SES Response to BEREC report on satellite connectivity for universal service
15 August 2022

SES would like to thank the Body of European Regulators for Electronic Communication (BEREC) for the opportunity to provide a contribution to their draft report on satellite connectivity for universal service in Europe (ref BoR (22) 83). SES is a European satellite company headquartered in Luxembourg that is providing state-of-the-art connectivity solutions from space. With over 70 satellites in two different orbits, SES combines a vast, intelligent network of satellite and ground infrastructure with industry-leading expertise to manage and deliver high-performance video and data solutions virtually everywhere on the planet. For more than 30 years, our success has been built on sustainable innovation as we reliably connect businesses, communities and government institutions in and deliver linear and on-demand video content seamlessly nearly everywhere in the world.

SES particularly welcomes BEREC's recognition of the role that satellite communications ("satcom") can play in providing broadband internet access services to underserved areas, complementing or extending the reach of terrestrial fixed or mobile networks, and we appreciate the efforts made by BEREC in this report to consider satcom solutions in an objective and technology neutral way to address the persistent digital divide.

We note that BEREC's draft relies on a questionnaire sent to all national regulators in Europe as well as two reports from Sweden and Germany. [See EN summary of the Swedish report in Annex 1 of this document]. Both reports acknowledge the critical contributions satellite makes to extending broadband reach in combination with Fibre and Fixed Wireless Access (FWA).

Some important considerations SES wishes to highlight are:

- The digital divide is a critical issue that needs to be addressed with high priority – the COVID pandemic has revealed how essential it is to ensure connectivity *everywhere*, and some citizens (e.g. young people at school, elderly in homes, disabled people with low mobility, isolated populations but also SMEs in remote or rural areas) have pressing needs

- The solution should fit the needs of a community. A mix of technologies is the most effective approach to address broadband for all, and the most recently designed satellite systems are providing a level of performance that is inequivalent to fibre.

- State-of-the-art super low latency connectivity such as Fibre or equivalent solutions may not be appropriate in every scenario because they require a lot of resources. It is very clear that many geographical areas and large parts of the European population will not be connected with Fibre or an equivalent before (many) years, and possibly not in any foreseeable future.

- A mix of technologies is the most realistic approach to address broadband for all, and the most recently designed satellite systems are providing a level of performance that is inequivalent

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SES encourages BEREC to fully acknowledge the role of satellites at various orbits in supporting the goal of full broadband access for all EU citizens. To this end, SES shares the following comments on BEREC's consultation.

Satellites At Various Orbits Offer Flexibility, Coverage and High-Speed

Since 1988, SES has operated a geostationary (GEO) satellite constellation today made up of nearly 50 satellites for video and data services. Thanks to their high altitude and wide field of view, a GEO satellite with a lifespan of 15+ years can cover the entire globe with as few as three satellites and the entirety of Europe. SES has notably launched several High-Throughput Satellites (HTS) in geostationary orbit since 2019 with very significant innovation, combining traditional wide-beam coverage and high-powered multi-spot beam payload, Such HTS satellites are hybrid and provide immense flexibility in addressing customers' needs. This is enhanced even further with digital processing ability, allowing to optimise the allocation of capacity to key growth areas.

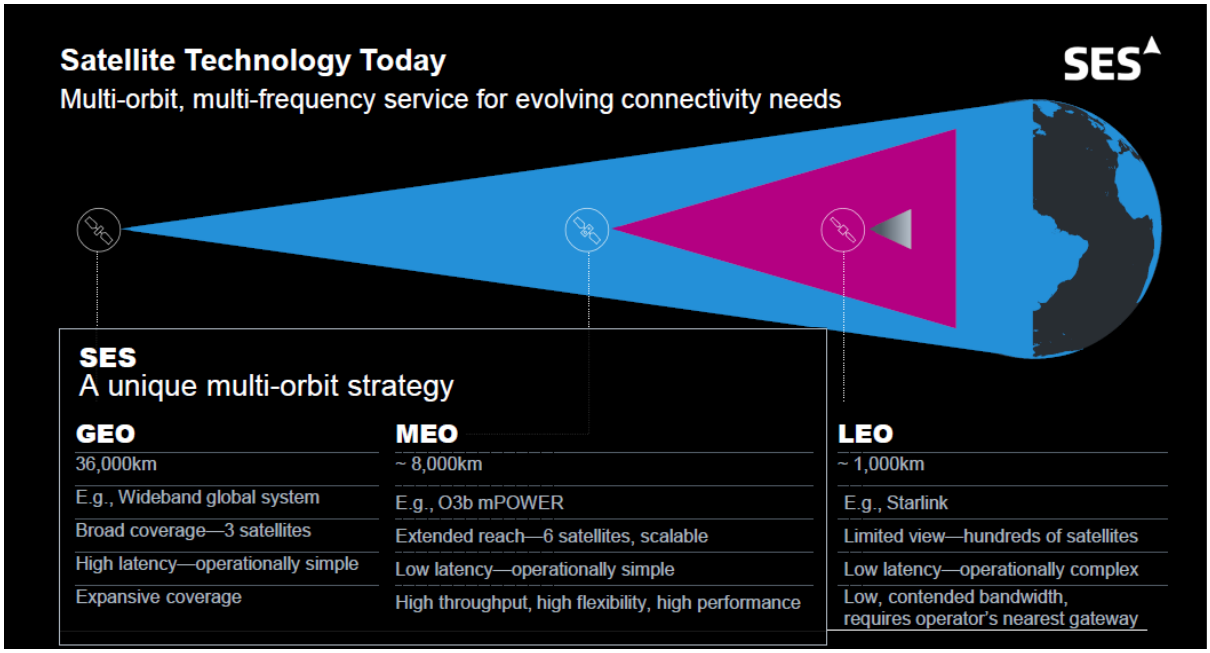
Non-Geostationary orbit (NGSO) satellites have also been in operation for many years and are used today for a broad set of space applications such as Earth observation, navigation and communications services. SES operates its O3b constellation at the medium earth orbit (MEO).[1] Made up of 20 satellites, it is designed to provide low-latency broadband connectivity to remote locations for mobile network operators and internet service providers, maritime, aviation, and government and defence. O3b has been offering service all over the world since March 2014, and the service will be integrated into the REACH platform co-developed between ESA and SES to provide European government and institutional users for safety, security and emergency response.[2] Later in 2022, SES will launch the next generation of O3b satellites, called O3b mPOWER, with terabit-scale capacity and even more flexibility than the current generation.[3]

NGSO satellites operating in low earth orbit (LEO) cover a much smaller geographical area with each satellite, requiring LEO satellite operators such as OneWeb, Starlink or Kuiper to build much larger constellations to achieve global, continuous coverage, or simply to cover Europe. In contrast, a MEO constellation, made up of a small number of satellites (e.g. six spacecrafts flying at #8,000 kms are enough to cover the orbital arc), is able to support and serve applications with very high-throughput needs and strict latency requirements.

SES has the great advantage of operating a multi-orbit satellite network that provides the advantages offered by one altitude to be combined with those of another, whilst mitigating each other's disadvantages. For example, the wide coverage of GEO can be combined with the ultra-high

[1] https://www.ses.com/our-coverage/o3b-meo
[2] SES and ESA to Enable GovSatCom with Medium Earth Orbit Constellation, see from: https://www.ses.com/press-release/ses-and-esa-enable-govsatcom-medium-earth-orbit-constellation
[3] https://www.ses.com/o3b-mpower

speed and lower latency offered by MEO to support more demanding applications, such as voice or cloud computing, everywhere in the world from mobile platforms to hard-to-reach areas.



For more information about the importance or satellite orbits, see SES paper: Why Orbit Matters – SES Marketo

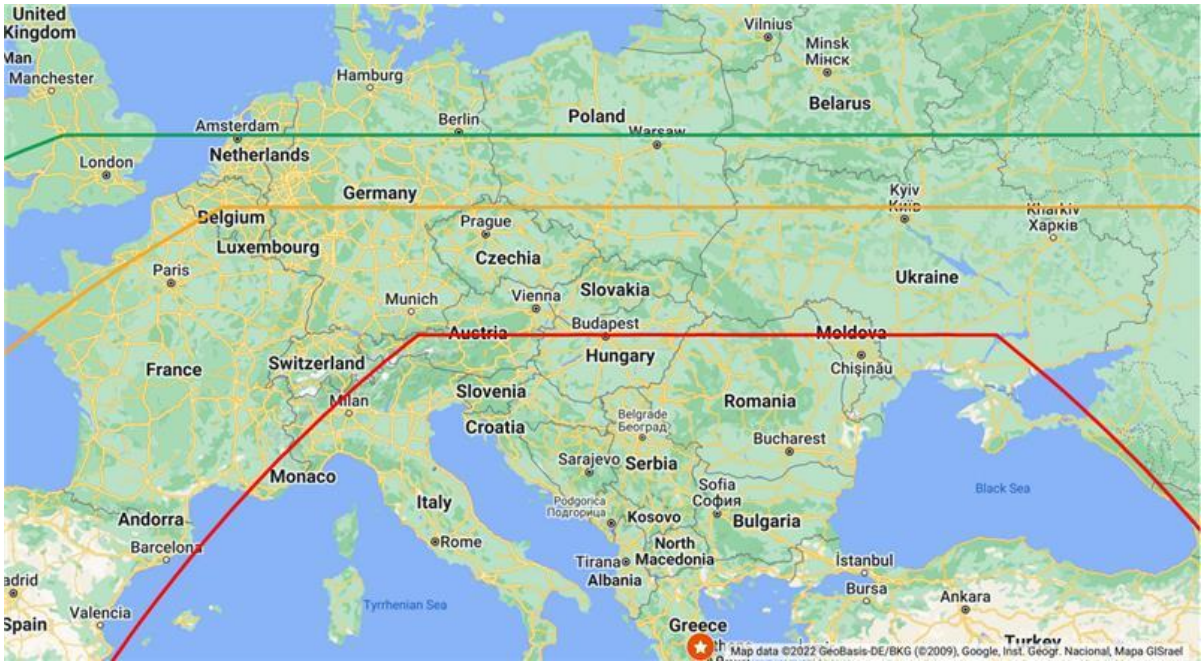
Key Innovation Trends

The satellite industry in general has seen significant innovation over the last decade. Both GSO and NGSO satellites launched today offer operators and customers the ability to dynamically assign spectrum bands and satellite capacity. Steerable spot beams using Ku, Ka and Q/V frequency bands combined with the deployment of new ground antennas has increased spectrum efficiency and flexibility in geographical coverage and spectrum use. Additionally, the cloud services and artificial intelligence (AI) integrated in these new satellite systems are improving network management allowing operators to offer speeds of several 100 Mbps anywhere in the world. Our recently launched SES-17 satellite illustrates it best with its almost 200 spot beams, the power of which can be dynamically adjusted in step with our customers' changing requirements.[4] SES is getting prepared to launch similar satellites over Europe within the next 2-3 years.

Our existing MEO O3b system, in operation since 2014, delivers low-latency broadband to any area within 53° North and South of the Equator. In practical terms, this means that the current MEO

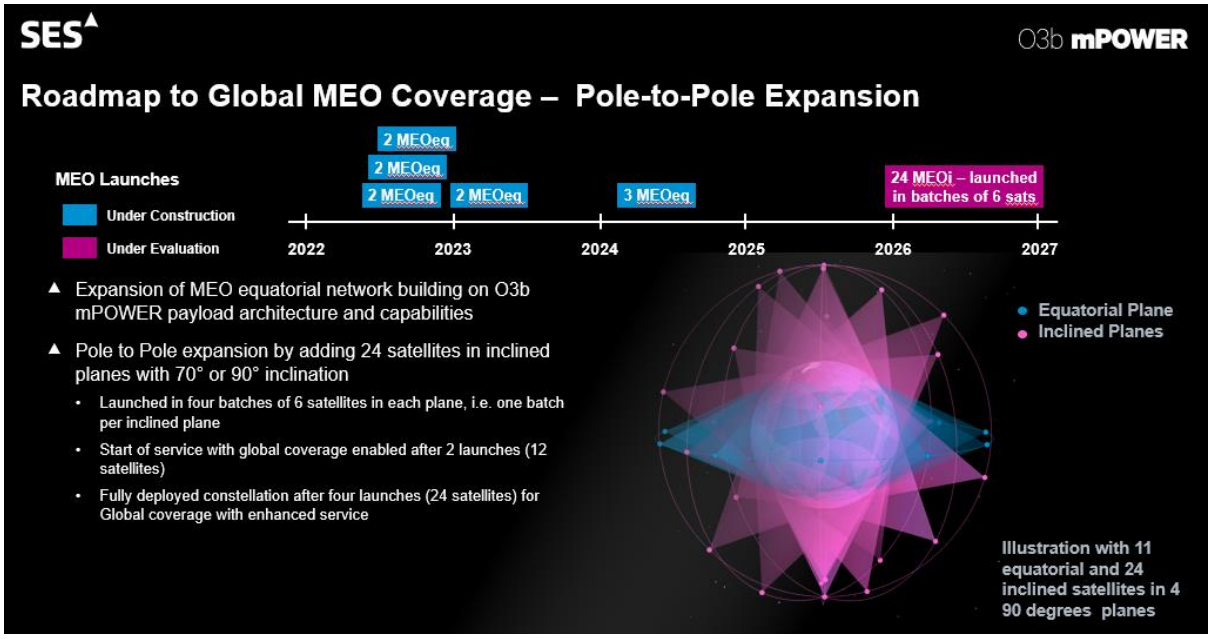
[4] SES-17: Experience endless connectivity | SES

constellation covers a large part of Europe, and certainly all Southern European countries. Our **new generation of MEO system O3b mPOWER** will follow the same logic as of 2023, as illustrated with the two maps below. Our MEO gateways in Europe are located in Greece (teleports of Nemea and Thermopylae) and in Portugal (teleport of Sintra), whilst a network operations centre (NOC) has been established in Bucharest, Romania. The latency is of our MEO systems is of maximum 150 ms, which enables SES to provide all essential broadband services without undue delay – as experienced today in many countries of the world.

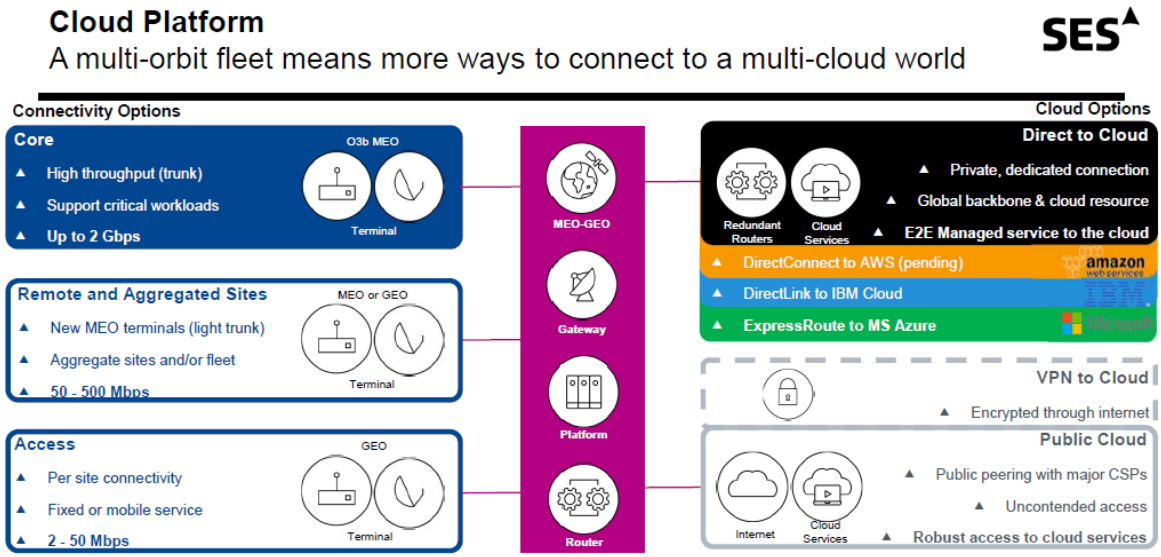


mPOWER coverage areas: Green is with 11 MEOs (2025), Orange with 8 MEOs (2023) and Red with 6 MEOs (Q1 2023)

O3b mPOWER will provide multiple Gigabits per terminal on the ground and will have some expanded geographical coverage. The mPOWER platform will first cover between 50° North and South of the Equator with 6 satellites. This coverage will increase over time with the addition of more satellites. SES is also concretely evaluating a Pole-to-Pole constellation by relying on inclined orbit, which would result in Global coverage by 2026/2027.



The MEO satellites operated by SES have been designed to provide a level of connectivity with 5G performances and full access to the Cloud. [5]



[5] SES in 2021 completed multiple field tests and technical demonstrations with a major mobile operator and cloud provider. The tests – which lasted a week – validated SES's ability to deliver fiber-like performance for mobile operators and came back with some unprecedented results. *See*: Reimagine_5G_Networks-Technology_Showcase.pdf (ses.com) and SES Leads Satellite-enabled 5G Tests | SES

Satellite communications solutions for universal service

Direct to end-users (standalone)

Today, the stand-alone B2C satcom solutions widely available in Europe are essentially GEO – at least until the Starlink service is up-and-running in its final version. GEO has the great advantage of providing solutions thar are technically simpler with lower cost end-user's equipment. We note that BEREC's report states: ""For several technical reasons, such networks may require a number of gateways for GSO networks". However, one single gateway located in Europe is enough to provide connectivity solutions all over the continent.

SES is using a broadband-to-consumer platform called AstraConnect that relies on several GEO satellites to serve the market (ASTRA 2E, ASTRA 2F, ASTRA 2G, ASTRA 3B). Similar platforms are exploited by SES' competitors such as Eutelsat (e.g. via Nordnet in France) or HellaSat (contributing to the universal service in Greece).

Backhaul & Trunking Solutions (hybrid)

Telcos as well as MNOs are still struggling to connect the most remote and rural communities where rolling out an infrastructure of fibre or base stations is too costly due to the low density population in these areas. We note that BEREC only refers to an experience of the Slovenian regulator according to which, "satellite use is a good solution if connected to mobile operator network as redundant backhaul." In reality, mobile network operators (MNO) base stations are already connected by satellite in a very quick and efficient manner to support 3G, 4G and even 5G. Especially in mountainous regions, low-density villages, or for remote industry, the economics of investing in a fibre or microwave infrastructure are risky so MNOs are relying on satellite to connect their cell sites to the backbone and/or to back-up unreliable terrestrial connections. Today satellite constitutes a viable solution to the problem of connecting remote cell sites and makes it possible to deliver an affordable service to end-users.

The use of satellite to support wireless terrestrial (cellular) backhaul began in the early 2000s. MNO reliance on satellite backhaul has increased as many countries adopted universal service policies and mobile operators had to cover more remote locations where terrestrial backhaul was not available or could not be deployed on a timely or cost-effective basis.

With our O3b MEO solutions, an MNO only needs to install two dishes on a cell tower to provide a high-throughput, large bandwidth pipe to all users relying on the tower for their last mile connectivity.

More information about **SES experience and ability to provide backhaul solutions** is available from: Mobile Backhaul | SES, and examples include:

SES and Vodafone PNG Join Forces to Deliver 4G and Future 5G Services via Satellite to Papua New Guinea | SES
Orange and SES Team up on O3b mPOWER Communications System and Open a New Era for Satellite Connectivity Innovation | SES
Tusass in Greenland | SES
Accelerating-mobile-network-access-in-northern-brazil

The same approach is adopted to provide trunking and empower the connectivity of fixed locations, without investing into new terrestrial solutions. Most parts of the world are equipped with xDSL or copper lines which satellite can boost to improve the last mile to end-users. Satellite trunking has long proved beneficial to geographical areas that are underserved. With our O3b MEO solutions, two dishes installed on a switching or nodal point of the terrestrial network makes it possible.

More information about **SES experience and ability to provide trunking solutions**, in collaboration with Telcos, is available from: Satellite Trunking | SES, and examples include:

Digicel Group | SES
RCS-Communication | SES
OptimERA | SES

Contrary to satellite-based consumer broadband solutions that rely on a dedicated and costly satellite end-user equipment, satellite backhauling or trunking do not require additional end-user equipment. Deploying an infrastructure incorporating satellite service into an existing or limited terrestrial wireless or wireline network in underserved areas can only contribute to the development of regions and territories that are left behind.

Satellite also provides a reliable backup option when terrestrial networks experience issues due to technology failure, accident or disaster. Therefore, investing in trunking telecom networks with satellite improve network resiliency, and one single satellite platform can address universal service and service continuity (in case or natural disaster) together.

Cost and Pricing

Satellite solutions have often been criticised as costly, both in terms of access to the bandwidth and equipment purchase and installation. These assumptions are typically based on comparisons between terrestrial and satellite consumer broadband solutions where, in fact, the price to end-users now proposed by several operators, including SES in GEO, have significantly decreased – as illustrated below for the German market.

When using satcom for backhauling or trunking telecom wireless or wireline systems, the cost and price analysis is different. In this scenario, satcom should be compared with solutions that are based on the deployment of Fibre or FWA. In this case, several factors need to be taken into account such as: location, price per km of deployment, opportunity costs related to speed of deployment, potential revenues for Telcos / MNOs, but also the level of public subsidies. One advantage with satellite is that the infrastructure cost is not variable based on the location of the end-user. The cost to install a satellite antenna on a base station in an urban area is basically the same as installing an antenna in a rural area. Therefore, the use of satellite in a terrestrial network does not greatly influence the end-user cost for one type of user over another.

Current and Future Satellite Systems Can Meet the EU Universal Service Goals

Data rates and data volumes

BEREC rightly notes that “the distribution between forward and return channel of private use is dominated by downloads and streaming. Predominant use is in the forward channel to the user.” However, the conclusion that “the available forward channel capacity therefore limits the number of

possible satellite users" is not correct. The existing satellite services are capable of supporting the forward link demand of a significant number of users. Furthermore, the dynamic spectrum assignment capabilities being deployed now offers very high flexibility in adjusting capacity to demand and will make it easier to drive capacity to where it is needed.

Service quality (latency)

Latency in any communications network is unavoidable. Certain applications are not affected by latency, while other applications can cope with latency by using mitigation techniques to overcome its effects. The latency requirement should therefore only be considered on a case-by-case basis in the context of the applications that the connectivity solution will support. Several considerations should be taken into account:

- GSO satellites are suitable to deliver all applications listed by the EECC as essential to provide broadband universal service in Europe.[6]
- Video streaming, which represents the bulk of Internet applications, does not suffer from latency.[7]
- GSO satellites can perform round-trip connectivity down to 470 ms.
- NGSO solutions, including MEO platforms such as O3b, operate with latency that is less than or equal to 150 ms.

Interestingly, some tests conducted recently with GSO satellite demonstrate that latency is not in itself a valid criterion to differentiate the Quality of Experience for a videoconference service.[8]

Available subsidized satcom solutions outside the EU

As mentioned by BEREC, "in Europe, Switzerland has implemented a scheme operated by the incumbent telecommunications operator under which satellite communications are subsidized." The scheme is operated by Swisscom to serve the remaining 2% of the houses that are not connected by the terrestrial infrastructure in using a satellite broadband solution.

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[6] *See* Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (Recast) - Text with EEA relevance (europa.eu), Annex V – Minimum set of services to be supported by adequate broadband internet access service

[7] More information about the actual criticality of latency and for which types of services it actually matters can be found from: 2017-04-Latency-in-Communications-Networks.pdf (gsoasatellite.com)

[8] See the testimony of a Fraunhofer Institute's representative, in a hearing held by the German Bundestag on 22 May 2022: "*the (non-) compliance with the required minimum connection latency does not necessarily indicate the "operability" of certain services: If a suitable and reasonable configuration is chosen (on the part of the user, the satellite radio operator and the service provider), video conferences are also possible via geostationary satellites, for example, and the "perceived quality" does not differ from other video conferences conducted in an international environment with the frequently used tools, according to the user's own experience." Translated with www.DeepL.com/Translator*. From 220503_Fragenkatalog ÖA TKMV_09.05.22 (bundestag.de)

Switzerland's Federal Communications Commission set forth certain requirements in its USO license to Swisscom:

- Basic telecom services should be made available to all populations and all regions of the nation;
- The services must be affordable and reliable;
- The universal service should include public telephone, broadband Internet, and special services for people with disabilities;
- In 2020, the minimum speed requirement for the broadband service must be 10/1 Mbps; and
- From 2018 to 2022, existing analogue and legacy digital connections, such as ISDN, need to be replaced by multifunctional connections based on IP standards.

SES has enabled Swisscom to deliver these performances by providing capacity on our GEO satellite ASTRA 2E, using Ka-band to enable smaller, more affordable user terminal equipment while providing reliable, high-throughput broadband. More information about the performance of our satellite solution is available from: Swisscom | SES

The universal service performance in the country is to further evolve to 80 Mbps as of 2024, and Swisscom will continue to rely on satellite GEO solutions to achieve full coverage.

Services for Disaster Relief

As noted above, the same satellite solutions can be deployed to address the needs for both universal service and disaster relief.

It is now estimated that the annual number of natural disasters is expected to increase by 37% (from 442 to 541 occurrences) by 2025 worldwide.[9] Terrestrial communications networks are particularly vulnerable to disasters such as hurricanes, floods, and earthquakes that can disrupt their services. Thanks to their ubiquitous connectivity and almost complete immunity from catastrophic events, satellite communications are usually deployed during most if not all disasters, when other communications systems have been destroyed or overloaded, enabling immediate vital communications for relief efforts, which otherwise would have taken days or weeks to set up. For example, when an earthquake and tsunami devastated Tonga[10], SES and other satellite operators were able to help restore connectivity within days using existing satellite infrastructure on the island. Other examples include:

https://www.ses.com/press-release/ses-enables-digicel-restore-first-international-calls-tonga

https://www.ses.com/blog/restoring-communications-disaster-stricken-mozambique-satellite

[9] *See* The Citizen | Natural disasters set to increase by 37% globally by 2025 – Report - Access Partnership
[10] *See* https://www.ses.com/press-release/ses-enables-digicel-restore-first-international-calls-tonga

https://www.ses.com/press-release/sess-and-gilat-telecoms-resilient-network-restores-connectivity-africa

Following the floods occurring in Europe during the summer of 2021, some countries have now adopted tailored solutions, such as Germany where containers with satellite equipment are being reserved to connect groups of 5,000 people as a backup secure solution if terrestrial connectivity fails: AB-ELW2 - ASP ONE

The COVID-19 pandemic has also revealed that, given the criticality of digitalisation to the daily life, education, healthcare and commerce, even a short-term disruption of the communication networks can have a high economic and human cost. Integrating satellite communications into the communications networks can guarantee that, in any situation, connectivity will always be available.

Concluding remarks on satcom based universal service

The COVID -19 pandemic has revealed the critical role that connectivity plays in ensuring continuity of social and economic life as well as access to essential services, and a recognition of telecommunications as an essential facility. It has also highlighted the disparities caused by the digital gaps in Europe (and worldwide). According to the EU Commission Communication on A Long-term Vision for the EU's Rural Areas:[11] "despite recent improvements in high-speed broadband connectivity, only 59% of households in rural regions have access to next generation access (NGA) broadband (>30Mbps)." Standard terrestrial solutions will not be able to connect these white spots without huge investments because for Telcos / MNOs, the business model in these areas is difficult to meet.

At SES we believe that any regulatory approach has to promote technology neutrality and inclusivity. Policy makers and regulators should keep the door open to a wide range of connectivity options and avoid imposing technical requirements in speed and latency that are theoretical and will likely only lead to delayed (or non-existent) deployment, as in the past. It is important to support, enhance and promote a wide range of connectivity options, by avoiding the imposition of artificial technical requirement on parameters such as down- and up-link bandwidth or latency that are only required for a limited number of applications and that will limit the connectivity options for many European citizens.[12]

[11] Areas A long-term vision for the EU's rural areas | European Commission (europa.eu)

[12] Again, the testimony of a Fraunhofer Institute's representative, in a hearing held by the German Bundestag on 22 May 2022, highlights what a minimum operational broadband connectivity could be: "*The question of whether "an average household of 2 people can use digital everyday digital services such as video conferencing, streaming or digital education can be used simultaneously and without problems with the proposed* ***minimum bandwidth of 10 Mbit/s for download and 1.7 Mbit/s for upload****", can be answered with "yes" as a rule, on the basis of the data collected. Although it is certainly possible to construct cases in which the combination of two telecommuting workstations or the combination of a home office and streaming exceeds the suggested minimum bandwidths, however, video conferencing or streaming applications*

All technologies offer different capabilities, and the technologies to be deployed should be based on actual users' needs; applications' requirements; geographical situations; time to deployment and cost in order to determine the best technologies needed. Hybrid solutions (e.g. a mix of technologies combining satellite, mobile, fibre, FWA and/or Wi-Fi) have proven successful in enabling meaningful connectivity everywhere in a cost effective way.

usually dynamically adjust the bandwidth requirement to the available resources and prioritize the data to be transmitted (e.g., the voice channel) in order to maintain the best possible quality of service (i.e., smooth voice transmission and jitter-free reception) for as long as possible." Translated with www.DeepL.com/Translator. From 220503_Fragenkatalog ÖA TKMV_09.05.22 (bundestag.de)

ANNEX 1

Swedish PTS contribution

Satellite: an opportunity for fast broadband in 2025 - PTS-ER-2022-18 – Summary
(from: Satellite: an opportunity for fast broadband in 2025 - PTS-ER-2022-18 | Pts)

PTS's assessment is that satellite solutions will be crucial to achieving the Government's broadband target for 2025 regarding the sub-goals of 30 and 100 Mbit/s. Unlike fiber and mobile networks, satellites can provide broadband coverage over large geographical areas without the need for operators to establish infrastructure on the ground. Reaching the last percent to meet broadband targets will be a major challenge due to sharply increasing costs of connecting the remaining households and businesses with fiber.

*Wireless access technologies via mobile networks upgraded with the fifth generation technical standard (5G), especially Fixed Wireless Access (FWA), could probably be used to provide fast broadband in certain areas that are difficult to connect with fiber. However, FWA is also unlikely to be used to connect the most remote areas of the country due to sharply increased costs**. Broadband by satellite now appears to be the only realistic option in these areas.***

*There is **rapid technological development and major investments** are being made in new and upgraded satellite systems by a number of global satellite operators. This development is expected to lead to a large increase in the available capacity for broadband via satellite in the coming years.*

It is likely that all households and companies in Sweden will have coverage that provides 100 Mbit /s from one or more satellite operators by 2025. However, the report makes it clear that there are challenges for those players who want to offer broadband via satellite on the Swedish market and that it is not obvious that services will be available in Sweden even if satellites offer coverage throughout the country.

End customers' knowledge of the existence of services is low, broadband access via satellite is perceived by many end users as secondary in terms of quality and speed to what fiber provides.

The operator that will offer broadband by satellite will need to reach out with information to end-users that broadband via satellite exists and convince them that it is a solution that works well. That could prove to be a challenge. At the same time, the satellite players make it clear in their discussions with PTS that their knowledge of the Swedish market is currently not established and that they have little knowledge of where potential customers are geographically located.

There is also a risk that the players, assuming that they are entering the Swedish market, do not necessarily see an opportunity to stay on it if they do not get customers for their services.

The need for communicative efforts to potential customers to make satellite visible as a solution for broadband access is therefore significant. Communication would be primarily aimed at increasing knowledge and confidence in the quality of services. It can also be about improving the ability for satellite operators to reach potential customers by helping to clarify who the customers can be and where they are located.

Even if the potential end-users have knowledge of the satellite services available and accept that they are adequate broadband solutions, there is a risk that they still do not want to use the services, especially if they are perceived as too expensive. At present, there is no pricing for broadband via satellite in Sweden. But there are many indications that the monthly fee for any future services may be in a range that exceeds the willingness to pay of many in the prospective customer group. In PTS's contacts with satellite companies, several of them have expressed that state aid money could therefore be useful.

PTS believes it is important that we have a broad approach to efforts for broadband expansion. There is a need to work towards making broadband via satellite available to more people.

Broadband via satellite is the best solution in some situations. At the same time, we need to assume that ***satellite, FWA and fiber complement each other in the fulfillment of the 2025 goal****. The need for efforts should therefore be managed so that it includes the various forms of access that can contribute to achieving the government's broadband goals. A palette of efforts and measures will be needed to deal with the many different types of challenges that exist to reach everyone in Sweden with fast broadband, regardless of geographical, social and economic circumstances.*