers.**

Avanti has no comments

- **Enable continuation of the benefits that citizens and consumers currently enjoy where appropriate, whilst exploring opportunities for spectrum sharing in the frequency bands currently used by the space sector and new uses in adjacent bands.**

Avanti would like to emphasise that efficient use of spectrum is a principle we support and recognises that Ofcom puts this as one of its pillars for spectrum sharing. However, where spectrum is already being efficiently used by different technologies consideration for further sharing runs the risk of jeopardising the complex and balanced mechanism already achieved in that band. For example, in the band 3600-4200 MHz in the UK, satellite services and some terrestrial services (point-to-point radio relay) are able to share with no major drawbacks. This is evident by the number of satellite gateway earth stations already licensed by Ofcom within the UK which share with coordinated point-to-point terrestrial links.

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



The UK Government agreed with this recommendation, stating that “Ofcom will continue to develop its approach to satellite and spectrum issues in close consultation with the UK space industry”. We therefore encourage Ofcom to ensure sustainable protection for existing and planned satellite services spectrum and to develop spectrum use policies that do not fundamentally jeopardise the viability of existing and future use of ITU satellite service allocations by satellite services within the UK.

As regards the benefits to UK citizens and consumers, the UK has a privileged and thriving space and satellite community. The space sector contributes £11.3 billion a year to the UK economy and has been growing at about 7% each year throughout the recession according to the UK Space Innovation and Growth Strategy (IGS), initiated in 2010 and refreshed in 2014. The same IGS is targeting a fourfold growth in the sector by 2030, or 8.5% CAGR over those two decades. (“A Space Innovation and Growth Strategy 2010 to 2030” - UK Space, 2010).³

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

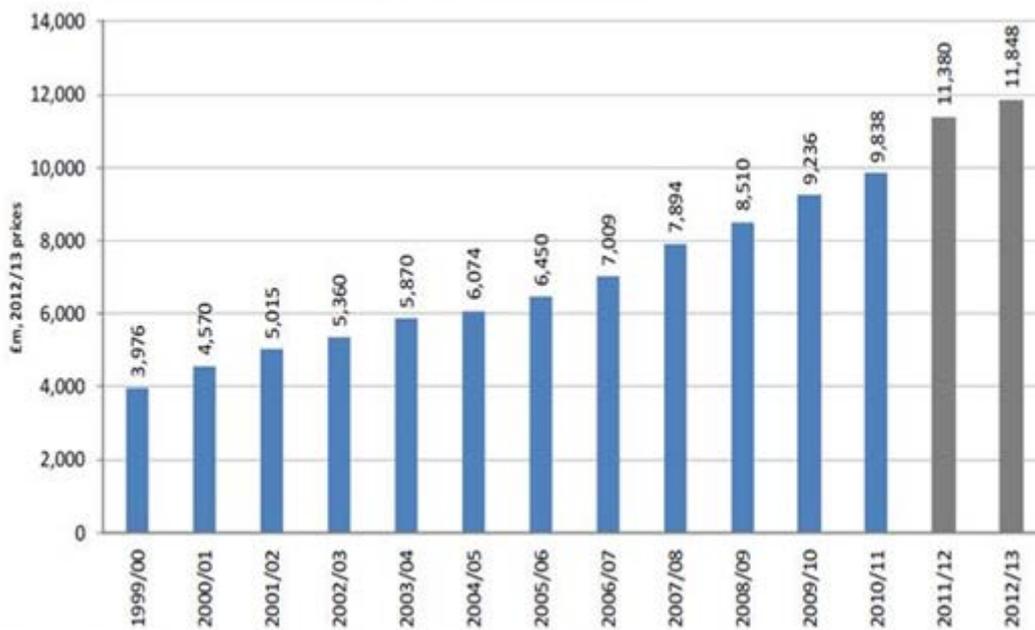


Figure 1: The UK Space Economy Turnover, 1999 - 2013⁴

As noted recently by the UK Spectrum Policy Forum: “Spectrum sharing in its many forms remains critical but unsolved: although there have been developments such as geo-location databases, the tension between flexible access for new usage, protection for incumbent usage

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

⁴ London economics analysis



and its foreseen expansion and the need for all to offer assured services hampers progress.” (UK spectrum usage and demand, March 2015 – UK Spectrum Policy Forum⁵). The same Forum acknowledged that spectrum allocations for space services have been fairly stable since the foundations were laid at a World Radio Conference in 1963. Most allocations are already shared with other radio services, with sharing arrangements made at national or regional level.

Even though space services have primary allocations totalling 30% of all sub-3GHz spectrum, 65% of spectrum between 1GHz and 10GHz, and 82% of spectrum between 1GHz and 100GHz, only 3% is available on an exclusive basis for space/satellite services; and between 3GHz and 10GHz, no spectrum is allocated on an exclusive basis. Most commonly, allocations are shared with fixed and/or mobile terrestrial services. Avanti notes that Ofcom now state that 4% is available for exclusive use (page 31), and we would like to seek further information on how Ofcom has determined the figure of 4%.

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

Avanti would recommend Ofcom to make the 17.7 - 19.7 GHz spectrum more useable for additional licence exempt FSS applications, by freezing additional new FS licenses in parts of this band (e.g. in/ near FS channel band gaps) in rural/ remote areas of the UK as a minimum, while also allowing the FSS to access it on a shared basis when large amounts of existing contiguous spectrum for coordinated Permanent Earth Stations (PES) are to be used for gateways. The objective would be to progressively allow for sustainable use by broadband and other Ka-band FSS satellite systems to serve customers within the UK in those geographical areas and frequency segments where there is no risk of harmful interference from current utilized terrestrial FS links.

Aside from purely spectrum issues, there is currently a need for the development of new technical standards for electronically steered antennas. The existing ITU recommendation and CEPT documents are all based on parabolic antennas. Including new antenna technology in formulating standards and recommendations would have a wide implication on the adoption of new services such as the connected car. Industry now look to Ofcom to be supportive of our efforts to advance such discussions in the relevant fora.

Question 9: Do you agree that existing bands are likely to provide sufficient capacity for considerable growth in satellite broadband and that we do not need to prioritise the identification of new bands? Do you have any comments on the analysis we have undertaken of supply and demand?

The frequency bands current allocated to satellite services in the RR are generally sufficient. However, the bands currently available for satellite services in the UK, under the UK authorisation regime, may not be sufficient.

⁵ Available from: <https://www.techuk.org/insights/reports/item/3773-uk-spectrum-usage-demand-first-edition>



Of particular concern is the inclusion in ITU Resolution 238 of the entirety of the FSS allocation in the V-band as a candidate for studies on their potential future use by terrestrial-based 5G / IMT-2020 technologies. Although some potential may exist for satellite communications systems to share portions of the V-band with terrestrial-based IMT systems, satellite networks will require unfettered access to the vast majority of the V-band to serve the very high data rate needs of end users. Further, as discussed in other sections of this response, other spectrum bands are identified in Resolution 238 as alternative potential candidates for IMT services and Avanti encourages their consideration in the ITU-R study process.

On a separate issue, and as mentioned in Question 8, FSS uncoordinated earth stations (space-to-Earth) in the band 17.7-19.7 GHz may operate within the UK on an unprotected basis with respect to the Fixed Service (FS). The adjacent band 19.7-20.2 GHz which is allocated exclusively to satellite services, has so far been considered by satellite operators and administrations for widespread FSS earth station deployment. However, with the development of high capacity Ka-band satellites systems, and traffic asymmetry that requires more downlink spectrum than uplink, there is a critical need to enable the viable operation of FSS uncoordinated earth stations under acceptable FS interference conditions within the band 17.7-19.7 GHz on a sustainable long term basis.

Question 10: To what extent does the proliferation of filings for ‘paper satellites’ create costs or barriers that hinder the provision of satellite services to UK citizens and consumers?

Avanti fully supports efforts to improve the current processes, although the major issue currently is more with incorrect notification of networks rather than filings for “*paper satellites*”. It is clear however that improvements to the current rules must be agreed internationally and applied fairly and consistently so as to ensure equitable access for all countries.

Avanti recognises that a National Administration’s regulatory framework for the management of satellite filings should have certain key objectives. It should protect existing satellite assets; attract future investment; facilitate coordination of satellite networks in conformance with domestic and ITU procedures; and reduce the administrative burden on the administration and satellite operators.

Whilst Ofcom clearly intends to establish such a framework, it should be remembered that The Growth Action Plan recognised that: “*The UK provides a strong and internationally highly regarded framework of regulatory principles*”. The document further to note that: “*Regulation is a globally competitive area and others such as the US, France and Luxembourg are doing more to reduce the regulatory burden on their industry and to encourage economic growth in the space sector*” “*We recognise the position of Ofcom as the UK national regulator, and the constraints that this will occasionally impose, but we need to match other nations who are seen to be more supportive of their industrial goals*”.

Avanti is concerned that some of the changes to Ofcom’s Procedures for the Management of Satellite Filings will have a detrimental effect on investment in the satellite industry in the



United Kingdom, and will jeopardise the UK's reputation for regulatory best practice. For example, Ofcom believes that the changes introducing additional milestones and evidence requirements will provide clarity and certainty for operators and that the changes will help Ofcom assure that a project is making satisfactory progress with regards to the appropriateness of maintaining the filing. The Avanti believes that the introduction of further milestones and deadlines are not necessary as these will not provide any further certainty that a project is progressing than the earlier established procedures. Resolution 49 of the Radio Regulations requires that Ofcom provides the ITU Radiocommunication Bureau with sufficient due diligence information relating to the spacecraft manufacturer and 'delivery window', and the launch services provider and 'launch window'. These requirements were already satisfied when satellite operators file in adherence to Ofcom's earlier procedures.

Furthermore, Ofcom's earlier procedures already required that operators immediately communicate to Ofcom any changes to the business plan, including the key milestones, progress reports for each satellite network indicating any variations from the previously-submitted business plan and details of their coordination progress and status. The earlier requirements relating to changes to an operator's business plan and existing reporting requirements were more than sufficient to allow Ofcom to judge whether a change to the business plan would impact an operator's ability to implement the plan in line with the technical parameters outlined in the relevant satellite network filing, and within the regulatory deadline. It is not clear what problem Ofcom's introduced procedural changes are trying to solve.

Ofcom's earlier procedures already placed upon operators' due diligence requirements relating to, among other things, satellite construction, launch and coordination. Given the significant capital and operational expenditure borne by the operators to satisfy these requirements, operators are best placed to determine the regulatory and operational consequences of any change to the business plan.

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

Although Ka-band uplink spectrum was discussed as a potential band for 5G / IMT-2020 at WRC-15 and rejected, a handful of administrations (outside of Europe) are still considering that band. The entry of 5G / IMT-2020 terrestrial use into Ka-band will disrupt critical incumbent Ka-band satellite services within the 27.5 – 30.0 / 17.3 – 20.2 GHz bands and will jeopardize the billions⁶ of pounds in investments already expended. Perhaps more importantly, such use of Ka-band spectrum would harm UK investment in the space sector by diminishing the regulatory certainty we currently have. However, Avanti believes that studies for a suitable band for 5G / IMT-2020 should be carried out as a matter of urgency in order to signal early enough to the mobile industry a global harmonized band for 5G / IMT-2020. In this respect Ofcom must take particular care to avoid deployment of any 5G / IMT-2020 in Ka-band frequencies as this would totally undermine the CEPT work. This was also reflected by the recent UK input to CEPT group ECC

⁶ Available at <http://siaorg.siteprotect.net/wp-content/uploads/2014/09/SSIR-September-2014-Update.pdf>.



PT1⁷ to consider the focus on the 31.8 – 33.4 GHz due to a number of advantages as an initial band above 24 GHz for 5G/ IMT-2020, including:

- It received support from all regions at WRC-15;
- It is lightly used globally and therefore it has a higher chance than any other band to become a global harmonised band for mmWave;
- There is potential for early availability of this frequency band;
- The in-band co-existence studies are likely to be relatively straight forward;
- Up to 1.6 GHz of spectrum is available.

It should be highlighted that the mobile terrestrial sector has identified different bands for different needs. Clearly, the coverage needs for deploying 3G/4G networks requires lower frequency bands identified in WRC-15 agenda item 1.1/1.2, whilst 5G / IMT-2020 spectrum needs for very high capacity links that require large contiguous bandwidth naturally leads towards mmWave bands in higher frequencies.

Technological advances in beamforming, phased antenna array deployment in mobile devices, and other areas have made the use of mmWave spectrum for terrestrial mobile broadband achievable. Samsung has already determined that a low-power base station can provide 1 Gbps service using 1 GHz of bandwidth at 38 GHz⁸ over a cell radius of tens to hundreds of metres. Considering the inherent characteristics and close proximity of the frequencies, it is quite conceivable that 5G / IMT-2020 services in the 31.8 – 33.4 GHz mmWave spectrum are a very promising option. Moreover, beamforming techniques—which are feasible for relatively small antenna arrays at these high frequencies—can mitigate propagation loss.

Avanti therefore encourages and endorses the UK's recent submission to PT1 to focus on a smaller number of bands and to make sure that satellite bands are protected in order to enable the sustainable and viable growth within the satellite industry.

Question 12: Do you agree that existing bands are likely to provide sufficient capacity for considerable growth in earth observation data downlink and that we do not need to prioritise the identification of new bands? Do you have any comments on the analysis we have undertaken of supply and demand scenarios?

Avanti has no comments

Question 13: What other specific actions should we be considering to facilitate earth observation data downlink?

⁷ <http://www.cept.org/ecc/groups/ecc/ecc-pt1/client/meeting-documents/>

⁸ "A Novel Two-Slope mmWave Channel Model Using 3D Ray-Tracing Technique in Urban Environments", submitted to IEEE PIMRC 2014; M. K. Samimi, et al., "Ultra-Wideband Statistical Channel Model for Non Line of Sight Millimeter- Wave Urban Channels," submitted to IEEE Globecom 2014.



Avanti has no comments.

Question 14: To what extent will access to suitable spectrum for TT&C enable greater use of small satellites and why? Do you agree with the specific actions we have identified and what else should we be considering?

Avanti has no comments.

Question 15: What other actions should we be considering to support long term predictability of access to sensing bands?

Avanti has no comments.

Question 16: Are there other actions we should be considering that could enable greater benefits from earth observation?

Avanti has no comments

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

Avanti supports Ofcom's vision to supporting existing benefits, predictability of spectrum access to provide an environment where operators can continue to invest in services which will provide benefits to citizens and consumers in the future. First and foremost, any sharing policy should allow for future growth and enable sustainable access of satellite services and avoid the restriction of certain bands or preventing the introduction of new satellite services.

Although the Ka-band uplink spectrum was discussed as a potential band for 5G / IMT-2020 at WRC-15 but was not approved by the ITU decision in Resolution 238, a small number of administrations which are not within the CEPT region are still considering that band as a potential band for 5G / IMT-2020. Avanti would also like to commend Ofcom's commitment to promote good practice internationally, through the CEPT and ITU by following the outcome of Resolution 238 and advocating for the bands listed in this outcome as the only possible bands to be considered for studies (please see answer to question 11). This should be of particular relevance when Ofcom participates in studies on bands above 24 GHz for potential use by terrestrial mobile services.

In this regard, Avanti brings to the attention of Ofcom that so far studies made by Inmarsat⁹ show that sharing within the Ka frequency band between 5G / IMT-2020 networks and satellite systems could result in harmful interference to satellites. Where the aggregate interference

⁹ <http://apps.fcc.gov/ecfs/comment/view?id=60001488878>



from IMT base stations deployed in urban areas will exceed the interference threshold of an Inmarsat's Global Xpress satellite. In respect of other more sensitive Ka-band GEO satellites, the aggregate interference from IMT base stations deployed will exceed the interference threshold even further. The matter is even more concerning when interference from multiple densely populated cities and its surrounding areas within the satellite's spot-beam are taken into consideration.

Therefore, Ofcom needs to be continually alert to risks to the satellite operators serving the UK in the Ka-band frequency. As evident by the specific example mentioned above as it runs a high risk of causing interference to satellite operations in the same band, which could cause interference to the signals received from UK users and would in any case reduce the overall efficiency with which the Ka-band can be used, thereby increasing costs for all operators and users.

Question 18: Do you agree that the applications we identify do not need to be a particular focus for regulatory action in the short to medium term?

The applications that Ofcom refers to here are:

- Higher resolution broadcast TV content
- Satellite navigation and positioning
- Machine-to-machine communications and the 'Internet of things'
- Safety-related communications

Avanti agrees that no particular regulatory action is current identified.