



SES White Paper November 2016

SES CHARTS RISING GOVERNMENT NEEDS

Global end-to-end solutions connect governments and institutions.

Government and institutional demand for connectivity is climbing. Surveillance technology based on remotely piloted aircraft, and operational networks, are using escalating amounts of bandwidth and causing an exponential growth in connectivity demand. In tandem, personnel in remote areas now expect to connect the same way they do at home, feeding bandwidth demand further. Overall, the expectations and challenges governments face are fuelling a boom in satellite communications and opening new avenues for customised services.

SES is pioneering innovative services and solutions that redefine the possibilities, and enable connectivity that exceeds expectations. The SES approach is defined by six characteristics that outline the variety of ways SES serves governments and institutions. **Reliable** describes the assurance SES gives to provide continuous connectivity. **Innovative** showcases the ground-breaking technologies that are changing the way that governments can operate. **Secure** defines a commitment to integrating advanced security

protocols into products and services. **High-quality** demonstrates SES's dedication to only providing services and solutions that customers can depend on. **Cost-effective** describes the principle of creating solutions that are accessible for governments around the world. And finally, **customised** speaks to the capability of SES to fulfil the most specific requirements. These six characteristics epitomise the way SES provides solutions that are future-proof, flexible, scalable, and stable.

SES[▲]
beyond frontiers



New government technology directs market tailwinds

MARKET TRENDS

Governments and institutions increasingly rely on connectivity to face their complex challenges. As commercial satellite communications (COMSATCOM) provides the versatility they need, the international market demand is accelerating. Globally the market for government and military fixed satellite service (FSS) capacity is expected to reach 615 transponder equivalents (TPEs) by 2024, compared to 470 TPE in 2014¹. For High Throughput Satellite (HTS) capacity, this growth is expected to be even larger, surging from 1.97 Gbps in 2014 to an expected 82.3 Gigabits per second (Gbps) in 2024.

In focus, four trends outline this dynamic market - Intelligence, Surveillance and Reconnaissance (ISR) technology using Remotely Piloted Aircraft Systems (RPAS), network connectivity, personnel welfare, and customised services.

1.

The first trend is the exponential growth in RPAS based ISR for both civil and military uses, which acts as a particularly good indicator of the direction of the international government market. In 2010 69% of the global demand for RPAS came from the US government, while only 5 years later in 2015 the US accounted for 49% of the global demand². This shift was not necessarily caused by the US government spending less on RPAS, instead it demonstrated an increased appetite for the use of RPAS internationally. In fact, even while experiencing constrained fiscal realities, the US Government increased their use of ISR systems as they decreased their physical presence in regions around the world. By deploying RPAS based ISR, governments can maintain an ISR capability without having to keep a team on the ground locally, decreasing risk to personnel

and saving costs. Yet, RPAS have demanding connectivity requirements. As an example, the Predator RPAS requires 3-5 Megabits per second (Mbps), the Reaper RPAS 5-10 Mbps, and the Global Hawk RPAS 10-50 Mbps. The next generation of RPAS are expected to demand over 100 Mbps. As demand for these systems increases, so will the demand for the communications infrastructure that supports them, satellite.

¹ NSR, Report on Government and Military Satellite Communications, 12th Edition
² Teal Group, 2016 World Civil Unmanned Aerial Systems Market Profile & Forecast

2.

The second trend driving growth is connecting and networking personnel for operational purposes, whether for military missions, peace-keeping, or civilian applications. As managed network access becomes critical for governments to deliver applications and services to their populations, connectivity is even more important. To ensure their needs are met, governments recognise the value of a resilient communications infrastructure that operates regardless of the location or situation. As terrestrial communications are not immune to disruption from natural disasters or conflict, COMSATCOM also provides the vital link where existing military satellite communications (MILSATCOM) capabilities are overstretched or lack coverage.

3.

A third trend regarding COMSATCOM demand is related to welfare use by the military. Military personnel serving overseas, like their civilian counterparts, have become accustomed to constant connectivity. Their desire to connect with loved ones back home or enjoy the same leisure activities does not disappear once they are posted to a remote location. This requires connectivity that can deliver regardless of

Why hosted payloads are a clear choice

	DEDICATED SPACECRAFT	HOSTED PAYLOAD
Cost per launch	€ € €	€ € €
Frequency of launches	🚀 🚀 🚀	🚀 🚀 🚀
Added expertise	💡 💡 💡	💡 💡 💡

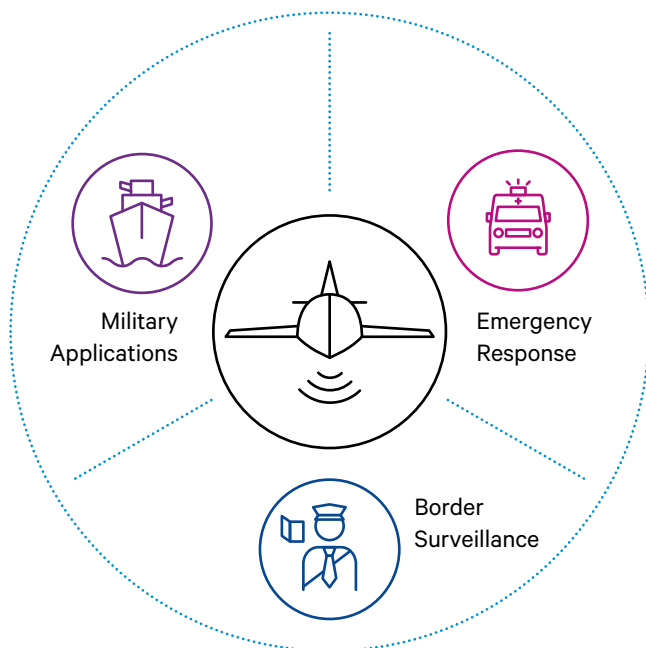
location. COMSATCOM is the ideal infrastructure to support this requirement. As this welfare factor becomes more important, the COMSATCOM service to government entities is expected to increase.

4.

A final trend is the growing demand for customised services. Governments are identifying new and efficient uses of satellite solutions, causing an increase in demand from this sector. Commercially hosted payloads are a good example of this. The flexibility

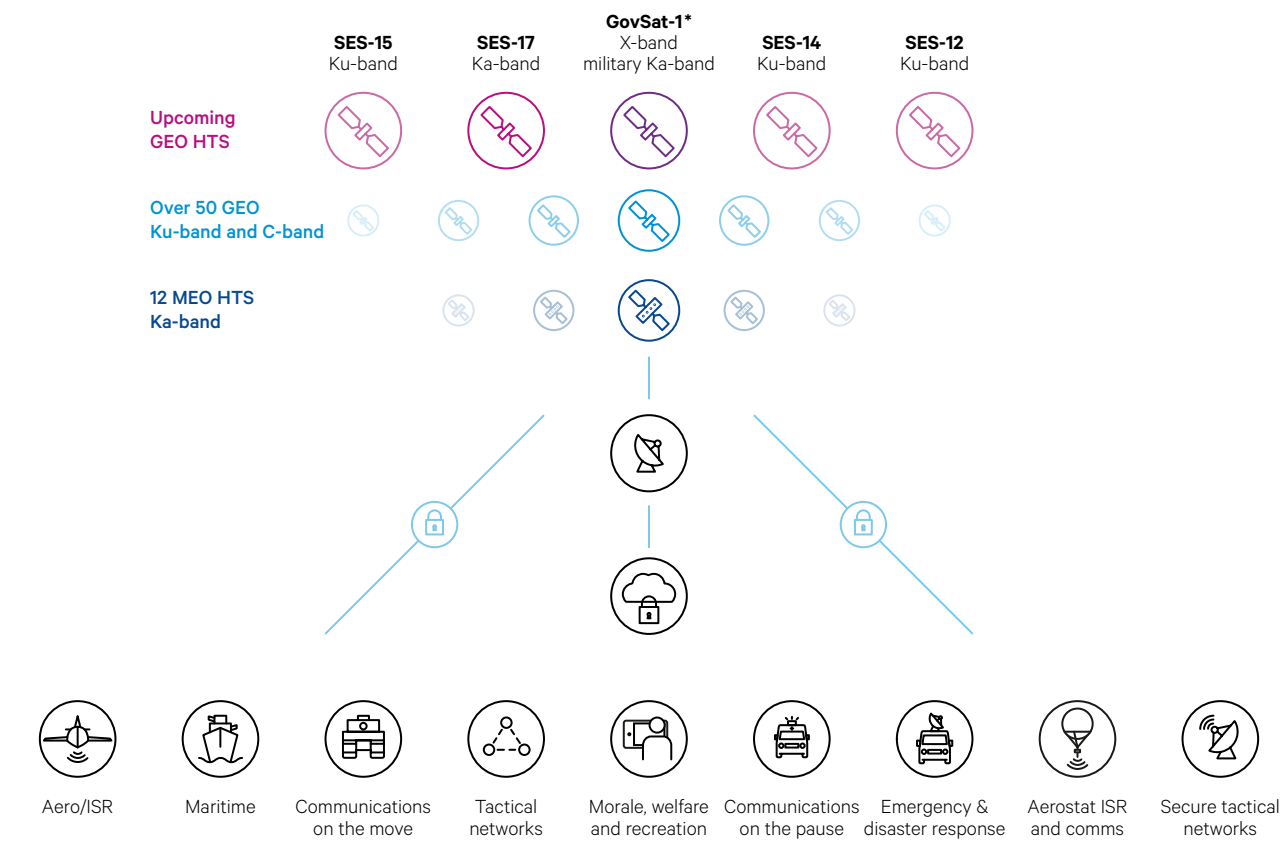
and cost-efficiency offered by hosted payloads ensures that a government can contract many relevant services that a satellite is required for on a shorter timeline than building their own. Hosted payloads are well suited for earth observation missions, hosting of sensors, proof of technology missions, or even dedicated frequencies and/or reflectors. A hosted payload can also be attractive for governments that do not yet have a spacecraft in orbit and want to take their place in the international space community.

The uses of ISR



Within these four trends there is one common defining aspect of the government market, the procurement process. Each government has a specific process in place in order to ensure that any purchase it makes delivers to its needs exactly. As governments feel the constant duty to live up to the public trust, they must be completely circumspect and pragmatic in their approach. Each procedure is different, but a common trait is a multistage process that takes place over the course of months or years. SES has the unique institutional knowledge combined with an industry-leading financial stability to support any government or institutional need.

SES's Global Network – Mobilising Government Applications



* Non-HTS

GOVERNMENT APPLICATIONS

THE SES APPROACH

SES is at the epicentre of a suite of companies that take a global approach for product development and customer service, forming a powerful collection of capacity, services, and solutions for the government and institutional sector.

SES Techcom Services creates solutions as well as designs and deploys services, working closely with governments as an SES commercial agent in Europe. In the United States **SES Government Solutions (SES GS)** exists with the mission to serve the US Government's needs particularly. In orbit SES's fleet in Geostationary Earth Orbit (GEO) is complimented by **O3b Networks**, which provides global managed services that are enabled by a completely unique constellation of satellites in medium Earth orbit (MEO) delivering fibre equivalent connectivity

to Earth. And finally **GovSat**, as a public-private partnership between SES and the Luxembourg Government, offers assured and highly secure X-band and military Ka-band services to support government and institutional operations defence and security projects, ISR and institutional civil emergency response.

In a sector where each situation requires different methods and technology, SES tailors its offering to provide the crucial support needed for the important projects of governments and institutions, both regionally and internationally. Six characteristics define the unique capabilities that SES brings to the sector. SES services and solutions are - Reliable, Innovative, Secure, High-quality, Cost-effective, and Customised.



Enabling critical and tactical communications

RELIABLE

In an industry where constant communications is crucial, SES provides reliable service, going beyond the capacity of its fleet. The SES fleet boasts a record level of technical availability for a satellite fleet at 99.999992%. With this kind of reliability, governments can depend on SES satellites to supply all kinds of crucial operations, including ISR applications and network connectivity.

RPAS based ISR is a large part of COMSATCOM government service as the aircraft are connected to their remote pilot with satellite communications. In this area, SES will support NATO's Alliance Ground Surveillance (AGS) project by delivering satellite capacity in commercial Ku-band for an end-to-end service provided by GovSat. This service will support the command and control, and sensor data communications required by

NATO Global Hawk vehicles over the AGS operational area. Also, SES Techcom Services provided satellite engineering support in the design and development of the NATO AGS implementation phase, and is building satellite ground stations.

In the United States, SES GS has maximised the potential of SES's global fleet by providing the US Government with the capacity needed for their ISR systems. SES satellites currently support missions on a number of different platforms, including Predators, Reapers, and Gray Eagles. SES's global fleet provides SES GS with the depth and operational flexibility necessary to adapt to the quickly evolving requirements of the US Government.

Providing access to everyday network services is also becoming more critical for government missions as well.

Embassies need to be connected to the national network, offices in remote regions need to access to the same services urban institutions have, and local civil service personnel and residents expect broadband service regardless of their location. SES supports these needs by providing reliable connectivity anywhere in the world. In Canada, SES was contracted by the Kativik Regional Government to do just that. Now SES is delivering critical C-band communications capability to more than 14 communities, increasing the amount of bandwidth available across the Nunavik region. While the service is feeding the need for reliable and faster internet across the region, it is also enabling important connectivity for schools, hospitals, government buildings and other critical facilities.



RPAS based ISR depends on reliable connectivity

INNOVATIVE

As technology for data gathering and communications develops, governments require increasing amounts of bandwidth for their applications. RPAS based ISR continues to generate increasing amounts of data, as do command applications, and personnel welfare requirements, among others. SES is serving these needs in ground-breaking ways by launching HTS in GEO, expanding O3b's constellation providing fibre equivalent connectivity from MEO, and innovating with secure frequency on GovSat-1. These services are game changers for governments as they will allow them meet the challenges of running security, defence and civil operations today.

O3b's globally managed MEO satellite enabled networks offer great promise for government connectivity. With an ultra-low satellite latency of less than 150 milliseconds round-trip, governments can operate the data-hungry interactive cloud applications they need in rugged terrain, disaster affected sites or at the edge of the battlefield. The steerable beams of the

O3b satellites resist interference and allow customers to position coverage where they need it most. Along with low-latency O3b delivers up to 2 Gbps of connectivity, allowing command operations to work with full motion HD video for their surveillance operations. Antennas are being developed today that will allow for O3b connectivity directly on a RPAS, which will completely change ISR with real-time delivery of remote sensing data and full motion video.

The US Navy's 7th fleet first tested O3b's fibre equivalent connectivity during a Limited Objective Experiment in the course of Trident Warrior 2015. During this test O3b demonstrated its ability to realise Network Centric Warfare capabilities, which create a military advantage based on providing more usable information directly to operations in theatre. In tandem with operational connectivity, O3b provided the connectivity for 4G/LTE, WiFi, HD video streaming and telemedicine. This is game-changing for troop welfare as it allows for personnel to access the same quality of services

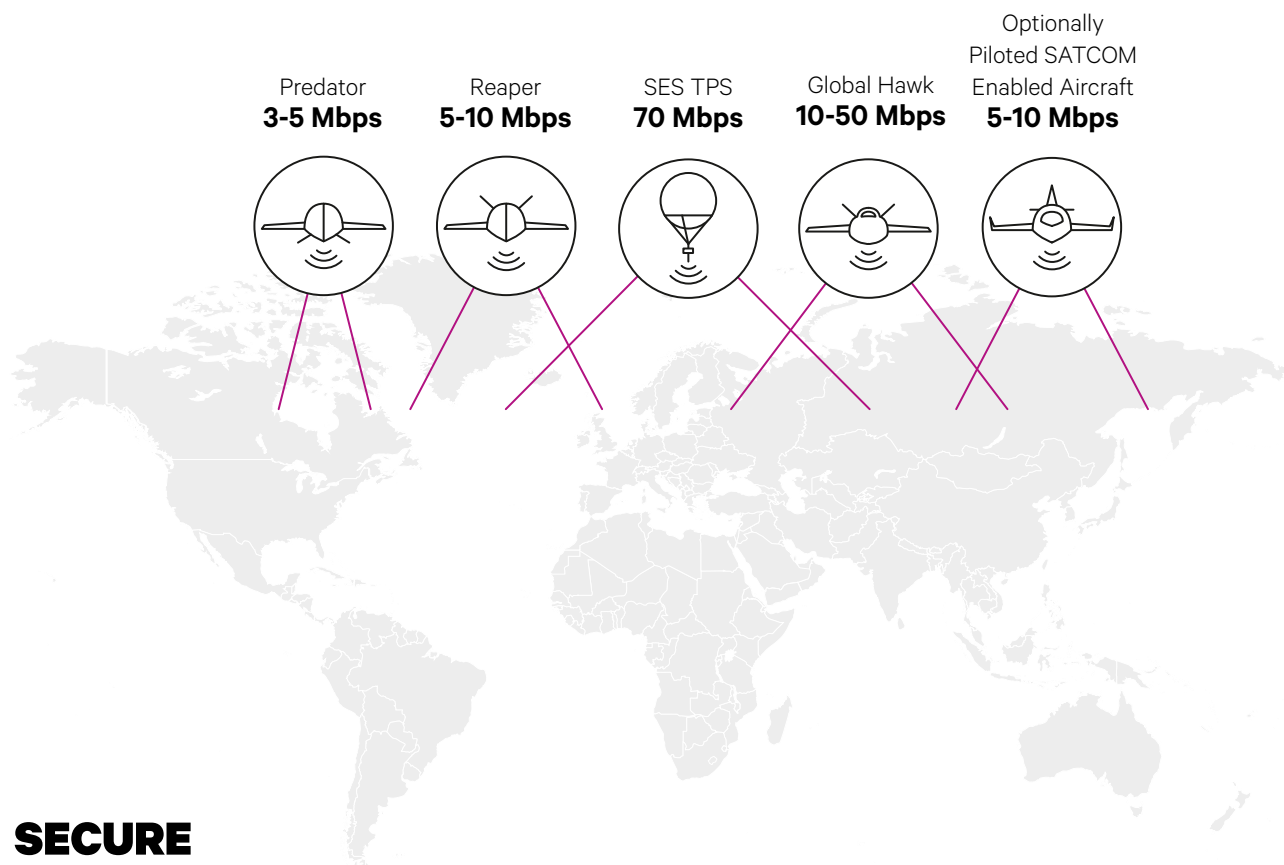
that they use back home, while they are in a theatre of operations. Since the Navy test two bodies of the US Government recently contracted O3b capacity through SES GS. The National Oceanic and Atmospheric Administration (NOAA) was the first US Government agency to sign an agreement with SES GS, and more recently a US Department of Defence end-user has contracted O3b capacity, again through SES GS, for a high performance network.

SES differentiates itself thanks to the endless possibilities that O3b's MEO constellation and SES's future GEO HTS fleet offer. Like O3b, GEO HTS will be a completely managed service, giving customers the flexibility to contract the specific amount of capacity they will use. This makes operating cost-intensive applications such as RPAS more cost-effective and enables more governments to take advantage of their benefits. Upgrading ground systems will allow the full potential of both SES's GEO HTS and O3b's MEO satellites to be realised.



O3b fibre equivalent connectivity is changing personnel welfare

SES can deliver to a complete ISR catalogue



SECURE

Security of any communications system is the top concern of any government or institution operating sensitive projects, and satellite systems offer the assurance that is needed. Located thousands of kilometres above the Earth's surface, satellites are shielded from terrestrial disasters such as hurricanes and earthquakes, power disruptions, cable damage, civil disturbances, or terrorist attacks. This makes them ideal for government operations, and COMSATCOM plays an important role in this critical infrastructure, allowing governments to diversify their communications planning. As an example, SES GS enables the US Army's TROJAN Network that provides access to a global, end-to-end network, complete with multi-band service tailored to meet specific US Army Intelligence and Security Command (INSCOM) requirements.

The innovation coming from SES further enhances the security of satellite communications. Starting on Earth, SES Techcom Services has the long-term experience to deploy innovative end-to-end ground

solutions and networks that are fully customisable and meet the highest standards of security. In orbit the steerable beams of O3b's MEO satellites make concerns about interference from the ground almost negligible, as the moving beam would need to be found and then disrupted from inside the spot beam's coverage. HTS satellites will operate similarly, allowing frequency to be reallocated and reused, which will provide equal resistance to jamming attempts. Finally GovSat-1, a highly secure multi-mission satellite, will use dedicated military frequencies (X-band and military Ka-band) to deliver high-power and fully steerable beams for multiple government-specific missions.

GovSat was created in order to address the demand resulting from defence and civilian security applications. As a public-private partnership between SES and the Luxembourg Government, the GovSat team has a proven track record thanks to combining Luxembourg and its benefits as a stable European Government and NATO member, with SES, a leader in satellite operations. X-band is a military frequency band

exclusively reserved for governmental use and ideal for establishing secure and robust satellite communication links, while military Ka-band is similarly reserved and ideal for high-throughput or mobility applications. GovSat provides accredited teleport and hosting facilities, emission security including tempest capabilities, transmission security such as anti-jamming capabilities, secured waveforms, and crypto security, as well as completely secure mission operations consisting of security cleared staff and best-practice security management. GovSat-1's potential institutional uses include supporting civil-military inter-agency collaboration, strategic and tactical networks, emergency response, disaster recovery, border surveillance, peace keeping, and connecting remote government offices. Its possible military uses include services for global deployed tactical and strategic operations (mission to HQ communications), communications on the move, communications on the pause, maritime operations, and aero operations (ISR).

HIGH-QUALITY

Providing high-quality services or solutions is integral to the SES approach, which is why it provides consultancy and training as a key service to assist governments in achieving their goals. SES can share years of experience providing top-of-the-line services and solutions that are cost-effective and capable of meeting tight timeframes. This includes but is not limited to ISR projects and satellite procurement.

More and more nations are looking to implement RPAS of their own for the first time. For those nations endeavouring to do this, SES is assisting at both ends of the process.

When a country is looking to procure a RPAS from a US company, it must follow a strict procedure from the US government for foreign military sales. SES can provide support during this initial procurement process by consulting on the procedure and the specification of capabilities. Once the technology has been procured and is being implemented, SES can then assist again by providing consulting and training services along with the satellite capacity and infrastructure.

SES also offers to partner with governments that are motivated to procure and launch a satellite of their own. Joining the international

community of nations who have satellites in orbit can be a milestone moment for a country, but can also be fraught with challenges. If a government has never procured a satellite, SES can ensure it receives a quality product, and operating such a spacecraft requires its own unique skill set that SES can provide as part of a technology transfer. SES assists governments in these endeavours to help them achieve both their short-term and long-term goals.

COST-EFFECTIVE

The international economic climate remains difficult, and therefore governments today are focused on finding cost-effective solutions that still meet their needs to the highest standards. End-to-end solutions for satellite communications are in many cases more cost-effective, which is why SES is going up the value chain to meet this need, developing complete solutions that already incorporate connectivity. SES Techcom Services uses a variety of connectivity building blocks to deliver end-to-end solutions that meet customer budgets. These include the design and deployment of ground infrastructure, secure networks, solutions integration, and operations of satellite IP platforms. By combining these building blocks created by SES Techcom Services, and capacity from both the SES and O3b fleet, SES is developing cost-effective and ground breaking products and solutions for the government sector.

SES recently unveiled one such end-to-end offering, the Tactical Persistent Surveillance (TPS) product. TPS responds to the market need for cost-effective surveillance technology that can be deployed quickly and

operated easily. The SES TPS is a portable Aerostat system (helium filled balloon) that carries both a connected surveillance sensor, as well as a communications payload that delivers a bubble of connectivity ranging over 40km. The TPS has a diverse number of possible uses that include border surveillance, crowd control and monitoring, as well as rapid communications capability to support first responders in locations where connectivity is not otherwise available. The system is quickly deployed in 30 minutes by two trained personnel, and portable when towed by a standard truck or SUV. A unique aspect of this solution is that governments can either purchase or lease the product from SES, with ancillary services if needed. This ensures its accessibility for governments around the globe as surveillance becomes a more important capability everywhere, regardless of budget limitations.

TPS is only one example of the way that SES is going up the value chain to ensure that governments receive the solutions they need. As emergency response and border control become more essential, SES is

developing a number of cost-effective products that support personnel in such situations. These create a full suite of end-to-end services that give governments the tools needed to face today's challenges.



Cost-effective solutions deliver ISR and connectivity to personnel operating in remote regions

CUSTOMISED

Creating customised solutions is a particular strength of SES, the leading commercial satellite provider for hosted payloads. Hosted payloads offer unique benefits to government customers by allowing them to contract a place on a commercial satellite and load it with their own service payload. This arrangement is attractive as it allows governments or institutions to avoid the cost of building and launching their own complete satellite. Instead a payload can be placed on a commercial satellite to complete its mission much more cost-effectively. Another added benefit is that the project timeline to get the payload into orbit is shorter with commercial operators.

SES is the ideal partner for hosted payload projects because of the openness it practices during the satellite manufacturing process.

This allows for governments and institutions to plan a hosted payload in cooperation with SES. The frequency that SES launches satellites also offers a distinct advantage for governments, opening up constant opportunities for hosted payloads.

The first hosted payload SES worked on was the European Geostationary Navigation Overlay Service (EGNOS) project's EGNOS-GEO 1 payload, launched in 2012. In 2014 EGNOS-GEO 2 also made the journey to space on SES's ASTRA 5B. SES's hosting service allowed the European Commission and the GNSS Authority to access space at a fraction of the cost of dedicated missions. EGNOS augments the US's GPS satellite navigation system, making it possible to be used for safety critical applications including flying aircraft and navigating ships through narrow channels.

In the future, it will also support GLONASS and the European Galileo navigation system. SES Techcom also provides customised services for the Galileo system, delivering satellite communications services for the Galileo Data Dissemination Network (GDDN). The services include the deployment, maintenance and support of a VSAT network (deployed at various remote locations around the world including Antarctica), provision of managed satellite bandwidth, and the network monitoring and control on a 24/7 basis.

SES's Hosted payloads



CRUCIAL SUPPORT

SES provides the ground-breaking solutions and communications infrastructure that governments and institutions need. The six characteristics that describe different elements of the SES approach - Reliability, Innovation, Security, High-quality, Cost-effectiveness, and Customisation, are tied together by the common principles of flexibility, scalability and stability. Flexibility in everything is paramount in an industry where responsiveness is crucial. Ensuring that all offerings are scalable is key to ensure that governments and institutions are able to have their needs met. And finally, stability is crucial, and a significant area where SES differentiates itself.

The stability that SES offers as a government and commercial satellite communications provider is unmatched because of two factors. First, as the world's leading satellite operator it has the long-range outlook, stability, and technological

knowledge necessary for complex government projects. Secondly, as the Luxembourg Government is one of SES's major shareholders, the company benefits from its positive political and economic reputation. Luxembourg has made significant contributions to the space industry and is continuing to make history today. As a NATO member and one of the founding members of the European Union Luxembourg has a reputation as an open country that seeks alliances and fosters relationships. These traits fortify SES in all of its work, but particularly in the government sector.

Together the unique capabilities of SES detailed above make it distinct in the government and institutional arena where it is not only responding to government needs but shaping the future of demand with services that go beyond capacity, and innovations that redefine possibility.





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