

## ALLOCATION OF NEW FREQUENCIES FOR 5G

### SES RESPONSES TO ARCEP CONSULTATION

18 December 2018

#### Introduction

SES very much welcomes ARCEP's consultation.<sup>1</sup> SES has important responses to ARCEP's questions specifically on innovation with 5G (Part 1). For the other questions related to specific frequency bands (Parts 2, 3, 4), SES fully endorses the responses given by our regional association ESOA in its separate submission to ARCEP.

#### SES Responses to Part 1. Fostering innovation thanks to 5G

Question No. 1. What kinds of new uses or improvements to existing uses do you expect to see with the introduction of 5G? Who will the users be? To what extent is 5G important to the development of these new uses? What alternatives to 5G could support them?

SES has identified the following new uses / improvements with the introduction of 5G:

- Extending / accelerating connectivity in "moving platforms" such as aircraft, ships, passenger vehicles, high-speed trains using satellite for backhaul
- Extending the reach of fixed and mobile services into unserved or underserved areas thanks to satellite backhauling or direct-to-home connectivity
- Enabling and accelerating efficient multicast of high-quality, high-bandwidth video and data to the edge of 5G networks via satellite

SES is encouraged to read that it is ARCEP's belief that the "new uses and applications to become possible, or to be delivered on an unprecedented scale with 5G" would include "4K-UHD and 8K very high-resolution video, both in downlink streaming to improve viewing quality, but also uplink for professional applications such as real-time image analysis from high resolution cameras, for detecting abnormalities in a manufacturing setting or for public safety purposes."

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<sup>1</sup> Document available on the Arcep website: [www.arcep.fr](http://www.arcep.fr)

**The delivery of same content (e.g. video content) in broadcast and multicast modes to multiple locations is a key strength of satellite technology.** SES has long been a leader in this field, and there is no reason why satellite technologies cannot play a comparable distributive role in the 5G ecosystem by delivering common content to edge caches. In fact, the pre-caching of commonly accessed content at the edge of 5G networks will be essential for some 5G applications in order to meet low-latency requirements.<sup>2</sup>

SES today delivers video content to more than one billion people worldwide, and our company overall distributes more than 2,600 HD video services as well as more than 40 UHD video services. Japanese NHK, one of the biggest and most innovative TV broadcasters in the world and a customer of SES, has just launched the very first 8K news channel broadcasting from the Vatican, using capacity from several satellite operators.

In France, all TV channels distributed in France have been into HD format since April 2016, and our main distributor is Canal + who's now working on the UHD format. However, only 25% of the population is covered by fibre connectivity, and ADSL typically doesn't have sufficient bandwidth for UHD video. With its distributor Canal+ SES covers 100% of the French territory, so every household is able to receive UHD.

SES is also developing solutions to distribute HD and UHD video and social media content to mobile smartphone applications: we have recently partnered with German video distribution solutions provider Smart Mobile Labs (SML) that contribute 5G-ready LTE/Wi-Fi hotspot technology for events, by using our OU (Occasional Use) Flex service. OU Flex provides a solution to ensure enough bandwidth and full coverage for high resolution video distribution and bidirectional IP connectivity in real-time for broadcasters, live event producers, event organizers and remote operators. More information is available from:

<https://www.ses.com/press-release/ses-optimizes-events-and-news-broadcasting-new-product-ou-flex>  
<http://smartmobilelabs.com/blog/pr-smart-mobile-labs-partners-with-ses/>  
<https://www.ses.com/fr/press-release/le-service-ou-flex-de-mx1-fournit-une-connectivite-sur-site-accrue-grace-la-solution>

It is not difficult to extrapolate from our current video business to a converged digital future where common content (whether video or non-video) is efficiently delivered via satellite directly to the home or to 5G edge caches (e.g. at or near 5G base stations) for redistribution by the terrestrial mobile network.

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<sup>2</sup> As GSMA put it in their report Understanding 5G: "services requiring a delay time of less than 1 millisecond must have all of their content served from a physical position very close to the user's device. Industry estimates suggest that this distance may be less than 1 kilometre, which means that any service requiring such a low latency will have to be served using content located very close to the customer, possibly at the base of every cell" - <https://www.gsmaintelligence.com/research/?file=141208-5g.pdf&download>

Our advances in the video business illustrate **how essential it is that 5G relies on a mix of technologies**. The inclusion of satellite technologies will be essential if the benefits of 5G are to extend to places not served or underserved by terrestrial technologies, as further explained below. SES has taken a leading role and proactive interest in ensuring satellite is seamlessly integrated into the new 5G capabilities, working collaboratively with other industry players from the terrestrial and satellite realms to develop standards, technologies and best practices.

**SES is a founding member, Board member and Vice Chair of the 5G Infrastructure Association (5GIA) created back in 2013.** The 5GIA is grouping European-based wireless industry acting as the private counterpart of the European Commission in the 5G Public-Private Partnership (PPP), the world's biggest 5G research programme aimed to deliver 5G solutions, architectures, technologies and standards. SES also makes important investments in both space and ground assets, as well as products and services, that are to be used to accelerate 5G deployment worldwide.

5G will take several years to get implemented, in a progressive manner, in being first deployed in urban areas. Before 5G ever reaches anyone, anywhere, anytime, traffic and performance needs with existing technologies will increase, and challenges such as coverage and resilience will become even more acute. In particular, the EC Broadband 2020 goals of 30 Mbit/s connectivity to 100% of citizens and 100 Mbits/s to half of these (as part of the EU Digital Agenda) is still not achieved in France, as in several other countries of the EU.

Question No. 2. What are the key performances criteria for the new uses listed in your answer to question 1? Is having a mobile network that delivers these performance levels enough to enable the emergence and development of these new uses, or are there other (technical, economic, regulatory, organisational...) prerequisites? If so, can you provide exact details on the impediments you have identified?

SES is of the view that the French regulator should pay attention to the following KPIs with respect to its 5G expectations:

- **Evolution of the digital divide** on "rural showcase areas" and beyond (whole territory). In line with the French 5G national roadmap of July 2018 to commercial rollout in a flagship major city, SES recommends electing to test 5G in 2-3 rural and isolated cities that are typically representative of the digital divide in France. The entire communal area of each isolated city should be part of the rollout in order to include remote households entitled to benefit from continuity of service and quality of service closer to the levels of urban and suburban areas.

To ensure that 5G deployment in major cities does not worsen the digital divide, the use of satellite-based technologies to cost-effectively extend 5G networks into rural areas should be further

encouraged and explored. In particular, satellites are used cost-effectively to extend 4G networks in many other countries today, and its potential to help extend mobile networks in France should not be discounted out of hand (especially with the launch of the latest- and next-generation High Throughput Satellites).

- **Field measurements of the quality of service** compared to the theoretical offer for the entire territory. Coverage obligations have been identified in the French 5G national roadmap of July 2018, but their modalities remain to be defined.
- **Comparative assessment of the economic dynamism** according to their 5G coverage level (especially in rural areas). It is essential to evaluate how much 5G connectivity does contribute to develop growth and plurality in economic activities, improved infrastructure, job creation etc. at local level.

Question No. 3. Within what timeframe do you expect to see the emergence of an environment that is mature enough to enable the new uses listed in your answer to question No. 1?

The success of 5G depends on the ability of the industry to build an ecosystem of networked networks, utilizing multiple different and at the same time complementary technologies. Preliminary 5G deployments are expected in 2019, with deployment expected to accelerate in the 2020-2025 timeframe. It is SES's conviction that satellite will help accelerate the deployment of 5G. SES has invested and is further investing in space assets and capabilities that can support 5G deployment:

- SES current fleet is made up of a combination of a multi-orbit fleet of Geostationary (GEO) and Medium Earth Orbit (MEO) fleet, where GEO provides wide reach / coverage, and MEO low latency high Throughput for latency-sensitive applications. SES currently has over 55 GEO including GEO HTS (High Throughput Satellites) and 16 MEO in orbit
- SES upcoming capacity will include 4 more MEO satellites to be launched in Q1 2019; as well as the next generation of O3b mPOWER MEO constellation, to be launched in 2021

**The O3b mPOWER terabit-scale capacity will be enabled by a fleet of 7 new satellites**, with more than 5,000 beams per each, and is to be ideal for cloud-scale applications. (See: <https://www.ses.com/networks/o3b-mpower>) New HTS GEOs will also enrich the existing SES satellite fleet, e.g. SES-17 that is being built by Thales.

Furthermore, SES is increasingly investing in the development and design of next generation of users' antennas, at low cost and easy to install. SES is today partnering with three companies (Isotropic, Alcan and Viasat) to this end. More information is available from: <https://www.ses.com/press-release/ses-networks-announces-partnerships-groundbreaking-o3b-mpower-customer-edge-terminals>

Question No. 4. In addition to the 5G standardisation roadmap, what do you expect the timeframe will be for the deployment and actual use of the above-mentioned technologies: i.e. eMBB, mMTC, URLLC, network slicing?

We expect initial 5G deployments to be primarily around eMBB, with mMTC following shortly thereafter. Significant deployments based on URLLC will most likely take longer, given the stringent quality of service requirements. End-to-end Network Slicing will be a common element among those three technologies and an important enabling factor for sharing network resources while offering highly customized and differentiated Service Level Agreements (SLAs) for different customer groups and their needs. Such End-to-End Network Slicing, and the efficient management and orchestration thereof, will seamlessly extend to satellite thanks to ongoing efforts integrating satellite into 5G, such as for instance supported by the Horizon2020 projects SaT5G and 5G-VINNI as well by the ESA project SATIS5, in addition to private investments by key satellite stakeholders. **SES notably participated to successful proof-of-concept demonstrations showing that SDN/slicing can work effectively and efficiently over satellite (See details in the Annex).** For the satellite industry, 5G technologies will be a game changer in the way their networks are dimensioned, deployed, configured, provisioned, managed and operated. This will tremendously simplify their seamless integration with terrestrial networks.

Question No. 12. How long do you think it will take for the improved technical performance introduced by 5G listed above to reach maturity? Are there any spectrum-related impediments that might hamper the deployment of these techniques? Are the performance levels cited above relevant? Are other ones needed? Why?

ARCEP's consultation document (in Part 1, Section 1.1) is reminding that the ITU IMT-2020 initiative has defined three key 5G usage scenarios: enhanced mobile broadband (eMBB), massive machine-to-machine type communications (mMTC) and ultra-reliable, low-latency communications (uRLLC). Recommendation ITU-R M.2083 has subsequently defined the capabilities of 5G networks.

The **CEPT ECC Report 280 "Satellite Solutions for 5G"** (<https://www.ecodocdb.dk/document/2989>) released in May 2018 informs that the relevance of each of these capabilities may be significantly different, depending on the exact use cases/scenario. This is well illustrated by Figure 1 of the Report: **Bandwidth and latency requirements of potential 5G use cases (source: Nokia)**. It is clear that satellite communications can and will contribute to the achievement of the 5G ecosystem, as explained through the catalog of Satellite Use Cases for 5G that are presented in Section 5 of the Report.

SES believes that some of the 5G performance expectations can already be met by today's HTS satellites (e.g. for a global reach of multicast or M2M services), whilst others will depend on the launch of a next generations of satellites such as the mPOWER constellation in 2-3 years from now. Very importantly,

satellite operators need continued access to radio spectrum to make this performance tangible and sustainable.

**Our key messages in relation to radio spectrum** are as follows:

- Mobile industry should be (more) supportive of satellite integration into 5G, with respect to standards, products & services as well as the regulatory environment. This would immensely help avoiding spectrum-related frictions and contribute to achieve a win-win approach whereby each technology contributes to 5G achievements
- Satellite needs continued access to a range of frequencies. Terrestrial spectrum considerations should respect ITU/WRC-19 agenda and not push for frequency bands outside this scope, which could undermine a stable and internationally harmonized regulatory environment that is needed for satellite. In this respect, SES fully supports the selection made by the CEPT of the pioneer frequency bands for 5G initial deployments, as reflected in their 5G Roadmap ([www.cept.org/ecc/topics/spectrum-for-wireless-broadband-5g](http://www.cept.org/ecc/topics/spectrum-for-wireless-broadband-5g))

Spectrum-related impediments to the development of HTS and Very HTS (VHTS) systems to support 5G can be overcome based on the recommendations herebelow:

- The need for access to sufficient spectrum for connectivity, for both satellite and terrestrial. For what concerns discussions for ITU WRC-19, it is necessary that only those frequency bands are discussed that are within the scope of AI 1.13 as in Resolution 238 (WRC-15). The 27.5-29.5 GHz band is an essential uplink band in almost every Ka-band satellite or constellation in orbit today or under construction. Continuing any uncertainty over satellite's future ability to use this band, which is not even among the candidate bands being considered by WRC-19 for IMT-2020/5G, would become a drag on investment – a result that is completely avoidable given the 33+ GHz of other spectrum that is being considered for 5G by WRC-19
- From the satellite perspective, there is a need for access to sufficient and sustainable spectrum for fixed-satellite service (FSS) user terminals, that is not shared with IMT (terrestrial 5G)
- There is also a need for continued access to spectrum for individually licensed earth stations which can be shared, but there must be reasonable regulatory measures to ensure protection of and sustainable viable access and growth for the FSS. To implement such protection measures, the location of IMT base stations must be available
- In bands that would be shared between IMT and FSS, there is a real potential for interference from IMT transmitters in the mm-wave bands into satellite receivers at '26 GHz' and '50 GHz'. Adequate and enforceable regulatory measures, such as a Total Radiated Power (TRP) limit and pointing limitations, must be adopted to ensure this is not happening.
- In addition, reasonable regulatory measures should be put in place to enable future deployments of FSS earth stations in shared bands, even after IMT has deployed

Question No. 16. Have you identified any other 5G rollout solutions? To what degree can satellite or HAPS solutions serve to complement terrestrial 5G networks?

As indicated above, satellite can help accelerate the deployment of 5G. Satellite is to be a key element of the 5G ecosystem due to its unique attributes including the following:

- **Ubiquity:** Ability to deliver service to un-served and underserved areas
- **Mobility:** Enabling network availability to “moving platforms” such as aircraft, passenger vehicles, high-speed trains
- **Security:** Support for future critical communications use cases such as public safety
- **Simultaneity:** Support for multicast/broadcast services for data delivery toward the network edges and even to user devices

The unique combination of GEO and MEO assets provided by SES enables mobile network operators and service providers to accelerate and expand their 5G deployment across a wide footprint, including into geographical areas that are difficult or impossible to serve via terrestrial assets, thus preventing a “5G Divide”. Satellite-enabled backhaul solutions can be tailored to specific requirements such as latency and coverage. SES’ end-to-end managed services approach also reduces the risk associated with deploying 5G use cases to more remote regions by providing turnkey solutions in a record time. Finally, HTS and VHTS will increase available capacity with a lower cost per bit, while being able to support a wide range of lower-latency 5G use cases. The main use cases, where the role of the satellite is crucial, are well explained in CEPT ECC Report 280 along these lines:

- Trunking and head-end feed: satellites provide a very high speed direct connectivity to remote or hard-to-reach locations
- Backhauling and tower feed: satellites provide a high-speed connectivity complement (incl. multicast content) to wireless towers, access points and the cloud
- Hybrid multiplay: satellites deliver content complementing terrestrial broadband to individual homes and blocks of flats
- Communications on the move: satellites already provide a direct or complementary connection for users on the move (e.g. on planes, trains, ships), and can further accelerate 5G expansion / usage of these

**Concretely, SES and other satellite stakeholders are advancing the case for “satellite integration into 5G” through key actions, notably around standardisation and technology development & demonstrations.** A complete list of these actions is made available in the Annex. These actions and developments have been made possible in capitalizing on the existing contribution of satellite operators to direct-to-consumers and backhauling services. Below are examples of today’s SES role in

complementing terrestrial services, which paves the way to future satellite integration to the 5G ecosystem.

**As for HAPS**, SES sees potential synergies whereby satellites provide backhaul for the High Altitude Platforms deployed in hard to reach areas. For example, we have worked cooperatively with some HAPS proponents in this way to restore connectivity after natural disasters. (See: <https://www.ses.com/press-release/ses-networks-works-project-loon-restore-connectivity-puerto-rico> and <https://www.ses.com/blog/ses-networks-teams-project-loon-get-peru-back-online>). However, we would not welcome upgraded access for HAPS to satellite that is currently heavily used for satellite services, such as the 27.9-28.2 GHz band. That would be a recipe for constraints on each service that prevents both from reaching their full potential.

**Our AstraConnect broadband service** is available in several European countries as one of the solutions to bring connectivity where there is no equivalent terrestrial service available. In France only, AstraConnect is distributed by several companies including Nordnet (subsidiary of Orange) and is using SES GEO satellite capacity that provides connectivity directly to thousands of households, with a performance of 20 Mbps downlink. SES is now working on upgrading this performance to up to 50 Mbps and, still based on today's satellite capacity, could deliver such a quality of service in France as of 2019.

By using the existing O3b capacity in MEO, **SES supports backhauling services to cell towers or DSL head-ends in many isolated areas, not only for 3G but also for 4G services**. One single beam from O3b enables to deliver 600 Mbps to a single point of presence in any given territory of the globe located within +/- 50 degree of latitude: associated to any wired or wireless LAN, such a pipe can bring high-throughput connectivity to thousands of end-users. SES thus backhauls cellular networks in several countries across Africa, Asia and Latin America,. See for example:

<https://www.ses.com/press-release/our-telekom-ramps-connectivity-across-solomon-islands-ses-networks>  
<https://www.ses.com/blog/connecting-peru-land-and-sea>  
<https://www.ses.com/blog/lte-now-made-available-anywhere>  
<https://www.ses.com/press-release/more-cities-drc-get-satellite-enabled-high-speed-connectivity-ses-networks-and-gilat>  
<https://gilat.net/uncategorized/drc-to-orange/>

As another illustration of innovative solutions, **SES has become a full partner of the IBM Cloud Direct Link Service Provider Program in expanding it globally**, as a complement to terrestrial solutions via fibre, notably. IBM Cloud Direct Link enables enterprises to securely and reliably connect to the cloud and take advantage of high value services including AI, IoT and analytics. O3b has been chosen because it provides the only satellite-enabled solutions that are MEF CE 2.0 certified: this certification recognises our ability to offer MEF-compliant service level agreements for key attributes such as latency, jitter and throughput which are considered at the performance level of fibre. For more information:



<https://www.ses.com/fr/press-release/ses-networks-premier-operateur-obtenir-la-certification-de-services-mef-ce-20>

<https://www.ses.com/fr/press-release/ses-networks-apporte-la-connectivite-directe-la-plateforme-ibm-cloud-son-reseau>

Question No. 17. When 5G is introduced, what level of performance is required to ensure base station backhauling? What differences do you see between the network performance required of wireline backhaul (notably optical fibre) and wireless backhaul? Have you identified any obstacles that need to be lifted to enable this backhaul?

Existing HTS capacity in GEO and MEO already provide base station backhauling for 4G/LTE in several regions of the world, as indicated in our response to question 16.

Most recently, the successful integration of satellite capabilities within 5G was showcased by SES during a live demonstration with SaT5G consortium partners at the EuCNC2018 conference in Ljubljana, Slovenia. SaT5G is a European Commission Horizon 2020 5G PPP programme. **The SaT5G demonstration showcased satellite backhauling features and efficient edge delivery of multimedia content as a proof-of-concept for their integration into the 5G network.** SES provided end-to-end managed connectivity between the remote node and the core network via its geostationary satellite and its teleport in Betzdorf. Another SaT5G over-the-air live demo planned for 2019 with SES's involvement will look at the 5G aero backhauling where SES will provide end-to-end managed connectivity between the remote node and the core network via its non-geostationary (MEO) satellite fleet.

As described in response to question 16, SES is very active in providing cellular backhauling solutions that are 4G or scalable to 4G, notably with O3b. With the advent of O3b mPOWER, SES will deliver connectivity of another magnitude: as of 2021, 7 satellites will provide more than 30.000 beams of half a Gigabit throughput each, in a fully scalable and flexible manner. The perspective is to enable satellite connectivity at speed, latency and availability that would respond to 5G performance needs, as explained here:

<https://www.ses.com/blog/terabits-space-next-gen-tech-redefines-satellites-role-global-networking>

## Conclusion

SES is committed to actively contribute to the development of 5G solutions that are spectrum and cost efficient, relying on its long and wide experience of connecting governments, businesses and citizens around the world. Would ARCEP need more specific information on our services and products, SES would be pleased to meet its representatives and provide all necessary details.

## ANNEX

### Satellite integration into 5G, with respect to standards, products & services

SES and other satellite stakeholders are advancing the case for “satellite integration into 5G” through key actions around standardisation and technology development & demonstrations. The mobile industry is already involved in these efforts, but could be more supportive.

#### 1. Standardisation efforts

5G service needs to be defined in a set of standardised specifications agreed upon by international bodies

- We are taking an active part in relevant discussions with 3GPP and the ITU, to agree on how long-term spectrum needs of all stakeholders can be met in an efficient way.
- In addition, projects we are taking part support 5G standardisation initiatives. E.g. SaT5G, 5G-VINNI and SATis5 projects support 5G standardisation initiatives including the 3rd Generation Partnership Project (3GPP) and European Telecommunications Standard Institute (ETSI).
- SES is Member of the Standardisation Special Interest Group (SSIG) of the ESA-funded ALIX project which aims at promoting satellite interests at 3GPP.
- We are taking a leadership role in driving a standards-based approach within the services we are providing already today (Linux Foundation, ONAP, MEF). This is creating a more automated and intelligent platform for delivering new services - including the cloud- and IoT-based services that will increasingly dominate the mobile landscape of the future.

#### 2. Live demonstrations and other initiatives

SES is advancing implementation of 5G through active participation in various initiatives, focused on satellite integration into 5G, addressing challenges such as latency mitigation, virtual network function (VNF) delivery, content distribution via multicast, among others.

European initiatives include the following participations:

- Satellite and Terrestrial Network for 5G (SaT5G) project, funded under the European Commission Horizon 2020 5G PPP Phase 2 programme. The successful integration of satellite capabilities within 5G was showcased by SES during a live demonstration at the EuCNC 2018 conference, in Slovenia last June. **Use case: satellite backhauling features and efficient edge delivery of multimedia content** as a proof-of-concept for their integration into the 5G network. SES provided end-to-end managed connectivity between the remote node and the core network via its geostationary satellite and its teleport in Betzdorf. Further live over-the-air demos are planned as part of the SaT5G project.
- SATis5 project funded under the ESA's ARTES programme, building an end-to-end 5G integrated network Proof-of-Concept testbed for satellite-terrestrial integration into 5G. The testbed infrastructure comprises SES's fleet of GEO and MEO satellites, integrated with terrestrial networks and technologies.

SES also hosts a SATis5 testbed node with prototypes of networks for satellite integration. First SATis5 live demonstration took place in November 2018 in Berlin, to showcase integration of satellite connectivity into a 3rd Generation Partnership Project (3GPP) core network via a Software-Defined Networking (SDN), Network Functions Virtualization (NFV) and Multi-access Edge Computing (MEC)-enabled 5G testbed. The demonstration also showed **efficient edge delivery and network slicing of enhanced mobile broadband (eMBB) and massive Machine Type Communications (mMTC, Internet of Things) over satellite**.

- 5G-VINNI (5G Verticals Innovation Infrastructure) project, funded under the European Commission Horizon 2020 5G PPP Phase 3 programme. SES is the first satellite operator to team up with the leading MNOs and mobile industry vendors to accelerate the uptake of 5G in Europe by providing an end-to-end facility that validates the performance of new 5G technologies by operating trials of advanced vertical sector services **such as public safety, eHealth, shipping, transportation, media and entertainment, and automotive**.
- MENDHOSA (Media & ENTertainment Delivery over Hetnet with Optimized Satellite Architecture): SES participated to the successfully concluded study, funded under the ESA's ARTES programme, which elaborated a vision and proposed a strategy for the SatCom sector and its integration within the 5G ecosystem, with focus on the **Media & Entertainment vertical**
- INSTINCT CCN (Scenarios for integration of satellite components in future networks): SES participated to the successfully concluded study, funded under the ESA's ARTES programme, which assessed the role of SatCom in 5G ecosystem, and investigated the feasibility of satellite networks **integration with terrestrial clouds to dynamically and optimally offer services towards 5G** networks and services
- M2MSAT (Demonstrator of Light-Weight Application and Transport Protocols For Future M2M Applications): SES leads as Prime Contractor to ESA the M2MSAT project which is funded under the ESA's ARTES programme and aims to critically review, propose improvements for, and assess in a satellite network testbed, the prominent **light-weight M2M/IoT application and transport protocols for future satellite M2M/IoT services**.
- HTS-DBS (High Throughput Digital Broadcasting Satellite Systems): SES leads as Prime Contractor to ESA the HTS-DBS project which is funded under the ESA's ARTES programme and develops key relevant technologies for satellite integration into 5G, such as **edge caching** through multimodal satellite backhauling, and **dynamic adaptation of uni/multi/broadcast** based on local and global content popularity.
- SES is a founding member, Board member and Vice Chair of the 5G Infrastructure Association (5GIA) created back in 2013. The 5GIA is grouping European-based wireless industry acting as the private counterpart of the European Commission in the 5G Public-Private Partnership (PPP), the world's biggest 5G research programme aimed to deliver 5G solutions, architectures, technologies and standards.
- SES is Member of the Steering Board and relevant WGs of NetWorld2020 (European Technology Platform for communications networks and services).
- SES is an active member of the ESA "Satellite for 5G" Task Force.