Your response

Question	
GSOA's views on meeting future demand for mobile data	GSOA welcomes the opportunity to comment on the discussion paper which Ofcom published on meeting future demand for mobile data. GSOA[1] (the Global Satellite Operators Association), the global CEO-driven association representing global and regional satellite operators, provides a platform for collaboration between satellite operators globally and a unified voice for the sector. Our vision is to help policymakers improve the state of the world by continuously bridging digital, education, health, social, gender and economic divides across diverse geographies and across mature and developing economies. Ofcom rightly refers to the role other technologies play in delivering the services offered by mobile networks, and we reiterate below the need to rely on a mix of technologies to address future demand. Indeed, *"these [other] technologies have different characteristics; their suitability for use will depend on a user's requirements for coverage, data throughput, latency, reliability, security and cost"* which can vary significantly. Existing and developing satellite connectivity solutions in particular will contribute to the capacity and reach of future mobile networks. These satellite solutions will include LEO, MEO or GEO constellations with spectrum usage spanning over L, S, C, X, Ku, Ka , Q/V, W and E band spectrum. As Ofcom raised in their 2021 report on Technology Futures, a key document that is referenced in this discussion paper:[2] "In satellite telecommunications, large geostationary [GEO] satellites remain important. Here, technologies adopted from the mobile sector such as small cell spectrum frequency reuse have enabled higher capacity satellites providing lower cost services. This trend is set to continue with mobile edge computing enhancing both network performance and the user experience for rural residents, and passengers on ships and aircraft[s] (…) constellations of telecommunications satellites deployed in Medium Earth Orbit [MEO] and Low Earth Orbit [LEO] have the potential to increase overall satellite broadband capacity and offer reduced latency services – meaning a more reliable, instant connections (…) The next generation of satellites will be all-electric, software-defined satellites, providing operators with greater flexibility over either the frequencies the satellite operates and/or the capacity delivered in different locations over the lifetime of the spacecraft." The foreseen trends depicted above are already a reality today: GEO, MEO and LEO satellites incl. all-electric, software-defined satellites were launched or are about to be launched in 2022 to reach performance levels that are without precedence.[3] **Satellite in 5G / 6G**

[1] The members, activities, and other details about GSOA can be found at www.gsoasatellite.com

[2] *See* Report: Technology Futures – spotlight on the technologies shaping communications for the future (ofcom.org.uk)

[3] *See* SES-17: Experience endless connectivity | SES

Your response

	Satellite is already an integral part of the 5G ecosystem through the satellite industry's active participation in research, development and standardisation activities, with virtualised and cloud-centric network capabilities becoming commercially available. In addition, specific further standardisation work is being undertaken in dedicated bodies such as for instance 3GPP (System Aspects SA and Radio Access Network RAN groups), ETSI and ATIS (NTN group).[4] This evolution has led to a much-increased ability of satellite and terrestrial systems to operate seamlessly within the 5G ecosystem and thus accelerate the deployment of 5G services to end-users in all geographical areas, whether urban, sub-urban or rural. Satellite can also extend and accelerate the deployment of very high-capacity fibre-like networks. As we note Ofcom's statement that *"[i]mproved coverage and greater capacity will result in access to higher quality mobile internet in more places, where people live, work and travel"*, it is indeed the conviction of GSOA members that satellite communications system can and will contribute to increased 5G reach and capacity. Examples of the most recent 5G-related achievements in our industry include: Intelsat's Global Network is First to Achieve MEF 3.0 Carrier Ethernet Certification for New Performance Tier | Intelsat SES Leads Satellite-enabled 5G Tests | SES INSTANT5G: Avanti and European Space Agency accelerate adoption of 5G with pioneering INSTANT5G project | Avanti Communications (avantiplc.com) SaT5G: Avanti Communications and ST Engineering iDirect Play Integral Roles in Successful Integration of 5G Core Network into Live Satellite Network | Avanti Communications (avantiplc.com) World's First 5G Backhaul Demo over LEO Satellite | Telesat GSOA also maintains that the European vision for future networks is one that is increasingly based on a network of networks in order to ensure that a maximum number of citizens can access 5G and 6G. Satellite networks constitute an essential but often invisible overlay for terrestrial networks to help realise the EU Gigabit society in which millions of connections between people, devices and things will require inter-connectivity and stability at unprecedented levels that terrestrial networks alone cannot deliver for citizens of modern societies. 6G is building on the important work that is being done to bring 5G to the world. While it remains to be seen which use cases for 6G will become widely deployed, 6G will need to incorporate the full range of terrestrial and non-terrestrial technologies that are under

[4] www.atis.org

development if its benefits are to be enjoyed by all. As all previous generations of wireless networks have demonstrated, the use of non-terrestrial technologies is essential for maximizing coverage and bridging the digital divide. Specifically, 6G needs will be best addressed if the capabilities of satellite in terms of coverage and reach, energy efficiency, reliability, resilience and capacity are fully integrated.

The use of satellite networks in 5G and 6G will indeed reinforce service reliability of terrestrial networks by providing service continuity to users. To reduce power consumption, satellite networks are also able to scale 5G networks through the provision of efficient multicast/broadcast resources for data delivery towards the network edges, or directly to the user equipment.

E2E Solutions for Cloud Everywhere

Another important evolution in the satellite sector is the association of the Cloud with satellite. Big players such as IBM, Microsoft Azure or Amazon are counting on satellite to extend the reach of direct access to the Core or access to the Edge, allowing users to connect and have great performance for the applications they need to capitalize on the productivity, scalability and operational agility that cloud computing enables, regardless of geographical barriers. GSOA members are deepening their partnership with cloud players to this end, and in a world where cloud technology is becoming essential to all institutions and companies, it is a key development. See for example:
SES's O3b mPOWER Tapped by Microsoft for Azure Network Cloud Services | SES

Satellite communications platforms in return benefit from much enhanced network agility and security coming out of the cloud functionalities. In particular, cloud technology combined with software designed networks and the expected advent of quantum technology are creating new ways of increasing cyber-security by using space technology, without deploying dedicated and expensive physical infrastructure. GSOA is pleased to reference its report on cybersecurity:
Satellites & Cybersecurity - GSOA - Global Satellite Operator's Association (gsoasatellite.com)

ESIMs, ESOMPs, ESVs

Earth Stations in Motion (ESIMs) and Earth Stations on Mobile Platforms (ESOMPs) () use fixed satellite antennas mounted on aircraft, ships, trains, and vehicles, which enable high speed

broadband services to consumers on the move. ESIMs and ESOMPs represent an extension of terrestrial-only broadband networks: connecting people and businesses while on the move and out of range of terrestrial wired and wireless networks. Thus, ESIMs and ESOMPs are one of the fundamental parts of current and next generation networks connecting business travelers, commuters, tourists, commercial shipping, and energy and natural resource production. ESIMs and ESOMPs also play a critical role in connecting government agencies, such as first responders following disasters, when local communications infrastructure is destroyed.

The increasing demand for broadband services on the move from airline and cruise passengers (mainly millennials and business travelers), as well as the government and enterprise sectors are resulting in rapid growth in the demand for flight and cruise ship broadband internet. Market research[5] indicates that the global connected aircraft market size was USD 4.18 billion in 2019. The global impact of COVID-19 produced a decline of –39.9% in 2020. However, the market is projected to grow again from USD 2.51 billion in 2020 to USD 10.49 billion in 2027, as the demand is expected to return to pre-pandemic levels.

ESIMs and ESOMPs are an application of the Fixed Satellite Service (FSS) and therefore could operate in any frequency band allocated to FSS, whether communicating with GSO or NGSO satellite systems. ESIMs and ESOMPs have been using the Ku-band and C-band Earth Stations on Vessels (ESVs) since the early 2000's. However, ESIMs already use millimetre wave frequencies such as the Ka-band (27.5-30 GHz and 17.7-20.2 GHz) to deliver higher broadband speeds and can use the Q/V-band for even greater throughput in the future.

The World Radiocommunication Conference 2019 (WRC-19) also adopted an agenda item (1.15) that calls for ITU studies on the possible operation of earth stations on aircraft and vessels communicating with geostationary space stations in the fixed-satellite service in the frequency band 12.75 – 13.25 GHz (Earth-to-space), in accordance with Resolution 172 (WRC-19).

Cellular Backhaul

Cellular backhaul provided by satellite is used extensively in several regions of the world to support MNOs efforts to extend their network coverage, both for cellular and mobility applications. Given the technological and business options available for using satellite

[5] *See* https://www.fortunebusinessinsights.com/industry-reports/connected-aircraft-market-101954

backhaul and recent technology innovations such as VHTS satellites and new constellations of NGSO satellites, there is good reason for MNOs to make more intensive use of satellite service for 4G and 5G backhaul. Examples include:
intelsat-MNO-Japan_case-study.pdf
Avanti Communications set to deliver life-enhancing connectivity to millions in rural Africa with launch of Avanti EXTEND - Avanti Communications (avantiplc.com)
Gilat Satellite Networks «SES Selected Gilat to Enable Tier-1 4G/LTE MNO in Brazil to Provide Broadband Connectivity for Education

Broadband everywhere

Satellite provides effective geographic coverage of telecommunications to everyone across the globe. This is particularly the case since a significant proportion of premises are rural or in underserved areas, in locations which satellite has a clear cost advantage in serving. Examples of this role include providing direct to home services to consumers for all uses including education, tele-health, business, agriculture and more. Today satellite also supports government and business broadband needs across the country as well as providing broadband to consumers solutions relying on a combination with Wifi. Examples include:
Tusass | SES
Broadband for all
Providing connectivity in rural maternity clinics in DRC | Avanti
Internet connectivity for Kenyan entrepreneurs |Avanti
Connecting South Africa's libraries | Avanti

Role of Satellite in M2M

Satellite support for 5G and 4G-enabled IoT markets is continuing to grow. In addition to the Inmarsat-MediaTek and Inmarsat-Microsoft IoT partnerships, EchoStar Mobile Limited offers pan-European mobile connectivity for M2M and IoT activities through a wide-variety of solutions. Examples illustrating it include:
Successful trial advances global 5G IoT communications - Inmarsat
Semtech and EchoStar Mobile to Test Satellite IoT Connectivity Service Integrated With LoRaWAN® | Business Wire
hiSky expands its cooperation with Avanti Communications, offering satellite IoT network as a service over UK and Scotland - Avanti Communications (avantiplc.com)

Spectrum Considerations

GSOA commends Ofcom for their recognition that: *"Overall, we anticipate that existing mobile spectrum holdings and spectrum*

already planned for release are likely to be broadly sufficient to meet future demand to 2030" – subject to more efficient spectrum use and full exploitation of the mmWave frequencies at their disposal. As Ofcom recognizes, the 26 GHz and 40 GHz bands have been identified in Europe as priority targets in this regard.

It is clear that the mobile industry has obtained harmonized access to a lot of spectrum within the past years. As a result of WRC-19, more than 17 Gigahertz of radio frequencies have been opened to IMT for 5G communications. Given how little some of these frequency bands have been used so far, there is a legitimate reason to feel that this is also enough to cover most spectrum needs for 6G, especially when considering the refarming of spectrum that will result from the progressive switching off of 2G and/or 3G services across the world.[6]

Satellite Role to be Enhanced at WRC-23

Today, Earth Stations In Motion (ESIM) are being used around the world by airlines on thousands of planes, by the maritime sector on cargo, tanker, ferry and passenger vessels, and for public and private transportation on trains, buses, emergency response vehicles and other motor vehicles. The increasing demand from airline and cruise passengers, government and enterprise sectors are resulting in a rapid growth in the demand for flight and cruise ship broadband internet.

In 2023, the member states of the International Telecommunication Union (ITU) will meet at the World Radiocommunications Conference (WRC-23) to amend the ITU Radio Regulations. At that meeting they will consider establishing globally harmonised frequencies in both Ku and the Ka-band for ESIMs communicating with geostationary orbit (agenda item 1.15) and non-geostationary orbit (NGSO) satellites (agenda item 1.16), as it did in 2019 for Ka-band geostationary orbit (GSO) satellites. This will enshrine a global framework for ESIMs and encourage more competition and lower latency for broadband services enabled by ESIMs as well as recognizing the convergence of this technology under the single 'ESIM' acronym.

It is important to note that there is no substantive difference between NGSO and GSO in terms of coexistence with other services. Indeed, many countries make no distinction between GSO and NGSO with respect to any applicable earth station

[6] The US in October 2021 have announced their plans to stop 3G: Plan Ahead for Phase Out of 3G Cellular Networks and Service | Federal Communications Commission (fcc.gov)

authorisations. In fact, countries need not wait for WRC-23 resolutions to enable Ka-band NGSO ESIMs operations in their territory. There are numerous jurisdictions that already permit ESIMs communicating with NGSO constellations using the Ka-band, including Argentina, Australia, Canada, New Zealand, Nigeria, The Bahamas, the United States, and member states of the European Conference of Postal and Telecommunications Administrations, just to name a few.

In terms of procuring the proper operation of satellite networks worldwide, WRC-23 Agenda Item 1.2 plays a determining role. This item seeks the identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz, and 10.0-10.5 GHz to IMT.

3 300-3 400 MHz

(Placeholder for comments from stakeholders if any)

3 600-3 800 MHz

The frequency range 3600-3800 MHz is globally allocated to the Fixed Satellite Service (FSS) on a primary basis, with characteristics supporting resiliency and cost-effective operations for end users. Countries in the Americas (Brazil, Colombia, Mexico, Peru and many others) rely on satellite services operating in part or all of this frequency range for a wide variety of essential services, including broadcasting, emergency response, air traffic control and management networks, maritime solutions, and rural connectivity. Although WRC-23 Agenda Item 1.2 considers identification of the 3600-3800 MHz to IME, existing IMT allocations below this range and in other mid-band frequency ranges are sufficient to meet 5G use case deployment goals for the foreseeable future.

C-band spectrum is unmatched for comprehensive, wide area coverage with the implementation of hemispherical and global coverage beams which are implementable thanks to the specific favorable propagation characteristics of the band. The wide area coverage simplifies the ground infrastructure required to provide connectivity between remote points and contributes to lowering the total cost of ownership of a telecommunications solution, compared to an equal-reach terrestrial microwave network.
Video services are a natural beneficiary of wide coverage beams: using hemispherical and global beams it is easy to reach millions of viewers and for other sectors such as enterprise, government, and defense.
The unparalleled capabilities offered by this frequency range in terms of resilience to service disruptions due to intense rain, makes

	it fundamental for high-reliability services with constant throughput requirements, especially in equatorial and tropical regions. However, that spectrum is increasingly put at risk globally through growing regulatory uncertainty. Resolution **246 (WRC-19)** calls for studies to consider possible allocation of the frequency band 3 600-3 800 MHz to the mobile, except aeronautical mobile, service on a primary basis within Region 1 and Resolution 245 studies the identification of 3600-3800 to IMT in Region 2. In relation to agenda item AI 1.3 of the WRC-23, the CEPT has in place a framework for 5G deployment in the 3 400-3 800 MHz band despite Mobile Service (MS) having secondary allocation in the Radio Regulations in Region 1. The frequency band is allocated to the Mobile service on a primary basis in Europe[7] and most CEPT Administrations have already assigned, or are in the process of assigning, spectrum for Mobile Network Operators (MNOs) in accordance with the ECC Decision (11)06. Upgrade of the mobile service, that may be subject to conditions that are in contradiction to the European framework, may have a detrimental impact to the ongoing 5G deployment in this band[8] [9]. Both the CEPT Brief and the RSPG Opinion on Common Policy Objectives for WRC-15 Agenda Item 1.1 dealing with this band the frequency band 3 600-4 200 MHz noted that outside Europe the band plays an important role for satellite communications. This is partly due to the impact of rainfall on the transmissions: as high rainfall in Equatorial and Tropical Regions means that alternative satellite frequency bands are less practical to use, a situation not present in Europe[10]. As stated also by the RSPG[11], the protection and equal access of the incumbent radio services usage in Region 1 in non-EU countries, which may diverge from the use in the European Union[12], will need to be considered in sharing and compatibility studies. GSOA would therefore respectfully request the UK to only support an outcome on the Agenda Item 1.3 that continues to protect and provide equal access to all existing primary services in the band now and in the future, which would be NOC. **6 425-7 025 MHz, 7 025-7 125 MHz** The frequency range 6425- 7075 MHz is globally allocated to the Fixed Satellite Service (FSS) on a primary basis, however there are certain frequency bands which are of the upmost importance for

[7] European Common Allocation Table (CEPT ERC-Report 25). Available at: https://efis.cept.org/sitecontent.jsp?sitecontent=ecatable
[8] https://apnews.com/article/technology-business-united-states-north-america-european-union-5ff38e3620b4f59d2e1cdffdb8b39f2a
[9] https://www.eca.europa.eu/Lists/ECADocuments/SR22_03/SR_Security-5G-networks_EN.pdf
[10] CPG15(15)084 Annex iV-01 – CEPT Brief onWRC-15 AI 1.1
[11] 'Interim Opinion on WRC-23,' RSPG 2021
[12] In Europe only earth stations in the FSS (space-to-Earth) are protected through appropriate coordination at a national level on a case-by-case level.

	the operation of existing, planned, and future networks of the fixed-satellite service. For example, the frequency band 6 725-7 025 MHz in which the use of the FSS is in accordance with the provisions of Appendix 30B, this appendix is essential for some developing countries because it helps to guarantee equitable access to the geostationary satellite orbit. Another band that is crucial for the FSS is 6 700-7 075 MHz, which is widely used to enable the global operation of feeder links for non-geostationary satellite systems of the mobile-satellite service in accordance to No. 5.458B of the Radio Regulations as well as telecommand operations, essential to the station keeping of satellites. **10.0-10.5 GHz** *(Placeholder for comments from stakeholders if any)* We respectfully encourage Ofcom to protect the satellite services currently operating in the frequency bands included in Agenda Item 1.2 and not to consider additional allocations to the mobile service or an identification of IMT in these frequency bands. In relation to agenda item 1.3 of the WRC-23, the CEPT has in place a framework for 5G deployment in the 3 400-3 800 MHz band despite Mobile Service having secondary allocation in the ITU Radio Regulations in Region 1. The frequency band is allocated to the Mobile service on a primary basis in Europe[13] and most CEPT Administrations have already assigned, or are in the process of assigning, spectrum for Mobile Network Operators (MNOs) in accordance with the ECC Decision (11)06. Upgrade of the mobile service, that may be subject to conditions that are in contradiction to the European framework, may have a detrimental impact to the ongoing 5G deployment in this band.[14] [15] The largest impact of the outcome of Agenda Item 1.3 will be felt by African administrations whose reliance on C-band satellite services is more pervasive and exhibiting a wider variety of FSS services is more wide-ranging than in Europe, as well as on the European satellite industry, for which C-band is a cornerstone of many of the services offered. With the existing CEPT framework in place there is no similar direct business impact to mobile industry. Ofcom is therefore respectfully requested to only support an outcome on the Agenda Item 1.3 that continues to protect and provide equal access

[13] European Common Allocation Table (CEPT ERC-Report 25). Available at: https://efis.cept.org/sitecontent.jsp?sitecontent=ecatable
[14] https://apnews.com/article/technology-business-united-states-north-america-european-union-5ff38e3620b4f59d2e1cdffdb8b39f2a
[15] https://www.eca.europa.eu/Lists/ECADocuments/SR22_03/SR_Security-5G-networks_EN.pdf

	to all existing primary services in the band now and in the future, which would be NOC.