ESOA response to the UK Department for Digital, Culture, Media and Sport (DCMS) regarding its call for evidence on the Future Telecoms Infrastructure Review (FTIR)
30 January 2018

ESOA[1] (the EMEA Satellite Operators Association) welcomes this call for evidence from the Department for Digital, Culture, Media and Sport (DCMS) regarding the UK's future telecoms infrastructure needs[2]. Back in 2016, ESOA provided a response to the National Infrastructure Commission's (NIC's) call for evidence regarding 5G development, and ESOA has long been an active responder to Ofcom's consultations regarding spectrum for the UK's digital future.

Satellite communications will be an integral and critical part of future Internet ecosystems, and true geographic ubiquity of mobile broadband can only be achieved through a 'network of networks,' an ecosystem of technologies in which all kinds of satellites (both geostationary and non-geostationary) will play a major role. Satellite communications already today delivers mobile backhaul, push data services, linear and non-linear TV, converged media, broadband services and many M2M services that will be part of the 5G ecosystem in Europe and world-wide. In the future, consumers of 5G services will also expect to be able to use their devices in aircraft, ships and vehicles and in remote areas; and the continuity of 5G networks will be critical in times of natural disasters or terrestrial network outages. Satellite communications is a means to support these important aspects of 5G deployment scenarios.

DCMS has asked for evidence to help it consider five major questions, and ESOA is pleased to offer its response to each question set out in this consultation. As an introduction we also think it is prudent to highlight the innovation in the satellite industry that will make satellite an integral part of any future infrastructure development for the UK. In particular, three technological breakthroughs allow satellite to support present and future requirements on future telecom infrastructure of the UK.

[1] ESOA is the world's only CEO-driven satellite association, and leads a coordinated and impactful response to the global challenges and opportunities the commercial satellite communications sector faces. Established as a non-profit organisation, ESOA has as its objective to serve and promote the common interests of satellite operators. Today ESOA represents the interests of EMEA satellite operators who deliver information communication services across the globe. The activities and other details about ESOA can be found at www.esoa.net

[2] Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/663060/Future___Telecoms___Infrastructure Review- terms of reference.pdf

High-throughput GEO and MEO satellites

New generations of high-throughput satellites, at both geostationary and non-geostationary orbits, are delivering order-of-magnitude improvement in data rates and capacity. Today, geostationary high throughput satellite (HTS) networks are operating on a global basis and can provide broadband service to end-users with speeds of 25 Mbps and higher and non-geostationary satellites at Medium Earth Orbit (MEO) can deliver 10 times the throughput of the previous generation of satellites. With multiple spot beams and digital payloads able to be flexibly configured, these satellites are designed to also support mobility. Broadband GEO satellites are under construction that operate in the millimetre wave bands and will offer speeds of 100 mbps. This means consumers, wherever they live, can obtain access to high quality high speed broadband services with high capacity.

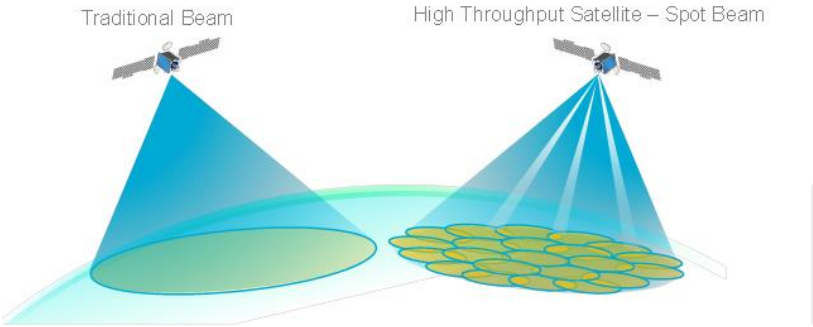

Figure 1: Difference between Traditional Satellite Beam and HTS Spot Beam

Low-Earth orbit (LEO) constellations

The MEO and LEO satellite systems can provide broadband trunking and backhaul capacity that rivals fibre, offering speeds up to 2 Gbps and latency below 150 ms round-trip to large end-users such as Fixed and Mobile Network Operators. Some of the LEO systems are designed to have latency below 20 ms, with 50 Mbps delivery to homes and offices.

New antenna technology

A key dividing line between satellite and terrestrial networks is softening. Developments in terrestrial wireless networks and services are influencing the prospects for satellite services. In the past, the establishment and configuration of services across satellite and terrestrial segments was mostly performed manually and in a static way. Today, the delivery of services and content over networks calls for new types of partnership arrangements and for a unified end-to-end control and management, agnostic of the communications technology used.

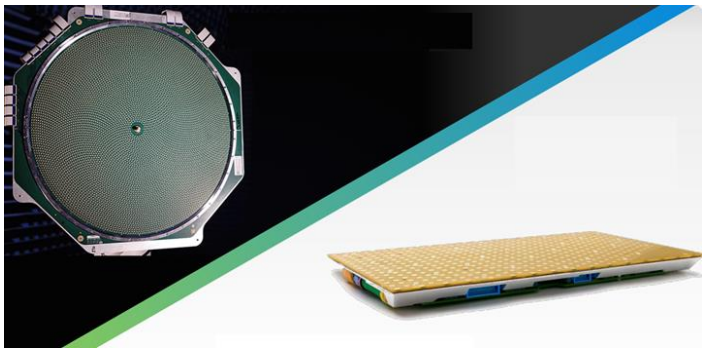

Figure 2: Examples of antenna array antenna technology

Such antennas offers electronic beam-steering performance of a typical phased-array antenna, with much lower power consumption offering a dramatic cost reduction compared to mechanical products and many of the size, weight and power challenges associated with the existing techniques are alleviated. No longer will accessing satellites require traditional equipment with high power requirements for the user; new technology is unlocking the full potential to track satellites while also being portable enough to attach to a vehicle or take into the field.

1. What is the existing UK telecoms market structure and policy framework able to deliver?

ESOA notes that the UK's market structure has already supported development of national infrastructure for smart traffic management (STM) and intelligent transport systems (ITS), which are two of the most transformative new technologies, and which are already delivering real world benefits to British citizens. By making make full use of the data produced by transport systems and networks, they improve safety, efficiency and security, as well as reducing the transport sector's environmental footprint. Recent innovations in satellite technology used to deliver STM and ITS services, focusing on advances in satellite and antenna technology will ensure satellite technology is recognised as a key enabler of STM and ITS services in any future assessment of the UK's infrastructure needs.

- ***When will it deliver, and how certain can we be that it will fulfil the Government's ambitions for full fibre networks and 5G deployment?***

Last-mile fibre penetration is expected to remain low in Europe. The drivers in the satellite channel are, however, different than those in cellular or fibre depending on the satellite orbit. There is much to be gained from an interworkable and integrated system which uses as much commonality as possible with terrestrial, such as implementing software, for example.
Satellites are the most cost and energy efficient content-delivery infrastructure when it comes to distributing content to large territories and/or a large number of recipients. The key will be to include the satellite links into the 5G infrastructure resource level with the configurations for satellite gateway and user terminal into the 5G business enablement level.
Wireline systems will only be able to satisfy the UK target value of 24Mbit/s for those closer to the exchanges and thus there is a role for satellite HTS technology in both suburban and rural areas. Satellite systems will clearly be preferred for suburban and rural areas, where fibre will be slow to roll out and is critical for public protection and disaster relief when the terrestrial infrastructure may not be available, as was seen during the 2017 Hurricane Season.

- ***What will this mean for roll-out of these technologies and for competitive models in different geographic locations?***

Satellite systems essentially tackle the coverage challenge and are global in nature. They are not a competitor to higher rate delivery as provided by 5G in urban areas, but rather complement 5G by extending the coverage of services. Traditionally satellite has three key strengths which can be summarised as follows:

- Ubiquity: The signal can be received virtually everywhere within the coverage beams
- Resilience: Satellite systems are largely immune to the impact of natural and manmade disasters because of their limited reliance on terrestrial infrastructure
- Mobility: The signal can be received by users on the move
- Simultaneity: The same signal can be received by many end users at the same time

This makes it clear that satellite can and will play an important role in the 5G network as illustrated in Figure 1 below which illustrates many of the ways that satellite communications can form an integral and critical part of the future Internet ecosystems. A large number of satellite interworking and integration scenarios[3] can be envisaged including:

- Satellites in the backhaul or even the fronthaul;
- Satellites as a means to deliver intelligent content;
- Satellites to provide ubiquitous control plane;
- Satellites to provide an IoT overlay;
- Satellite broadband in edge cases (underserved areas, mobility for maritime/aero etc.);
- Satellites as a diverse path for resilience or security;
- Broadcast (separate or overlay).

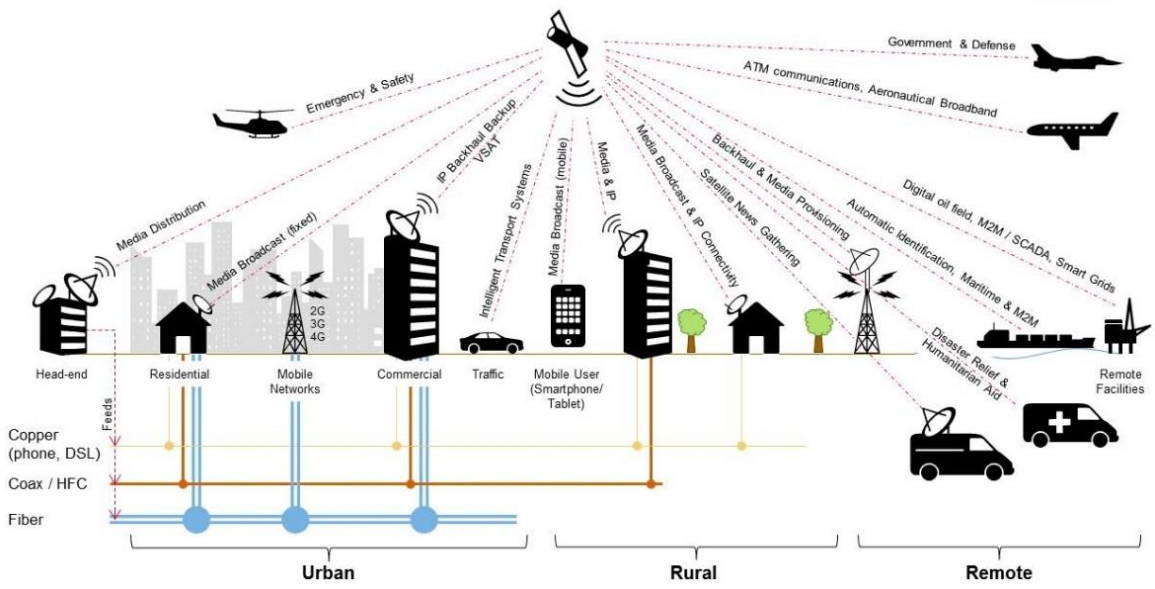

Figure 3: Satellite in the future communication ecosystem [source: Booz&Co]

2. What barriers exist to long term investment in the UK telecoms market (beyond work underway by the Local Full Fibre Networks programme to stimulate demand, and by the Barrier BustingTaskforce to reduce build costs)?

- ***What effect do existing revenue streams have on investment plans?***
- ***What effect do visibility and predictability of returns have on investment plans?***
- ***What is the effect of current infrastructure deployment models?***
- ***What impact do current infrastructure sharing arrangements have on investment?***

[3] These include those that have been mentioned in a number of initatives about the incorporation of satellites in future networks – e.g. see EU research program H2020 SaT5G (https://5g-ppp.eu/sat5g/) or ESA SATis5G project (https://artes.esa.int/news/esa-live-testbed-satellite-terrestrial-integration-context-5g)

- ***What is the impact of the existing relationship between wholesale and retail markets?***
- ***What changes to spectrum licensing and sharing could foster greater innovation and investment in 5G?***

ESOA offers these suggestions to DCMS as ways to ensure the long term contribution of the satellite sector:

- Integrate satellites into the ecosystem: DCMS should adopt a policy of technology neutrality, which will encourage stakeholders to examine multiple potential technologies, including satellites, to best address the connectivity needs and demands of the U.K. For example, the term "5G" does not simply apply to the terrestrial component of that service; "5G" will be an ecosystem, sometimes called a "network of networks," and the satellite industry has been working since an early inception stage within the relevant standards organizations to ensure the inclusion of satellite technology in 5G.
- Protect access to spectrum that is used for both user devices and gateways, both below 6 GHz and above 30 GHz. This is crucial to enable sufficient production volumes and hence minimise the cost of terminals. Spectrum already in use by satellite broadband must be protected so there is long term certainty. ESOA is pleased to note DCMS's desire to preserve satellite usage of some key frequency bands, as stated in their 5G strategy paper[4].
- Improve the efficient use of existing IMT bands below 6 GHz by using new radio access and modulation schemes. DCMS and Ofcom should be ensuring that out-of-band emissions do not effectively prohibit adjacent services from operating.
- Encourage massive MIMO that would be suitable for mmwave systems.
- Spur roll-out beyond urban areas; there is a need to at least address the coverage challenge at an early stage. A goal of less than 100% population and 100% geographic coverage is not acceptable in a country such as the U.K. Satellites can cover the country, and operators should be given market incentives (funding, tax relief, etc.) to use all technologies, to cover all of the U.K.'s people.
- Addressing the backhaul bottleneck when fibre is insufficient or unavailable.

More specifically on spectrum sharing and licensing, it is essential to highlight the following points:

- Ability to share spectrum in the same frequency band depends on technologies and deployment scenarios. This is different for each frequency band with some spectrum still required for use on a primary basis for widely deployed user terminals.
- Sharing of satellite spectrum used for large satellite earth stations (gateways) with individually coordinated and individually licensed terrestrial fixed links (e.g. microwave links for mobile backhaul) is generally considered feasible - and such sharing is already routinely done today
- Sharing of satellite with IMT is generally considered feasible in cases where a specific frequency band is used for large satellite Earth stations at known locations (i.e., gateways) and the terrestrial mobile base stations operate in the same band under an individual license regime (subject to certain conditions). This

[4] "In the context of international harmonisation, the UK does not favour use of the 28 GHz band for 5G mobile in Europe, given the need to protect satellite services at those frequencies" and "the Government wants to **retain C-band satellite services as users of the 3.8-4.2 GHz band**, and **encourages Ofcom to continue to look at appropriate 5G sharing opportunities in the band on that basis only"** – Next Generation Mobile Technologies: An Update to the 5G Strategy for the UK**,** page 19

is typically the case in the 24.25-27.5 GHz band and is possible in some of the higher millimeter wave bands such as 47.2-48.2 GHz.

- Sharing of satellite with IMT is generally not considered feasible in cases where a frequency band is to be used for ubiquitous hand-held mobiles, or high-density deployment of small satellite Earth stations (VSATs or terminals used for consumer broadband, enterprise connectivity, mobility applications etc.). This is typically the case in the 27.5-29.5 GHz band and some of the millimeter wave bands.

3. What can the UK learn from the widespread deployment of fibre networks in other countries?

- ***What factors have led to higher full fibre investment in other countries and how applicable are these to the UK?***
- ***What have been the impacts of fibre roll-out models in other countries on competition dynamics, consumer bills, and risk allocation?***
- ***To what extent can the fibre that has been rolled out internationally be used for mobile backhaul, and what lessons can the UK learn?***

Fibre is not the only technology enabling to provide mobile backhaul. A number of satellite operators and equipment vendors offer services and products to support 3G and 4G backhauls today, and will continue to do so in the 5G ecosystem.

The trend towards greater international collaboration in business and more global manufacturing is likely to continue. Satellite's fixed-cost distribution model for the most popular video or non-video content, combined with the variable cost model of terrestrial networks for connectivity and content, would create the optimal solution for both customers and providers. Rather than filling up broadband networks with the transmission of thousands of copies of the same asset, a caching solution based on satellite distribution to ever cheaper in-home storage could be part of a modern and efficient way of operating broadcasting in the UK.

In addition, satellite is particularly attractive for supporting IOT and M2M uses for both narrowband and broadband uses where the cost of fibre deployment is prohibitive. For example, satellite can be used along utility and other transmission lines to bring important data to the operations centre. Further, satellites are increasingly being used for PPDR uses to ensure that communications are available when the terrestrial infrastructure is unavailable.

4. The Government wants to consider all market models that will facilitate the next generation of technologies.
a. What different market models might work in the UK in the longer term, and what risks and opportunities do they present?

- ***What consequences could different market structures, including ones which support longer pay-back periods, have on the investment environment, competition and outcomes for consumers?***
- ***How might these vary in different geographic areas of the UK, including urban and rural areas?***
- ***Over what timescale could market models be changed, and what policy conditions would be necessary to enable this?***
- ***Are the current arrangements for BT legal separation working effectively? Market models which you may wish to consider in responding could include:***
    - ***Infrastructure competition between different network providers wherever possible***

- ***Collaborative models at an infrastructure level***
- ***Regulatory asset bases, franchise models, cap and floor regimes, a diversified model to account for geographic variation, and/or gain share models for infrastructure provision***
- ***Risk sharing models between infrastructure providers and retail providers***

b. What should Government consider when assessing the potential for migration from copper to full fibre networks?

- ***Over what time period could migration occur?***
- ***What phases might migration be required to go through?***
- ***What would be the pros and cons for markets and competition?***
- ***What would the implications be for different groups of consumers?***

5. The Government wants to achieve its digital infrastructure goals at the least additional cost. How should new digital infrastructure be paid for?

- ***Are consumers (residential and business) willing and able to pay for new digital infrastructure, given its expected benefits?***
- ***What could incentivise investors and shareholders to make long-term investment decisions in telecoms infrastructure?***
- ***What is the potential role of government in stimulating demand or otherwise de-risking new infrastructure investment?***

For satellite, there are some keys to encouraging long term investment. This includes spectrum and orbital certainty, and ensuring there is long-term access to both. Furthermore, the regulatory regime must be technology neutral to allow the development of competition among platform.
In terms of providing service in rural areas through Universal Service Funding, all technologies have to be included and be treated in a neutral manner.

Conclusion:

With the continued introduction of new and innovative satellite services, it is clear that satellite is going to continue to play an increasingly important role in the telecommunications infrastructure. Satellite technology is uniquely well placed to reduce the coverage gaps where terrestrial telecom networks cannot function, ensuring these benefits can be enjoyed by all UK citizens. In addition, satellite technology is the optimum mode of delivery for services such as traffic information, software upgrades and other mentioned above. The reach and scalability of satellite communications make it an extremely cost-effective solution, compared to either existing solutions or the cost of proposed terrestrial infrastructure deployments.
A variety of satellite solutions will be integral to the truly ubiquitous and “wireless” ecosystem that could potentially achieve true convergence in communications. DCMS should ensure that the policies they put in place to encourage the development of the infrastructure needed for next-generation communications do not exclude the vast potential of satellite networks.