Ofcom "Call for Input":
Spectrum Review: A review of the management of the spectrum currently used for point to point fixed links and other services that share this spectrum.

Introduction
ViaSat Inc. (NASDAQ: VSAT) is a satellite and digital communications provider, specialising in satellite network and antenna systems. Its primary service offerings are global mobile satellite services and satellite broadband services in the US and Europe. ViaSat offers high-speed Ka-band satellite broadband, featuring ViaSat-1, the world's highest capacity satellite.
ViaSat is grateful for the opportunity to respond to this consultation. Given the number of questions asked, we have only answered those questions which fall within the range of our immediate interests. We understand that Ofcom intends to consult further on these matters and we look forward to continuing participation in this process.

ViaSat has interests in several European countries, including the UK through subsidiaries in Dorset, UK and in the Isle of Man. Further, one of ViaSat's satellites, used to provide service in North America, is actually operated under a radio frequency assignment which was filed with the ITU by the UK. However, at this time, ViaSat does not hold any licences under the Wireless Telegraphy Act to provide radio services in the UK, although this may change in the future as ViaSat's European business expands and evolves. Our main European interests are as an equipment provider, and provider of services such as network management. In North America we provide satellite network services, and this is extending to terminals on international mobile platforms. Although we do not have our own hub in Europe, we do have agreements with a number of teleport operators who provide this facility, and European and international satellite operators, which enable the operation of terminals on ships and aircraft as part of our international, vehicle-based "mobility" networks.

Response to Call for Input:
1 What are likely to be the key underlying factors influencing changes in demand for this spectrum (in terms of quantity of spectrum or preferred bands) over the next 5 to 10 years? Please provide band-specific evidence to support your view.
Although it is not possible to provide a comprehensive answer to this, there are certain sectors and services in which we are seeing very strong growth and for which this strong growth appears likely to continue. These are – in no particular order – HDTV, consumer broadband, and "mobility" services providing TV, Internet and other services to road vehicles, trains, ships and aircraft. Other specific applications in which growth appears likely include increased use of electronic document exchange or "EDI" within corporate and commercial networks, again including both fixed and "mobility" services, and within the context of "narrow-band" services, increased asset-tracking and monitoring, particularly for environmental monitoring and enforcement.

2 Will the reducing trend in the numbers of fixed links in the spectrum under review to support mobile backhaul continue? If so, in which bands will this reduction be most apparent and how will link capacity/bandwidth requirements change? What factors will have the biggest influence on the outcome? In your view, what will be the impact on spectrum demand, of developing next generation mobile networks, for example using Long Term Evolution (LTE) standards?
We offer no comment in response to this question, but we draw attention to the example we describe in our answer to Question 8 and Question 10.

3 How might the changes to current of future public safety networks influence the existing and future requirement of the spectrum under review for fixed link backhaul for public safety applications over the next 5-10 years? In which spectrum bands is demand most likely to arise and how much spectrum would be required? May demand for bands currently used by public safety applications decrease? Is it likely that the public safety services may require access to the spectrum under review for other data networks or for alternative uses?
We are unable to comment at this time.

4 How likely is it that use of CCTV by local authorities will significantly increase overall demand for fixed link infrastructure over the next 5 to 10 years? If so, in which bands is the additional demand most likely to be required and why? Do you have any information about the relative costs of wired and wireless CCTV links in urban and rural areas?
We are unable to comment at this time.

5a What are the main factors (technical or regulatory) that determine preferences for one band over another for satellite applications? Do these factors vary between different types of satellite applications (Fixed, Mobile, Broadcasting and Science services)? In which bands will we see the most significant changes in demand in the next 5 to 10 years, and why?
Certain bands are more suitable for certain applications than others, and in some areas, the necessary technology is well developed but in others, further work is needed before those bands become viable for satellite services. The robust nature of the C Band is well known, and technology to exploit the Ku Band is also mature. Most of our current commercial offerings are in the Ku Band, although our modem technology can also be used in other bands, and our spread-spectrum system facilitates sharing with other services. Our main consumer offering in North America is in the Ka Band, and we have provided support to other operators and providers elsewhere, including in Europe, in the development of the Ka-Band systems which are now being deployed.

As we describe in more detail below, as well as "fixed" services we are seeing very strong growth in "mobility" services, where FSS spectrum is used to transmit and receive signals from mobile or nomadic platforms, typically earth stations on vessels or aircraft, but increasingly trains and road vehicles as well. Although the technical and regulatory requirements for Ka-Band fixed terminals in Europe are fairly well established, and the framework for C- and Ku-Band mobility systems is maturing, the deployment of Ka- Band mobility services requires additional work which is still ongoing. ViaSat and others have been particularly active in supporting this work, which has included the development of standards for "Earth stations on mobile platforms" at ETSI, and continuing work on sharing studies which is being conducted by CEPT/ECC, particularly project teams SE40 and FM44: as this work has not yet concluded, we would caution that although there is a need for Ofcom to plan ahead and see what spectrum demand will be like in 5-10 years' time, in this instance, it might be better to wait for the outcome of the ECC's work on these issues.

Similarly, although ViaSat and other companies continue to conduct and to invest in research and development work, at this stage, it is not clear when the technology needed to exploit higher bands than the Ka Band will be mature enough for commercial deployment.

5b A number of the frequency bands under review are currently used for satellite Permanent Earth Stations (PESs), for example to feed Direct to home satellite broadcast services. What are the continued and future spectrum requirements for satellite PESs (E-s & s-E) likely to be and in which bands? Please provide evidence to support your views.

Please also see our answers to questions 5a above, and to 5c and 5d below. Although we do not have a hub in the UK, we would note that the sort of earth station included in Ofcom's definition of PES would not only be used for DTH feeds, but is also highly likely to be capable of acting as a hub station for a network of outlying terminals such as VSATs, or terminals on mobile platforms. Although the UK and many other European countries encourage the use of the FSS "exclusive" band for this sort of terminal operating in the Ku Band, internationally many of these operate in the C Band, or the shared Ku band, and increasingly, in the Ka Band. Therefore, it is highly likely that the hub will be operating in the same band. As we are seeing strong demand for these terminals in all current bands, it can be concluded that associated requirements for and by hub stations, or PESs more generally, is unlikely to decline from current levels and is more likely to increase, even as some services may move away from using satellite as a solution, so they are replaced by new services.

5c During recent years, some commentators have forecast significant demand for spectrum to support satellite consumer terminals. To date this demand has been slow to materialise. Do you have information which would help inform a more accurate assessment of future demand for spectrum in bands currently shared with fixed links?

ViaSat equipment and satellite bandwidth supports other networks and applications which are used to deliver reliable, high-speed Internet access to seagoing vessels over the vast majority of the busiest maritime corridors. One particular product, with over 1000 terminals shipped in the last three years, is believed to be the fastest growing maritime VSAT broadband system in a sector which is expanding rapidly and where growth looks likely to continue steadily (see for example, Stark Moore Macmillan's research into the maritime VSAT sector published in 2011, which examined the likely take up of VSATs in general by the global merchant fleet; however we would also note that larger pleasure craft, non-international vessels and fishing vessels are also a substantial potential market, but are not included in merchant fleet statistics). Operating on ViaSat's Yonder® network in the Ku Band, we have found demand increase rapidly for its services. ViaSat expects more commercial business customers especially in the oil and gas, and cruise industries.

Other service offerings in the Ku-band include a similar "mobility" offering the aviation industry which is also continuing to see increased international interest from airlines and aircraft operators seeking to increase their own operational efficiency and at the same time improve the quality of services they can offer to passengers. In both of these cases (aeronautical and maritime) the satellite system is used to provide connectivity when terrestrial networks are out of range (due to distance offshore, or altitude). However, in some applications, these satellite links are also used to provide backhaul for wireless connections in other bands, such as traffic from consumer mobiles through on-board cellular systems, thereby using spectrum which could otherwise be regarded as fallow under the circumstances (and so, increasing efficiency overall). Whilst these services are provided in response to clear indications of demand, it also appears that in some instances "supply creates its own demand"; in reality this only highlights where demand had not yet been identified.

These existing services are operated in the Ku Band but our North American service is in the Ka Band, and as is being seen in Europe, the Middle East and elsewhere, future systems and services are likely to use the Ka Band where conditions permit it. The satellite industry is subject to long lead times, and it takes time from an international allocation being made to a particular service,

to that service emerging into maturity. This apparent delay is not necessarily a reflection of the volume of demand, or likely speed of adoption – the technology has to be developed, international allocations have to be transposed in to national regulatory requirements, the international agreement to deploy the spacecraft must be obtained, and so on.
Please also see our other answers within question 5.

5d Are there factors specific to the satellite based communications sector which mean that it faces particular difficulties evidencing and satisfying demand for spectrum? If so, how might these be overcome?

There are many factors which set the satellite communications sectors apart from other sectors in the industry. Space does not permit a complete and accurate description here, but two indicative and non-exhaustive examples of the particular circumstances faced are described below.
Identifying Consumer Demand:

The satellite industry faces challenges which are in some respects similar to those which Ofcom is trying to address in this Call for Input.

When planning satellite networks, the industry is subject to long lead times, and requires long periods of regulatory certainty during which to develop the necessary technology, demonstrate its capability, and to build and launch the spacecraft. Even then, once launched, the main radio characteristics of the spacecraft cannot be changed, so the need for regulatory certainty continues through the life of the spacecraft (15 years is a normal expectation at present, but each generation of satellites has substantially longer service life than that before it).

Predicting consumer demand, and the speed of adoption is inevitably difficult and the reality when a network is deployed can sometimes differ from what was anticipated during planning and development. In the case of our North American service, take up was faster than expected and revealed a substantial amount of demand which had not been identified or met until that point. We describe this in more detail in our answer to question 10.

International Nature of Resource and Regulatory Frameworks:
The demand for spectrum which such terminals create is not necessarily demand for spectrum "in" that particular jurisdiction – the vast majority of satellite networks are inherently international, and the nature of the satellite communications industry, including the regulatory requirements of the ITU, increases this "international" characteristic. For example, in the case of our North American service, provided to customers in the United States and Canada, we are subject to regulation in both of those jurisdictions, we also have a service partner in Canada who is subject to Canadian regulation, and our satellites are covered by the regulatory frameworks of both of those jurisdictions, one of the satellites is notified to the ITU by the UK and is subject to the UK's regulatory requirements on this, and both satellites are covered not only by the requirements of the ITU but also the international framework for activities in outer space.
The international nature of the spectrum assigned to satellite services, and the need to secure international agreement for its use, means that the choice of spectrum available to satellite operators is limited, effectively a supply-side factor which also influences demand for the limited number of bands which are available in regulatory terms, and can be exploited by reliable and affordable technology.

The demand for spectrum cannot be examined in isolation as the spacecraft has to be located in a suitable position in orbit, thus the concept reflected in the ITU's basic texts is the "spectrum/orbit resource". Satellite operators need to secure international agreement for the use of the satellite. Assignments are recorded by the ITU "first come, first served", and this essentially determines

the order in which international negotiations ("coordination") to reach agreement on the use of satellites is conducted. By locating satellites at different locations, the same spectrum can be used more than once. Similarly, other techniques such as coding, the use of spot-beams, and different polarisation, not only enable sharing and coordination agreements between different satellite operators, but also enable more efficient use of the spectrum, and minimise interference. The international nature of the spectrum/orbit resource, and the regulatory frameworks for its exploitation, means that national or sub-regional deviation from these internationally agreed norms and regulatory frameworks can substantially undermine the viability of satellite services.

6 What is the likely timetable for rollout of Smart Grids and what impact will these developments have on demand for spectrum in the bands covered by this review?
We offer no comment at this time.

7 What impact will DAB expansion have on demand for the spectrum under review? Are there any other demand drivers that Ofcom should consider in relation to broadcasting use or services related to broadcasting?
We are not able to comment at this time.

8a What is the likely demand for broadband wireless access applications in the spectrum under review and which bands is this likely to specifically impact? How should Ofcom consider the demand for backhaul to support such applications and is such backhaul demand likely to arise in the spectrum under review?
8b Do you consider that the emergence of rural broadband fixed wireless access will influence overall demand for the spectrum under review and to what extent? Which bands is this likely to impact most?
Questions 8a and 8b: please see the example described in our answer to question 10 below.

9 Do you consider that there will be a material additional demand from the PMSE community for access to the spectrum under review? Which bands under review is likely to impact most and to what extent?
We understand that in the UK, much spectrum used in programme-making and special events is managed, and assignments are made, by a specialist organisation and we offer no comment on their work. However, in this we would also note the role of satellite-newsgathering, which shares many similarities with PMSE, but is also dependent upon an FSS link from the field to the television company for inclusion in the main broadcast.

ViaSat's interest in this is essentially as an equipment manufacturer, and we would note the worldwide use of the C and Ku bands for SNG, and the rising use of the Ka Band. In addition, these live feeds are increasingly moving towards high definition (HDTV). The problems of sharing between these short-term and time-limited operations from known locations are simpler to solve than more complex sharing issues posed by mobility services, and long-term/permanent installations, and the current online clearance system provided by Ofcom is a useful tool to facilitate this.

The London Olympics 2012 will be a substantial and significant demand-factor: substantial because it is a major global event which will require live coverage, and significant because it should provide Ofcom with an opportunity to review statistics of not only PMSE use, but also the "SNG" element of the FSS links used, and we would expect that these will in many instances be international in nature, even when the actual recording and transmission many be done by domestic (UK) contractors.

10 How might the economics of new fibre provision (with or without reliance on regulatory remedies – whether active or passive), as compared with wireless provision of both terrestrial and satellite based services, impact on the requirements for wireless backhaul? We are interested in the possible impact, in terms of the extent of possible substitution for wireless links and in terms of the nature of wireless links affected (urban v. rural, lower/higher frequency bands).

As other respondents have probably noted, in many areas relatively rapid infrastructure upgrades to provide higher-speed internet connection has been achieved in two ways, by upgrading urban fibre networks, particularly providing higher-speed access to businesses, and by deploying satellite based systems in rural and remote areas, either to provide individual high-speed access to homes and businesses, or to provide backhaul for larger community-based projects. The conundrum in such cases is how to upgrade networks in the suburban context, particularly in the residential context, and finally, the "last mile" problem. The assumption, perhaps quite reasonably, has been that when urban fibre upgrades are complete, so the suburbs will be upgraded in a short time afterwards.

To a certain extent, these were some of the assumptions underpinning the rollout of consumer broadband services in the Ka Band in North America, including our own project and those of other operators, including one whose business is now part of our own. In fact, not only was the take up of these new services much faster than was anticipated, it also became apparent that rather than the relatively high proportion of rural and remote connectivity which had been anticipated, the majority of this rapid demand was from suburban and outer-suburban customers. The consequence was that the pioneering satellites offering these services were "full" in far less time than had been anticipated. In addition, estimates suggest that total global bandwidth consumption is doubling every two to three years. This, in turn, has led to increased innovation and the development of a new generation of satellites with vastly increased capacity, "high throughput satellites" such as ViaSat-1. On its entry into service in January 2012, this was the highest-capacity satellite yet launched, although we anticipate that higher-capacity systems will follow. In brief, with 140 Gbps total throughput capacity, the new satellite can serve the accelerating growth in demand for multimedia bandwidth for the next decade with these attributes:

- Economically deliver Internet multimedia
- 100 times the capacity of Ku-band
- 10 times the throughput of any other Ka-band satellite
- In-orbit costs per Gbyte only a fraction of even the newest satellites in orbit
- More – and cheaper – bits in space
    - Nearest comparable capacity operational now at 70 Gbps
    - ViaSat-1 has more capacity than all current North American satellites combined
- Enable service on par with median DSL and a better broadband choice than some terrestrial alternatives, including DSL at the edge of service areas, mobile 3G wireless for fixed home use, and many cable systems
- ViaSat-1 to offer 12 Mbps download service packages to approximately 1 million subscribers

11 What issues relating to spectrum access for different services do you think Ofcom should review? How might Ofcom start to rely more on commercial decisions when determining allocations of spectrum in the bands covered by this review?
12 We would welcome views on the potential for more widespread use of market based approaches to the spectrum under review such as third party band management, and the regulatory steps which would need to be taken to facilitate this.
We will attempt to address questions 11 and 12 together. The fixed-satellite service can already demonstrate market-based approaches to the spectrum which it uses, and these show certain similarities to "third party band management", albeit within a limited scope of application, and as a means of promoting efficient use of spectrum within the network, rather than because of any regulatory reason. However, this is not the same as spectrum trading, and the scope of "liberalisation" and alternative licensing models such as recognised spectrum access, which Ofcom has proposed in the past.

For example, as well as the North American service described above, elsewhere we adopt a slightly different business approach, but one which is common in the satellite communications industry. Although we are not a global satellite operator, we do lease capacity or "space segment" from other satellite operators, and agreements with earth station hub operators around the world which operate with those operators' satellites, and then in turn sell our equipment to other networks operators who provide services to their customers. Although the exact terms of these agreements will vary according to their particular circumstances, the result is that the end-user has "connectivity" and the satellite operator and hub operators are able to manage the actual spectrum used to take account of local (national and regional) regulatory requirements, and ultimately use the spectrum available to the most efficient level possible.

In these cases, "regulatory requirements" essentially means local and regional variations and restrictions on spectrum use, including where the prior agreement of other satellite operators (or in some instances, terrestrial operators) may have been reached before the satellite or earth station was deployed, and it means that the network as a whole must assign and reassign channels. Overall, this approach is one of practical necessity and network management, in order to ensure the most efficient use of the resources available. We do not see that the introduction of a third party band manager would bring any additional benefits under these circumstances, or in cases where coordination is needed with other satellite operators, or other services sharing the bands, which often features negotiation with those other operators.
We have described above the work which is being undertaken elsewhere (particularly at the ECC), and in which we are involved, to address questions of sharing in the fragmented Ka Band.

13a Do you consider that any changes should be made to the Ofcom licence fixed link product set?
We have no suggestions to make at this point, but we will consider this further, particularly in the light of any clear suggestions which may be made in future consultations.

13b Might a more flexible approach to licensing, in bands where demand is unlikely to exceed supply for the foreseeable future, enable more intensive use of these bands? If so, what form might the licensing take and in which bands would this be appropriate?
We have no suggestions to make at this point, but we will consider this further, particularly in the light of any clear suggestions which may be made in future consultations.

13c Are there other actions which Ofcom could take to improve spectrum efficiency by encouraging migration to or use of higher, less heavily used, bands, with a view to freeing up spectrum in popular lower frequency bands?

The "popular" bands are not "popular" without reason, and as we have described above technological factors, the laws of physics, and matters such as meteorology all combine to make some spectrum more suitable for certain applications than other spectrum, particularly the C Band. Some systems and services are easier to migrate than others – satellite services are by nature international, relatively long-lived and are not "nimble" enough to be migrated quickly. Conversely, some of the bands above Ka Band are good candidates for the provision of high-capacity short-range links, such as for local "hot spots" with backhaul provided by other means.

14 What is your view on the impact of geographically uniform fees for spectrum bands included in this review? If you consider that a geographic fee modifier would promote more efficient use of spectrum, how might that modifier be constructed?

Although we do not currently hold any radio licences in the UK, this suggestion, which implies also a geographically-limited form of licensing more broadly, might offer some scope for better flexibility and sharing between services. We would welcome the opportunity to explore this further in a future consultation if one is held.

15 Are there other aspects of the review on which you have evidence that would help inform our consideration of these issues and formulate proposals for consultation?

16 Is the proposed list of bands to be included within the review (as set out in Figure A.5.1 in Annex 5 appropriate?

We have no further comments but understand that this is a continuing process and will be glad to remain part of it. We look forward to participating in further consultations in the future.