

Air League - Sir John Slessor Memorial Lecture

Defence & Security in the New Space Age

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My Lords, Ladies and Gentlemen, I am honoured to stand before you this afternoon to present the 2018 Slessor Lecture and I'd like to thank The Right Honourable Matt Hancock for hosting us today.

Following a long list of eminent speakers who offered thought leadership on Air Power and defence capabilities, today, for the first time in these settings, I have the opportunity to focus on Space as a key element for defence and security.

I think this timing couldn't be more appropriate for the following reasons:

- 1- The **Space Sector is thriving** globally and across sectors
- 2- **Space has become a key element of Defence and Security**
- 3- **We're at the dawn of The New Space Age**, across sectors and beyond frontiers.

I'd now like to expand on these points.

1] The Space sector is thriving. According to Morgan Stanley, the global space economy will grow from \$350 billion today to \$1.1 trillion plus by 2040. Space technology is enabling new opportunities across sectors such as aerospace and defense, telecom services, media, and mobile connectivity — ground, air, sea — and generating new types of business and research.

Satellites are at the core of this success.

For this reason, in just the last few years, investments in space have increased exponentially and across the globe: governments, private ventures, startups are all trying to be part of the race towards **The New Space Age**.

Allow me to briefly introduce SES and Luxembourg in this context.

We are the world-leading satellite operator connecting and enabling broadcast, telecom, corporate and government customers everywhere on Earth. We therefore operate in both the global broadcasting and connectivity industries.

Our rapidly growing constellation of over 65 satellites is the first to deliver a differentiated and scalable GEO-MEO offering worldwide. The multi-frequency and multi-orbit fleet includes over 50 Geostationary Earth Orbit (GEO) at 38,000 Km and 12 Medium Earth Orbit (MEO) satellites at 8,000 Km above the Earth. 4 additional MEO satellites will be launched this Friday.

We are organized in two business units: **SES Video** and **SES Networks**.

Our satellites serve 7,741 TV channels to more than 1 billion people in 325 million homes,

In addition, SES provides communication services across the world, even in the most remote areas and to mobile platforms and deployed forces. For example, we serve about 90% of the world's connected planes. This means that a majority of aircraft across the world providing Internet and/or live TV via satellite use SES's network – either exclusively or partially. Recently, SES has also launched Maritime+, allowing our customers to serve cruise ships, shipping, fishing and leisure industries.

From a Defence and Security perspective, our newly formed **Global Government** business unit provides global end-to-end connectivity solutions to governments and institutions through our combined fleet of GEO and MEO satellites. Our portfolio of international government business has doubled over the past two years, reaching 70 government entities globally.

SES is based in Luxembourg. Yes, that tiny country in the middle of Europe, counting a population of 600,000 (of which 47% from abroad) on a surface of 2,586 sq km, with forests covering more than a third of it. Luxembourg is indeed a beautiful place with one of the highest quality of lives in the world - now if only we had the sea nearby and a bit more sun... ☺ But you might not know that Luxembourg has a Maritime Administration and is a world leader in maritime shipping, with over 330 maritime companies based in the Grand Duchy.

Some of you might also be surprised by the level of investment that Luxembourg has put into the Space sector. Today, the Grand Duchy devotes 0.03% of its GDP to the European Space Agency, and ranks fourth among European countries in terms of space investment.

SES was at the centre of this investment since its beginning. Luxembourg in fact started to develop its space industry in 1985 through the creation of SES as Europe's first private satellite operator. The initiative was not without controversy, with some of Luxembourg's neighbours fearing it would threaten their own satellite programmes. These fears were compounded in France, where there was concern the new satellite could become a vehicle for 'US cultural imperialism'. Of course this never happened. ☺ It is also interesting to note that when our very first satellite was launched on 11 December 1988, half of its capacity was acquired by BT from the UK.

The second step in positioning the country in the space sector was Luxembourg's accession to the **European Space Agency (ESA)**. This membership, preceded by a cooperation agreement on the telecommunications programme of the Agency (ARTES), became effective on 30 June 2005, with Luxembourg becoming the 17th Member State of ESA.

The third step taken recently by the Luxembourg government has been to position the country as a pioneer in the development of the space resources economy, which has been announced in February 2016 and promoted under the branding **SpaceResources.lu**. This initiative, and Luxembourg's entrepreneurial spirit towards Space Mining among other initiatives, led within only 1 year to the definition of a specific space law and the establishment of several companies active in this domain.

The Luxemburgish government itself is providing networks in support for the various players in the Grand Duchy's aerospace sector by helping them to develop synergies and new national and international partnerships through research, development and innovation (RDI) projects.

LuxInnovation, for example, is the national agency for the promotion of innovation and research, is the national contact point for all collaboration with the ESA. Luxinnovation encourages innovative activities and collaboration in European research programmes through the Luxembourg Space Cluster. The companies of the aerospace sector also collaborate with

national research institutes, such as the University of Luxembourg and the Luxembourg Institute of Science and Technology (LIST), for satellite communications and earth observation.

As for Luxembourg, the British Space sector is also thriving and is the object of significant investments.

The Space sector in the UK saw in fact a £11 bn turnover last year, with 34K people directly employed in the sector of which 1,150 apprentices. 82% of UK Space companies are in fact investing in high-tech skills and we all know how much these are needed for the prosperous future of our industry.

At SES, we are working closely with The Satellite Applications Catapult based at Harwell Campus, in Oxford, where next week, on 13 March, my colleagues will have the pleasure to speak at the first “SES and Harwell Innovation and Technology conference” titled “Collaborating for a connected world”.

Harwell Campus is in fact a public private partnership between Harwell Oxford Partners, U+I Group PLC, the Science and Technology Facilities Council and the UK Atomic Energy Agency (UKAEA). Harwell is in line with the UK government’s Industrial Strategy to maintain the UK’s global leadership in science, innovation and research and received a major new £100 million investment by the government in February 2017. Today, it is one of the world’s most important science and innovation locations it is seeing rapid growth in the Life Sciences and HealthTec sector.

Harwell Campus is a wonderful example of national investments strengthening links between research and industry in UK and abroad and we will continue to work with Harwell and facilitate collaboration among startups, companies and academic institutions across Luxembourg and the UK.

2] This therefore leads me to my second point: Space has become an important element of Luxembourg and UK’s economies, contributing to technological innovation, prosperity, job creation and collaboration beyond frontiers. Beyond economies, **Space and Satellites play a vital role in defence and security.**

Satellite solutions are in fact increasingly the preferred and fundamental medium of choice for governments seeking the most secure transmission paths and cost effective solutions for homeland security, defence and security operations, border management and rapid response to natural and man-made disasters.

First, satellites are a resilient capability, not subjected to terrestrial devastation such as hurricanes and earthquakes and disruptions due to civil disturbance or conflicts, power disruptions or cable damage.

Secondly, satellite connection transcends physical barriers and span geographic distances substantially wider than ground-based networks, and can be established almost immediately, virtually anywhere.

Satellite solutions are thus **resilient, flexible, secure and rapidly deployable** in case of emergencies, when the terrestrial infrastructure is overloaded, is left inoperable or does not exist.

Each of our GEO satellites provides coverage over vast areas of the Earth's surface enabling connectivity from sovereign Nations and deployed forces connecting people and businesses in a cost-effective way. The key GEO differentiator is a powerful downstream connectivity for full motion video and high throughput data transmission.

Our globally managed MEO satellite-enabled-networks offer complementary promise for government connectivity. With an ultra-low satellite latency of less than 150 msec 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 our MEO satellites allow customers to position coverage where they need it most providing resilient connectivity. These satellites 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 enhance our connectivity directly onto Remotely Piloted Aircraft Systems (RPAS). This will completely change ISR scenario with real-time delivery of remote sensing data and full motion video.

Our unique combination of GEO and MEO is a technological leap and is a well proven force multiplier for defence forces and peacekeeping missions who need flexible, scalable and resilient services across domains and geographies.

The security of communications systems is thus the top concern of any government or institution, and satellite-enabled solutions offer the assurance that is required. More than ever, the application of speed, flexibility, resilience and the deployment of the right set of tools are important in fighting conflicts. This 'hybrid warfare approach', a recurrent theme in modern defence and security strategies, defines Space as a key component.

As stated in the "Space Domain and Allied Defence Report" by the NATO Defence and Security Committee in October 2017: *"The Space domain and Allied Defense improvements in space technology drive the development of advanced military systems; they are important force multipliers when integrated into joint operations"*

Government and military forces must deploy at a moment's notice. When surges occur, there simply must be additional agile COMSATCOM and GOVSATCOM capacity available, when and where needed.

The ability to offer high-speed data rates and make efficient use of bandwidth is essential to meeting rising defence expectations. But today it takes more than that — it means enabling dynamic, flexible services that can be turned on rapidly and adjusted on demand across the entire global network. SES provides the technology building blocks to support true service agility at every point in the process from network implementation to optimized end-to end service fulfilment.

The exponential growth in RPAS-based Intelligence Surveillance and Reconnaissance (ISR) for both civil and military uses, acts as a particularly good indicator of the direction of governments requirements.

The total number of RPAS used worldwide reached about 30,000 in 2016, more than doubling from 2014. Consequently, the RPAS demanding connectivity requirements is also increasing. As way of example, when the Predator RPAS required 3-5 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 and this is enabled by satellites.

Real time exchange of an increasingly exponential amount of data is in fact required for improved situational awareness and information superiority at multiple levels of command to enable better coordination. Real-time dissemination of still images or full motion video up and down the chain of command is essential to execute missions more effectively whilst enabling better-informed, life-saving decisions in the field.

High-powered satellite-based solutions are therefore transforming the security environment globally. Future Intelligence Surveillance and Reconnaissance (ISR) platforms will monitor borders, events and municipalities, while HD surveillance platforms on RPAS will develop even further alongside this new satellite technology.

To meet that insatiable demand, mostly driven by bandwidth-hungry Intelligence Surveillance and Reconnaissance (ISR) platforms, RPAS as well as other autonomous land and maritime platforms, SES is investing in new satellite technology and solutions which will entirely change the scope, applicability and potential of satellite-based constellations and ecosystems and will bring rapidity, agility and security in our collaboration with Governmental users.

Today, in the ISR arena, SES serves in fact as a preeminent provider of capability to support these platforms, ranging from an extensive foundation in supporting the U.S. government, to the more recent increase in support to NATO and friendly forces globally.

We in fact deliver Ku-band capacity, as well as engineering support in the design and development of the system for **NATO's Alliance Ground Surveillance (AGS)**. NATO AGS serves as a major data source for Joint Intelligence, Surveillance and Reconnaissance (JISR).

AGS gives commanders a picture of the situation on the ground in an area of interest. Five unarmed Global Hawk remotely piloted aircraft and the associated ground command and control stations make up the AGS system. The AGS system performs all-weather, persistent wide-area terrestrial and maritime surveillance in near real-time. AGS is able to contribute to a range of missions such as protection of ground troops and civilian populations, border control and maritime safety, the fight against terrorism, crisis management and humanitarian assistance in

areas affected by natural disasters. NATO AGS is based on the Northrop Grumman Global Hawk RQ-4 high altitude, long endurance (HALE) unmanned aircraft system.

Information superiority is key and satellites provide that capability.

Today we are in the House of Commons, the place at the forefront of the negotiations between the UK and Europe towards **Brexit**. Whilst trade, borders, defence and security policies are under negotiation, the inherent collaborative and innovative nature of the Space sector will continue to thrive across Europe, and so must UK and Europe's collaboration in Defence and Security through the development of technology, policies and applications. The Space sector will remain the common ground for this collaboration.

This was confirmed in Prime Minister May's speech at the Munich Security Conference on 18 February where she said: *"...it will also be in our interests to continue working together on developing the capabilities – in defence, cyber and space - to meet future threats.[...] And as our lives move increasingly online, so we will also become increasingly reliant on space technologies. Space is a domain like any other where hostile actors will seek to threaten us. So we very much welcome the EU's efforts to develop Europe's capabilities in this field. We need to keep open all the options which will enable the UK and the EU to collaborate in the most effective way possible."*

On 31 January 2018, GovSat's first satellite, GovSat-1, was successfully launched by SpaceX from Cape Canaveral. GovSat-1 is the first satellite of the public-private-partnership between the Luxembourg government and SES and represents a key milestone for the Space industry and defence sector.

This multi-mission satellite in fact represents our first engagement in military frequencies and further indication of our commitment to serve this market. The satellite has just entered service, offering NATO and allies highly secure and accessible, encrypted command and control and anti-jamming satcom capability. This is obtained through a X-band and Military Ka-band capacity over Europe, Africa, the Middle East, and substantial maritime coverage over the Mediterranean and Baltic seas, as well as over the Atlantic and Indian oceans.

I have mentioned 'encrypted' because the fundamental characteristic of satellite technology

applied to Defence and Security is 'resilience': a tool that strengthen capabilities cannot be a source of vulnerability.

GovSat-1 mission goes far beyond pure military uses and services and includes civil, security, surveillance and humanitarian purposes. There are vast numbers of non-military applications where RPAS are involved, including humanitarian and civil protection.

This further underlines the power of Space in Defence and Security when it is linked to economic growth and social stability. The same connectivity used to broadcast video to millions of viewers can be used to provide broadband services and "fiber in the sky" capacity to generate economic growth and contribute to gross domestic product.

In recent years, we've in fact seen a proven link between connectivity and the ability to tackle global economic and societal challenges: reducing poverty, climate change, saving energy, and building access to equal opportunities, disaster relief, education, job opportunities, and improved health services for people everywhere.

This brings me to the third point of this Lecture:

3] We're at the dawn of The New Space Age, across sectors and beyond frontiers

I've mentioned Space as a new, important factor for economic growth and as de-facto key element for defence and security beyond frontiers. I've also mentioned how this technology doesn't stop at the satellite transmission but has a positive impact on society.

Today, we are at the dawn of **The New Space Age** because Space technology has transformed the way industries as diverse as banking and farming operate. Data has become information. Information has changed processes and opened opportunities.

We have moved from one tiny satellite, the Sputnik, launched in 1954 by the Soviet government, to the landing on the Moon in 1969 led by NASA, to SpaceX Falcon Heavy, tested two weeks ago in Florida.

At the Starmus Festival 2017, Stephen Hawking said *“I am convinced that humans need to leave Earth...We've entered a new space age demanding we expand or die.”*

Whilst this approach can sound depressing it has become in fact a positive statement of reality: we as humans, are already projected beyond Planet Earth. Right now, there is a dummy in a spacesuit driving a car and they're in orbit around our planet listening to David Bowie. What an amazing moment to be alive! 😊

The New Space Age is thus already here. The global Space industry is no longer dominated by the world of aerospace engineering giants but sees the increasing success of venture-capital-funded start-ups such as SpaceX that can rely on ever-cheaper services for ever more customers.

This, especially in the last year, has been a game changer.

SES for example pioneered SpaceX launchers and last year we were the first to launch a satellite on a flight-proven rocket. A first in 'space reusable technology'.

The technology on board of our satellites is also rapidly evolving: all electric satellites can be smaller, less expensive to launch, more durable – when the average life of a satellite is 15 to 20 years. We now also have the potential to refuel satellites in space, enhancing their operational lives even further.

From 2021, seven next-generation MEO satellites, built by Boeing, will be added to our fleet, setting new industry benchmarks. Called O3b mPOWER, the new system marks a new era of space economy in which distributed capabilities become more accessible. O3b mPOWER will have more than 4000 steerable beams per satellite, covering about 400 million of square kilometres and be capable of powering any mission, anywhere.

O3b mPOWER will provide 'fibre in the sky' connectivity, multiplying its beneficial effect on economies and society even in the most remote areas of the globe. It will bring high-performance and global cloud-scale connectivity to exponentially more people, communities, and businesses whilst challenging the conventional wisdom of where and how satellites are used in a world of seamless networking.

Our new satellites will be able to transmit thousands of Gigabits per second, multiplying on-board traffic by one or more orders of magnitude. SES is serving these needs in groundbreaking ways by launching HTS in GEO, expanding our MEO constellation, providing fibre equivalent connectivity and innovating with assured frequency bands 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 in a timely way today.

As a global satellite operator, the service we provide to the men and women of the security and defence sectors, emergency first responders and institutions around the world is a source of passion and pride. We know that at the very heart of these missions with our friends and partners in this room and around the world, SES is delivering a communications capability that at the end of the day, saves time, money and more importantly lives.

Today, in **The New Space Age**, we are therefore in position to go further and explore new frontiers of opportunities - and do what just yesterday was thought to be impossible.