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Award Winning Teleport



Making the most of home-grown opportunities



Editor - Amy Saunders ●●●

For space industry observers, it's easy to believe that anything is possible, that there are no limits to what we can do. All this talk of self-driving cars, hotels on Mars, and super-fast global Internet for everyone makes people think we're so much further along than we actually are. While all these ideas are under research and development, we're still some way off seeing them actualised just yet.

If we look backwards, it hasn't even been 50 years yet since man first set foot on the moon for the first time. In total, there have been six manned moon landings, the latest in 1972. A lot of people have theories, some crazy, some entirely reasonable, about why we haven't ventured back to the moon since then. But the argument that just keeps coming up is money, or lack thereof. It costs a lot of money to visit the moon, money that could (arguably) be better spent developing more affordable launch systems.

In order to keep forging ahead, it's absolutely vital that investment in new technologies continues; reusable launch vehicles, for example, which in theory will one day provide considerably more affordable access to space, are just one aspect of this. It's also important that we take advantage of every resource that is available to us.

Here in the UK, we're doing just that. Shetland Space Centre (SSC) bosses are adamant that their site in Unst offers unrivalled (in the UK) natural advantages for delivering small satellites into space. As the farthest north potential site in the UK, it is ideal for launching small satellites into Polar and Sun-Synchronous orbits, and there are no obstacles to direct launch to these orbits such as populated centres or oil and gas installations. In addition, the airspace in the region is clear, with no major trans-Atlantic routes or military restrictions. Indeed, voices from the UK Space Agency, government and industry have all agreed Unst would be an ideal location for a dedicated small satellite launch facility in the UK.

The UK might still be considered by some as small fry in the global space sector, but don't expect that reputation to last long. With ambassadors, government, academia and organisations all working together to advance our home-grown capabilities, making the most of the resources here at our fingertips, the UK expects to account for 10 percent of the global space industry by 2020. I, for one, am looking forward to seeing us make a bigger mark on the international stage. 🌟

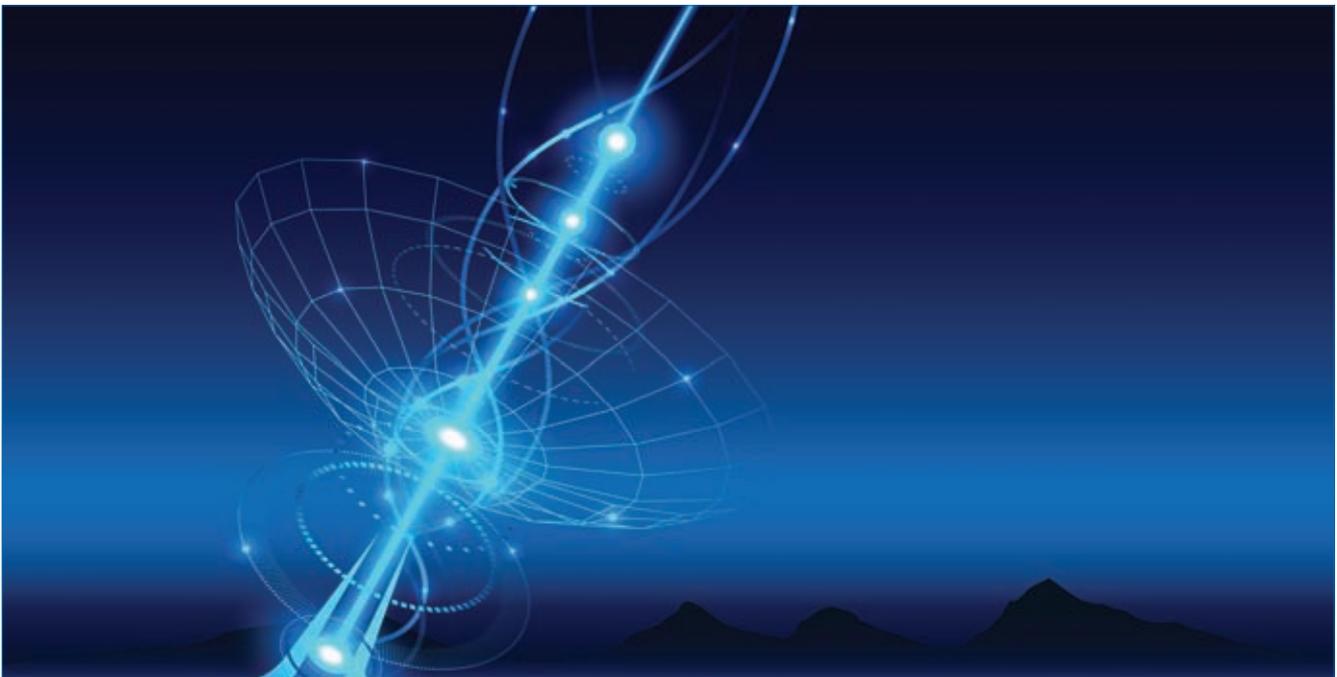


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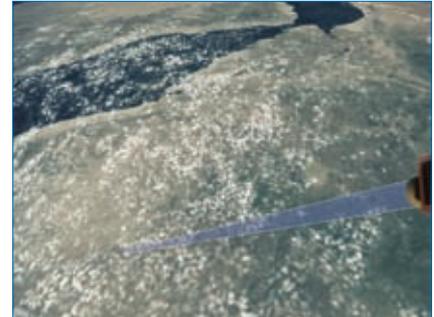
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The IoT platform market has entered a consolidation phase

According to a new research report from the IoT analyst firm Berg Insight, the global market for IoT device management and application enablement platforms reached US\$ 1.1 billion in 2017. Growing at a compound annual growth rate (CAGR) of 36.2 percent, the total market value is expected to reach US\$ 4.9 billion in 2022. IoT platforms provide middleware to connect and manage devices and integrate collected data into various applications and services. These platforms are intended to reduce the cost and development time for IoT solutions by providing standardised components that enterprises can build upon.

The IoT platform market is notably crowded and hosts a multitude of players spanning from small start-ups to major companies in the technology and industrial sectors. These companies have developed offerings that typically have a specific focus on a set of capabilities, often related to their core businesses. GE and PTC spearheaded the effort of promoting IoT in the industrial sector on a broader scale. While GE has shifted focus to mainly provide solutions rather than its Predix platform alone, PTC has emerged as the leader in the space. Software AG's Cumulocity IoT business and the wireless IoT module vendor Telit have also built strong positions in the industrial sector. Software AG's platform has for example been selected by Siemens to complement its IoT operating system MindSphere. Telit holds a strategic partnership with Wind River that leverages Telit's technology in its Helix Device Cloud. Additional providers with high involvement in the industrial sector include Bosch, IBM, SAP, Oracle, Exosite, Device Insight and Altair Engineering.

In 2017–2018, the major cloud infrastructure vendors Amazon, Microsoft and Google continued to invest heavily in their IoT offerings to drive growth in their cloud businesses. "The involvement of the cloud infrastructure providers will over time lead to commoditisation of some services currently offered by vendors in the IoT platform market and result in further specialisation of IoT platform providers", said Fredrik Stålbrand, IoT Analyst, Berg Insight. Merger and acquisition activity has risen sharply in recent time and the market has now entered a consolidation phase. "Some level of fragmentation in the market is expected to remain due to lack of standards, but also due to specific requirements in industries characterised by mission critical applications such as automotive, healthcare and manufacturing, as well as in the critical infrastructure industries", concluded Mr. Stålbrand. ■

Open Cosmos and Satellite Applications Catapult announce expanding In-Orbit Demonstration Programme with new 6U CubeSat mission opportunity

Open Cosmos has been contracted by the Satellite Applications Catapult to provide its fast and affordable space mission service to the In-Orbit Demonstration program (IOD-6). This will enable the space technologies with the best commercial capabilities to benefit from Open Cosmos' 6U full mission services.

The Satellite Applications Catapult is expanding with this mission its landmark In-Orbit Demonstration (IOD) Programme offering IOD-6. In collaboration with Open Cosmos, the IOD-6 mission offers companies the opportunity to trial their service using a larger 6U CubeSat platform in a diverse range of orbit options. By demonstrating the operational capability of their service through IOD-6, companies are in a stronger position to secure investment and customers. Successful candidates will be able to design, develop and launch their IOD-6 mission within 18 months.

Open Cosmos will be working with the successful candidate to integrate the payload and simulate the mission performance on qbkit and qbapp. Once the payload is validated, Open Cosmos will provide a one-stop-shop mission service integrating the payload in a 6U qbee multipurpose nanosatellite, performing full functional and environmental tests, procuring the launch and enabling the successful candidate to operate the payload in orbit through their qbapp mission control software. The Satellite Applications Catapult will provide comprehensive mission, operations and business support to help the company accelerate to operational capability and initial service delivery. The IOD-6 mission is supported by a grant of £700,000 from the UK Space Agency.

Rafael Jorda Siquier, CEO and Founder, Open Cosmos said: "At Open Cosmos, we are obsessed in making space accessible so organizations of all sizes and industries can solve the world biggest challenges. We are delighted that the IOD-6 Programme have contracted our space mission services to bring to orbit the most competitive service-oriented space technologies. There is no better way to demonstrate."

Stuart Martin, CEO, Satellite Applications Catapult said: "The UK is the only country in the world to offer an In-Orbit Demonstration Programme. By lowering the cost of access to space and accelerating services to market, IOD addresses key barriers to innovation in the sector. IOD-6 is a great opportunity for companies looking for a larger satellite platform and represents a significant milestone in the IOD programme. We are looking forward to working with Open Cosmos to deliver the mission. They are a great addition to the IOD programme network and part of a wider dynamic and entrepreneurial community that is driving growth in the UK space sector."

Catherine Mealing-Jones, Director for Growth, UK Space Agency said: "We recognise that low cost access to space is vital in developing a range of innovative space applications which will help grow the UK space sector. We are working hard with partners, including the Satellite Applications Catapult, to make space more accessible. This exciting mission with Open Cosmos is a great example of the support out there for small companies with big ideas." ■

Viasat acquires Horsebridge Defence and Security to enhance military opportunities with UK defence forces

Viasat has acquired Horsebridge Defence and Security, a UK-based company focused on design, system integration and support of deployable secure networks.

Through this acquisition the Viasat UK group gains deeper military communications integration expertise; enabling the Company to continue to grow its business in the UK defence market by delivering mission-critical ground-based communication networks and services.

From their UK-base in Cheltenham, Horsebridge Defence and Security have developed robust relationships with the UK Armed Forces, supporting a number of UK Ministry of Defence (MOD) programmes.

“By acquiring Horsebridge Defence and Security, we hope to accelerate the trajectory of our ability to support UK defence operations,” said Ken Peterman, President, Government Systems, Viasat. “Viasat builds best-of-breed technology solutions that leverage commercial innovation; and by combining our strengths with the deep domain expertise of the Horsebridge Defence and Security team, we intend to reliably extend commercial, military or emergency service networks to the tactical mobile edge.”

The Horsebridge Defence and Security team will be integrated into Viasat’s already established and growing Farnborough, UK-based organization. They will have immediate access to Viasat’s full communications portfolio from the Company’s most advanced satellite communication (SATCOM) and Link 16 mobile networking solutions to its innovative cybersecurity and information assurance capabilities.

“Viasat is a strong match for the Horsebridge Defence and Security team; we are aligned both culturally and in our technical vision for how to bring secure ground networks to UK MOD and adjacent markets,” said Martin Flather, Director, Horsebridge Defence and Security. “Having access to Viasat’s broad portfolio of technologies and capabilities will enable us to create new secure communications and mobility platforms that leverage high-capacity mobile networks with assured availability—with accredited secure voice, video and messaging services—whenever and wherever military forces require it in the UK or overseas.”

Horsebridge Defence and Security develops and integrates technologies under its Kestrel II-branded services portfolio. The Kestrel brand has a strong reputation with MOD through successful delivery of a high-capacity ground network for a specific operational mission. The Kestrel II portfolio offers a range of complementary secure network products, solutions and services that

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are specifically targeted at today’s UK Defence requirements and are continuously integrated and continuously developed (CI/CD) to stay at the forefront of technology. Financial details of the transaction are not being disclosed. The transaction is not expected to materially affect Viasat non-GAAP (pro forma) earnings for fiscal year 2019. However, Viasat has not completed its valuation analysis and, accordingly, has not determined the impact to GAAP earnings. ■

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Meir Moalem, CEO of Sky and Space Global ●●●

The core Sky and Space Global business is to construct a communications infrastructure based on nano-satellite technology and develop the highly complex and sophisticated software systems that will deploy, maintain orbit control and handle communication code between each of the nano-satellites to give a global coverage.

Sky and Space Global aims to provide low cost, nano-satellite communication coverage on an anywhere to everywhere base with relatively low maintenance costs. Due to the experience and expertise of the founders in the aerospace industry, the business will be able to develop inherent upgrading capabilities within short intervals, utilising their unique IP-nanosat software protocols.

Connecting the world

Incorporated in the UK in 2015, Sky and Space Global plans to launch a constellation of 200 nanosatellites into equatorial low Earth orbit (LEO) for narrowband communications. With inter-satellite links and the ability to autonomously monitor and manage satellite health and the in-orbit communications network, Sky and Space Global is set to shake up global communications. Amy Saunders met with Meir Moalem, CEO of Sky and Space Global, to learn more about the company's plans and market assessment.

Question: From the outside, Sky and Space Global appears to be well on the way to developing its own unique satellite constellation. Can you tell us more about the company's vision?

Meir Moalem: Sky and Space Global will connect the unconnected. It's a very innovative, disruptive NewSpace company based on nanosatellite technology that has set out to provide narrowband communication services. We're talking about voice conversations, text messages, instant messaging, machine-to-machine (M2M), Internet of Things (IoT), to anyone, anywhere, anytime.

At the moment, we're focused on the equatorial region, because there's currently no infrastructure there. If you try to provide narrowband services in London, nobody would use them, because you can use your phone to connect to the Internet. But, in the

equatorial region, there's almost nothing. That's where the market is, that's where the demand is, and that's where we're going to be.

Question: June 2017 saw the launch of the 3 Diamonds nanosatellites. What can you tell us about these three satellites, what they've achieved so far, and what they mean for the planned constellation?

Meir Moalem: It's an interesting story. The 3 Diamonds satellites were a pathfinder mission; they were supposed to be technology demonstrators to help us gain further investment for the constellation. They were designed to be very small and very efficient, but also able to deliver narrowband communications services. Most notably, they were built to demonstrate inter-satellite communications, which is key to building a satellite network. No one has created inter-satellite links between nanosatellites before: We're the first.

As we started to negotiate with potential customers, they asked whether they could procure services on the existing 3 Diamonds nanosatellites, even though they're only passing overhead once or twice a day for several minutes. So, the 3 Diamonds satellites became actual commercial assets, as well as providing validation for the business model by proving that people are willing to pay for these kinds of services.

We've achieved a long list of world-firsts with the 3 Diamonds satellites. The first ever text message, voice recording, phone call, the first email, data transfer, data store-and-forward, financial transaction, cyber-security measures, and inter-satellite links. All of those were



June 2017 saw the launch of the 3 Diamonds nanosatellites ●●●



world-firsts for nanosatellites. When we started the business several years ago, we were told it was impossible, that you couldn't do a phone call over a nanosatellite; we've proved them wrong.

Question: What can you tell us about the full constellation plans?

Meir Moalem: Our satellites are being manufactured by GOMspace in Denmark; we have a contract with them to develop 250 satellites. We plan to start launching a year from now, and by 2020, we'll have the full 200 required for the low Earth orbit (LEO) constellation in space. At first, it'll take a time to manufacture each satellite, but towards the end of the process, we'll be producing two or three satellites each week. We're building a production line, and once it's working and we've cleared out the early problems and technical issues, manufacturing will really speed up.

The constellation latency is expected to be very low. Of course, latency is only really an issue for phone calls, it doesn't really come into play with the other services we provide. Latency comes not only from the location of the

satellite or the relative distances of the satellites, but also from the hardware and software involved. It's all about how the data is processed, encoded, and compressed, and that's the biggest challenge. We're working very hard to ensure we're very efficient.

The satellites will operate over S-band; we're not selling the customer bandwidth or throughput, but availability. Our promise to our customers is that when they try to use our service, we will provide the availability. It's the same as when you make a regular phone call – you don't know what the bandwidth is, all you care about is that it works when you need it. Because we're providing narrowband services, we don't need a great deal of spectrum; we only need a few MHz, and we can squeeze millions of network users onto this very narrow slice of spectrum, over the entire equatorial region.

The inter-satellite links are based on S-band as well, using a small flat panel antenna. We've tested them up to 3 Megasymbols per second on the 3 Diamonds satellites, and I think they can achieve more than that. The links work over distances of 500-1,000km.

On the next generation of nano satellites, the Pearls, which are a slightly larger satellite with a more advanced payload, we think the links will work over greater distances still, which is more than enough for our purposes. The challenge right now is the ground devices and connecting many end-users to the network.

We have a contract with Virgin Orbit to launch our satellites – we've acquired four dedicated launches, and we have the possibility to buy more. I think we'll be looking at around 20 satellites per launch, but of course it depends on the actual performance of Virgin Orbit, which we won't know for sure until they do their first launch. It also depends on the final mass of our satellites, which are still under development.

Question: The satellite market has seen a great deal of change in recent years, and Sky and Space Global is poised to be a part of that. What's your assessment of the market today, and where will Sky and Space Global fit within it?

Meir Moalem: There are around three billion people living in the areas we're



SAS constellation (by SCISYS) ●●●

looking at i.e. Africa, South America and Southeast Asia. Those are areas with either no infrastructure at all, or poor infrastructure. It's a huge market: Demand is there, and it's growing. There's no foreseeable future for deploying terrestrial networks in these areas, it's just too expensive. That means that the only way of providing connectivity is through space.

There is connectivity provided to those areas right now from space, but it's too expensive; for phone calls, you're looking at US\$1-2 per minute, on top of fees of around US\$50 per month just to have that connection. It's not really affordable for the people. However, it's not just about the individuals; it's also about the corporate entities, the businesses, the governments. They all need connectivity as well.

The market is growing for both narrowband communications and other applications as more and more IoT and M2M devices are deployed all over the world.

We're the first company to provide these kinds of services, and we're also the most advanced. The other constellations we're hearing about are mainly for M2M and IoT, which is a very small part of what we do. We believe the market is big enough for multiple players, for a lot of companies to step in and still be able to resell their services. We're very different from companies like OneWeb or SpaceX because they're planning to sell high speed Internet, which is a different kind of service that requires expensive ground infrastructure which isn't particularly mobile. It's an entirely different market to ours. Traditional space industry constellations require billions of dollars to develop systems, while we, as a NewSpace company, only need tens of millions – that's quite a difference. Traditional space industry constellations are also looking at much longer lead times before they're operational, while we'll be fully up and running in the next two years.

Question: Interest in NewSpace is booming the world over, but opinions are mixed on what it all means. What's your assessment of the NewSpace movement?

Meir Moalem: We're building our company based on NewSpace technology. The nanosatellite tech-

nology has really matured: I think that two or three years ago, people were talking about nanosatellites as 'toys for boys,' or objects for students to explore, with no commercial viability. But they've matured, and nanosatellites are very reliable today. Our 3 Diamonds satellites, for example, have been working perfectly for almost a year now, and another nanosatellite, key management people from SAS were involved in that was developed by High School students, is still operating perfectly in space after three years.

Nanosatellite technology has reached a point where you can actually do something with it. The question is, can we build commercial applications for nanosatellites in space? We believe that we can. Planet, for example, believes that it can provide remote sensing capabilities with nanosatellites, and they're doing that. I think the future is really promising.

Question: The digital divide remains a pressing issue throughout much of the world; do you feel enough is being done to address the issue, and how will Sky and Space Global attempt to tackle this problem?

Meir Moalem: It's an opportunity because it's such a pressing issue. If you solve the problem, or at least provide a partial solution, you're improving your business. If you're connecting more people, your business develops.

My PhD dissertation is about space programmes and their importance, and there's a chapter about the information, communication and technology (ICT) revolution. In today's research, there's a lot of proof about the benefits of ICT; with connectivity, there can be better healthcare, better education, improved financial systems and government organisations. Everything is improved with an ICT infrastructure.

The areas that we're talking about have almost no infrastructure, so just imagine the possibilities once they do! If you have an infirmary manned by a paramedic or nurse with no ability to consult with a medical doctor; with connectivity, they can make a call to a doctor, or send a photo of a medical problem, and can be advised on the best course of action. How about a government which has no idea there's been a flood in a remote location? With

connectivity, not only can the government be aware of what's going on, it can receive an early warning to warn people to evacuate the area.

We believe that, not only because of what we're doing, but other providers as well, we can create a major leap in the existing infrastructure that will improve the ecosystem in these countries. That means these areas can expect an economic boom.

As for the power requirements for devices and infrastructure, solar panels are probably the answer. For your phone, for example, you can get a small folding mobile solar panel that you can charge from anywhere. More and more in Africa, people are installing solar panels on top of their houses because it has become quite affordable. It's a circular process: No one is investing in power supply in these areas because there is no demand, but if you provide an incentive for people and companies such as connectivity, then the pressure to build power supply infrastructure increases. It works both ways. We're creating an incentive for the economy to improve, which in turn improves our business.

Question: What's on the horizon for Sky and Space Global in the near future?

Meir Moalem: I'd divide our plans into three different channels.

The first is the technology channel; developing the satellites. We're almost at the Critical Design Review (CDR), which is the step before actual production. Once we've passed that, we'll have a high level of confidence that our plan will work. We expect this in the very near future.

The other channel is the commercial channel. We're talking to additional customers and trying to develop new agreements and finding out what customers are willing to pay. Moving out of our comfort zone in Africa, where we already have a lot of agreements set in place, we've moving on to the Americas and Southeast Asia.

The last channel is the funding. We're talking to investors and strategic partners, and we strongly believe that we can acquire the US\$100 million that will secure our constellation. This is not required all at once, and a lot of options are on the table, so I am confident we will find the best one for the company. 

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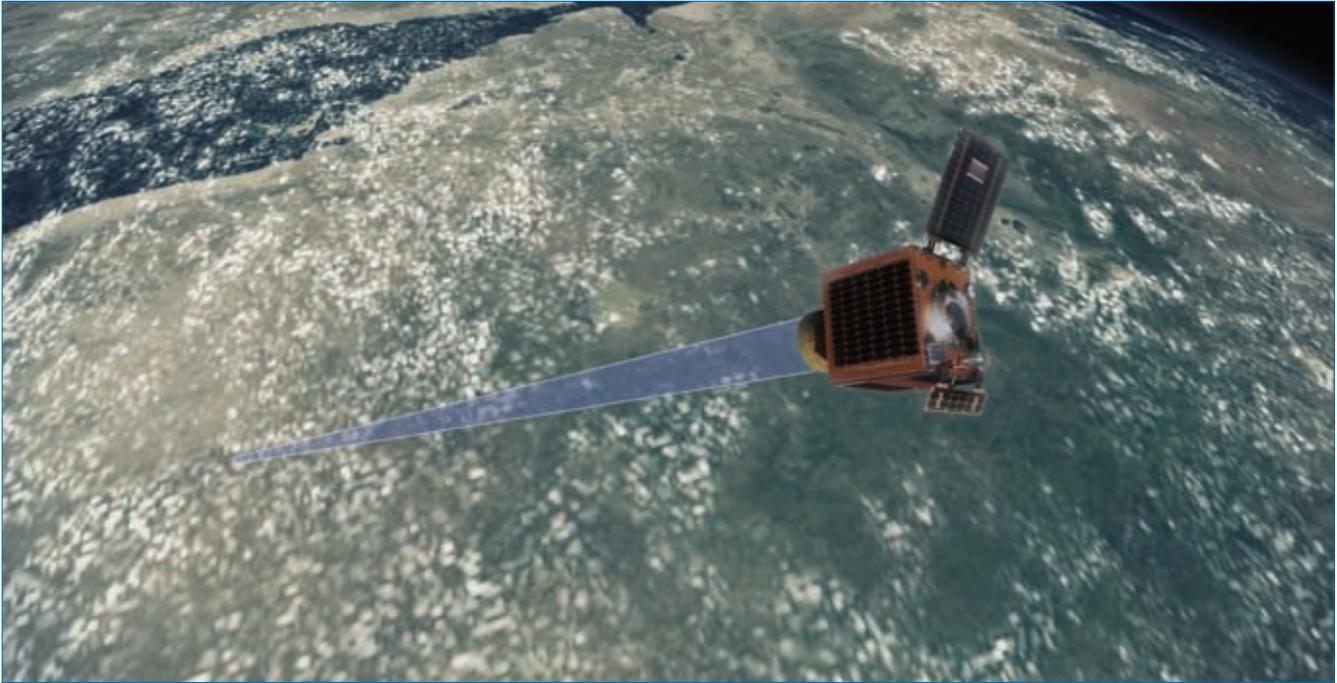
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Artist Impression - VividX2 in Space ●●●

Colour video from space – A unique challenge

Earth observation is a rapidly-expanding sector right now, and certainly one of the most active in the NewSpace movement. UK-based Earth-i has recently launched VividX2, a prototype for the world's first commercial satellite system designed to capture high definition colour video from space.

12 January 2018, 04.18 GMT, 505km above the Indian Ocean: 31 satellites cascade away from the nose of a PSLV launcher. As the upper stage of the rocket orbits the Earth at 28,000km/hr, the satellites tumble across the bands of white cloud and deep blue ocean below.

One of the first satellites to be ejected from the launcher was a boxy spacecraft around the size of a small fridge and covered in solar panels. Known as VividX2, this compact satellite may not look particularly impressive, but the technology inside promises to help transform the multi-billion-dollar global business of Earth observation. VividX2 is the prototype for the world's first commercial satellite system designed to capture high definition colour video from space. It has been built by small satellite manufacturers Surrey Satellite Technology Limited (SSTL) in partnership with Earth-i, a provider of satellite imagery and analytical services.

"It was extraordinary to watch," said Adrian Norris, Earth-i General Manager, who had a front row seat at mission control in Sriharikota in southern India for the launch. "There's a tremendous feeling in the company that everything we've been working towards in the last few years is becoming tangible."

Providing space-derived products

Only established three years ago, UK-based Earth-i has quickly built a global reputation for providing images and space-derived products to a wide range of clients in both the public and private sectors. Earth-i currently uses data from existing satellite constellations, such as the DMC3/TripleSat Constellation and the KOMPSAT series of satellites, but VividX2 represents the first stage in the development of the company's own fleet.

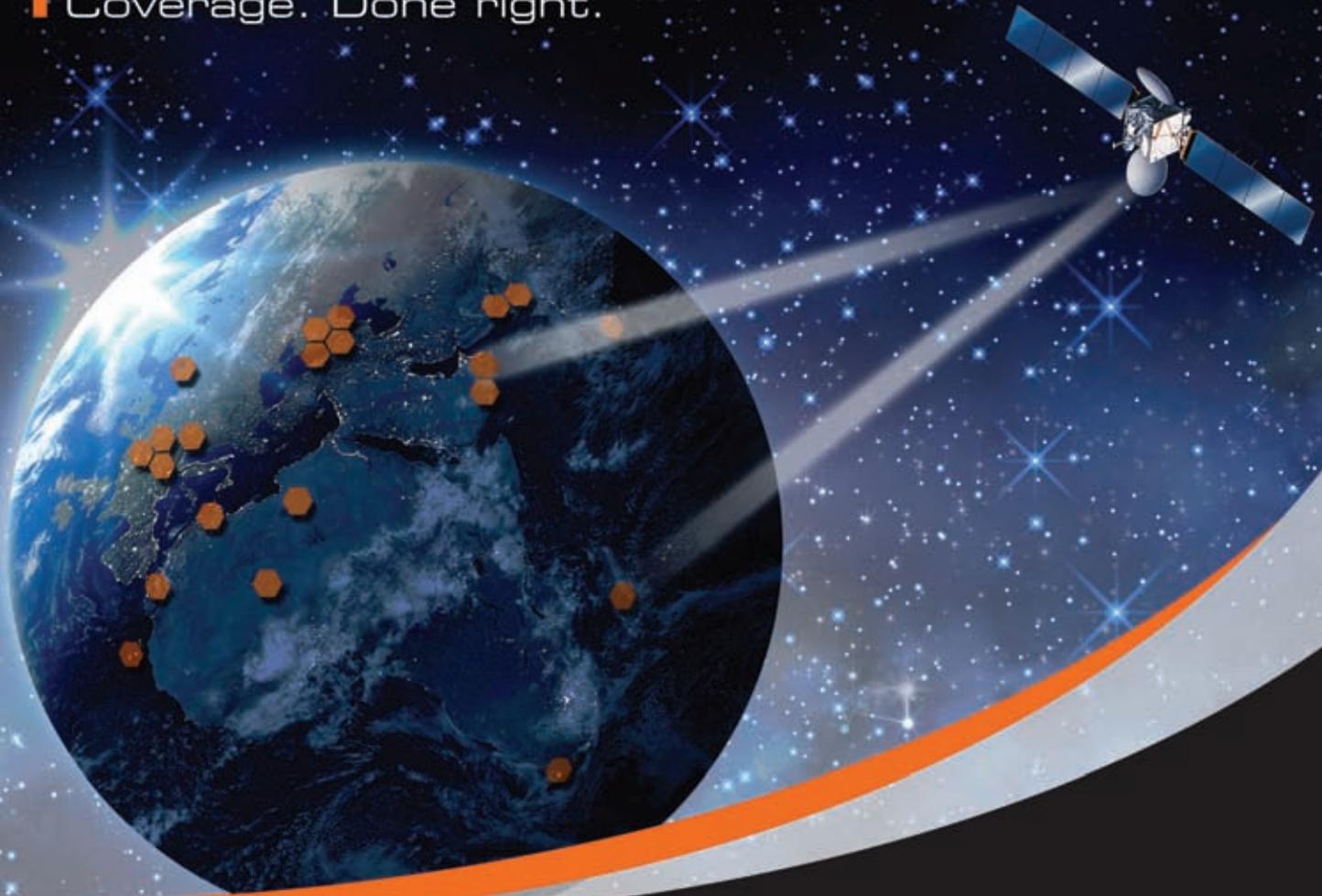
"The view we take is that to fulfil the needs of our clients, it's vitally important we have our own source of data," says Earth-i CEO, Richard Blain. "The vision for Earth-i is to become one of the world's leading providers of Earth observation derived data."

Earth-i recently signed a contract with SSTL to build the first five satellites in its new constellation, due for launch in 2019, with two further groups of five planned by 2022. With its single powerful HD camera, designed to take still images and around two minutes of video at a time, VividX2 will put the technology through its paces.

"Having a fleet of satellites means we can revisit the same point on Earth several times throughout the course of the

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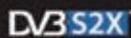
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Earth-i CEO, Richard Blain ●●●

day,” says Blain. “With video we’re revisiting every fraction of a second and creating therefore a whole new type of information from space that isn’t available today – that will drive an amazing array of new and interesting applications.”

A potential challenge

But capturing video from space isn’t easy, otherwise many other companies would probably already be doing it. Just considering the physics involved is mind boggling.

Satellites orbit the Earth at around 7km/s, which equates to passing over the ground at the same rate. At that speed, while the planet is rotating 500km below, the satellite needs to constantly adjust its position to stay focussed on the same area, record HD video and transmit it back to mission control. Two minutes is about the maximum time it can point its camera at a single location before passing over the horizon.

Norris agrees that operating the satellite, and the eventual constellation, will be potentially challenging. “We’ve got a very precise attitude control system – unusual in a satellite this size – that lets the camera stare very precisely at a target on the ground as it’s flying over,” he says. “We’re expecting to get a very stable video sequence of quite a small target.”

In test footage, obtained by an earlier SSTL-built satellite called Carbonite-1, moving vehicles and objects of around one and a half metres could be made out. “With VividX2 we’ll be seeing objects about a metre in size, in full colour and with much improved quality,” says Norris. “It will be significantly better.”

As well as the satellites themselves, Earth-i is also building new ground infrastructure and an operations centre. The aim is to make the whole system as client-focussed as possible, delivering images of anywhere on Earth on-demand and within minutes of being taken.

“Clients will tell us what they want, and the constellation management systems will work out the best way to acquire images or video clips of that area,” says Norris. “We’ll send commands to the constellation, telling satellites when to switch-on and where to point, until the area the customer has asked for has been imaged successfully.”

Video from space?

So, what sort of demand is there for video from space? “The

key is to extract the information from the imagery, not just take pretty pictures for pretty pictures’ sake,” says Earth-i’s technical advisor, Paul Brooks. In other words, it’s about providing answers to people on Earth. “The remote sensing market is worth billions of dollars a year and we need to provide the information – the insights – to the end users of what they want.”

With global coverage and the ability for multiple daily revisits and video capability, Earth-i’s new satellites are likely to have a wide range of applications. One use might be to accurately measure the levels of a commodity on a global basis. A resource such as copper, for example, is mined and stored at multiple locations.

The satellites could also be employed to monitor agriculture, map changes in land use or assess the aftermath of natural disasters, observe the flow of refugees across a border or the patterns of traffic around a busy motorway intersection.

“Customers come to us with a wide range of needs,” says Product Development Manager, Owen Hawkins. “There’s a huge variety of different levels of questions – from data through to insights that people are coming to us with,” he says. “That challenges us to find solutions across that whole spectrum.”

To make sense of what Hawkins refers to as a “deluge of data” from space, he is overseeing the development of new AI and machine learning technologies. “We need to do some cutting-edge work to answer the unique needs of the satellites we’re putting into space,” he says. “Because of the way the satellites operate, we’re aware we also have hard technology challenges to process the video.”

At its Guildford headquarters in southern England, Earth-i is in the process of recruiting new staff from across the technology sector. Many are from, what might be considered unrelated, areas such as medical imaging. “We’re picking the bright stars, leading lights of these industries to come and help us to bring that knowledge into the space sector,” Hawkins says.

With the development of this supporting technology well underway, Earth-i Chief Technology Officer, John Linwood, argues that the company isn’t only in the space business but the business of predicting the future. “Whether it’s the insurance industry, commodity traders or the power industry, we can analyse patterns of life to predict traffic growth, power demand or even commodity production into the future,” he says. “We want to help people make smarter decisions.”

A globally-recognized player

Meanwhile, back from India, Norris is working with SSTL to oversee the commissioning of VividX2. With its solar panels now deployed, the team operating the satellite is slowly bringing subsystems online and aligning the camera.

“We’ll then go through a campaign to focus the camera and get a good understanding of how it’s behaving in space,” says Norris. “There’s a lot to do!”

For Blain, the successful launch of VividX2 means the expansion of his business remains on track. “Since 2015 we’ve been able to leapfrog ourselves to become a globally recognised player with a great deal of credibility,” he says. “We’re well on our way to becoming one of the world’s most successful space companies.”



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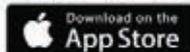


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Gary Wade, Product Manager at ViaLite ●●●

ViaLite Communications designs and manufactures RF over fibre links and systems. ViaLite is a division of Pulse, Power & Measurement Ltd (PPM).

The wide dynamic range and broadband nature of ViaLite technology supports the transmission of data of any modulation type with minimal degradation. A diverse range of applications is catered for by ViaLite products, optimised for specific applications including: satcom teleports, satellite ground stations, satellite downlinks, VSAT, interfacility linking, cellular networks, TV broadcast and GPS timing signal distribution.

The ViaLite user base is diverse from SME's to blue chip organisations.

Delivering RF over fibre

ViaLite Communications, a division of Pulse, Power & Measurement Ltd (PPM), designs and manufactures RF over fibre links and systems to meet a wide range of applications, including satellite teleports, downlinks, VSAT, interfacility linking, cellular networks, broadcast and GPS timing signal distribution. Amy Saunders met with Gary Wade, Product Manager at ViaLite, to discuss the global satcom sector and the company's place in a rapidly-evolving market.

Question: Can you provide a brief overview of ViaLite's development, from its founding through to where it stands today?

Gary Wade: We started out in 1994 and purchased a company, a year later, that manufactured scientific point-to-point fibre optic links. There was a limited market for those, and we soon realised that we had to move into a more commercial field. In 1999, ViaLite Classic was launched, and we immediately took on a 25-year service contract that's still running today. The contract really launched us into the commercial side of things and is for fibre optic links to bring GPS signals into base stations in the London underground. The links are used for TETRA radio for the police and London Underground operators.

In 2010, we launched ViaLiteHD which really brought us ahead of the competition. The HD stands for high density as there are more channels in

the chassis; it went from 8 to 26, so that's a huge jump. The product is a lot smaller and it's software driven, which means it's more dynamic and there are more options; meaning we can tailor a standard product into what the customer needs.

Question: There are a fair number of players in the market specialising in RF over fibre - What sets ViaLite apart from its competitors?

Gary Wade: We focus on RF over fibre products and also the satellite market. One of our big differentiators is that we have the widest dynamic range in the market. Some of our competitors used to have an uplink and a downlink product, whereas we have just one product that does everything. With the industry moving to high throughput satellite (HTS), having one product with a very wide dynamic range turned from a 'nice to have' to an absolute must-have, so that really played to our strengths. We have also recently stepped up our dynamic range even further and offering our Hyper Wide Dynamic Range product – HWDR – gives customers even more bandwidth across a single fibre.

Our flexibility also sets us apart. With the same chassis, you can have GPS, L-band links, S-band links, etc., so it's a very versatile product. It's what we call a standard customised product.

Additionally, ViaLite has the longest product warranty in the market at five years and offers a design service for simple and complex systems, which is particularly necessary for long distance link systems.

Question: Which markets are key to ViaLite's business, and how have



Site diversity link. Photo courtesy of ViaLite ●●●



Some of the ViaLite team ●●●

these changed over the years?

Gary Wade: Before, we were very focused on Europe as we're based in the UK. Then in 2013, we decided to focus on really opening up our market presence in the USA. At that point we made the leap from having a distributor who wasn't doing a great deal for us and didn't have the vision to grow, to having our own company registered in Washington DC. We also added a full USA rep network, and our sales have grown significantly since then with the USA now the biggest market for *ViaLite!*

The satellite communications market is 60 percent of our business. We're in a very fortunate position, as I have mentioned HTS has played into our strengths and the long distance links that we offer are an important part in Ka-band diverse sites that are necessary with the introduction of higher frequencies such as Ka-band. We work with Intelsat, Eutelsat, Telesat, SES, etc., most of the top 10 satellite operators! We don't tend to supply as many of the independent teleport operators, but that's mainly because they usually have smaller teleports so don't have RF over fibre. But when they do switch over, they are reassured that for the main operators we are the supplier of choice.

Question: The satellite sector is in a great state of change right now, with new technologies such as HTS, low Earth orbit (LEO) constellations, and re-usable launch vehicles shaking things up. What's your assessment of the satellite sector today, and *ViaLite's* place within it?

Gary Wade: HTS has been great for us.

Before, our product with its wide dynamic range was a nice-to-have and made installation easier. Now, with HTS, operators need our products' dynamic range as there are some products out there that just do not work with HTS. If you want to put the full L-band bandwidth through fibre, then *ViaLiteHD* allows you to do this.

Ka-band has also made a big difference. In the last three years, we've developed a long-distance capability; before, we could do 0-10km, 50km and 100km, and now we are doing Ka-band diverse systems, as well 600+km systems to join teleports together. Just to be clear, that's all via analogue RF over fibre so there's no digital conversion with its associated huge occupied bandwidth or latency in conversion; just the analogue RF to light conversion that we have been doing over 20 years – but much further. Our DWDM long distance system really

plays to our strengths in the current market.

There are, of course, already talks about moving to higher frequencies. We've not seen much demand for Q and V-band yet, although we do need to look at where that technology may take us. Those higher frequencies cause even more problems than Ka-band, particularly with rain fade, also more gateways will be needed as there will be even more throughput. That all means there will be more links with fibre, especially over long distances. It's definitely going to play further to our strengths.

Question: What about Brexit – As a UK-based company, have you felt the impact of that yet?

Gary Wade: The biggest issue for us has been the effect on the exchange rate. It's better for a UK company selling into the USA, but we buy from some of our key suppliers in US Dollars, so it's sort of break-even. So all in all, it's not hugely affected us so far.

Question: What's on the horizon for *ViaLite* in the next couple of years?

Gary Wade: In addition to our roadmap of new RF over fibre products, we are just starting a new phase of European grant-funding, which we hope will bring exciting and ground-breaking products to customers in the next two years. We are also making changes to our global organisation; sales team, customer support engineers and partners, to better support our existing customers whilst growing with the new customer base.



ViaLiteHD 3U Rack-Chassis ●●●



Passengers using Gogo ●●●

expected to gain US\$10.3 billion of revenues through 2035, while airlines in Europe and North America can anticipate US\$8.2 billion and US\$7.6 billion respectively.

“The opportunity available to airlines is enormous. The Sky High Economics study predicts the creation of a US\$130 billion market within the next two decades,” wrote Dr Alexander Grous, Department of Media and Communications, LSE and Author of *Sky High Economics*. “Globally, if airlines can provide a reliable broadband connection, it will be the catalyst for rolling out more creative advertising, content and e-commerce packages. We will see innovative deals struck, partnerships formed, and business models fundamentally changed for new players to lay claim to the US\$100 billion opportunity away from airlines. Broadband-enabled ancillary revenue has the potential to shape a whole new market and it’s something airlines need to be planning for right now.”

A word from the operators

“The IFC market is one of the fastest growing markets for broadband satellite communication,” confirmed Doreet Oren, Director of Product Marketing and Corporate Communications at Gilat Satellite Networks. “According to an NSR report issued last year, the number of connected aircraft is expected to grow by an order of magnitude within a decade. In 2016, 3,800 aircraft were connected and in 2026, the total connected aircraft are projected to be 28,400. NSR further reports that the annual aero satellite equipment market-size is expected to more than double within this decade, from \$280M in 2016 to \$590M in 2026.”

Don Buchman, Vice President and General Manager of Commercial Aviation at Viasat, agreed that there’s still a long way to go: “The IFC market is quickly growing and the competition to offer the best on board Wi-Fi service is rising,” he said. “However, there is still a disparity on the services offered, simply because of the capacity, speeds and coverage available by each IFC vendor. While some carriers, like JetBlue or Qantas, are offering unrestricted, high-speed connectivity at no additional cost, others are still providing slow speeds, often at a substantial premium for the passenger. In this environment, it’s perhaps unsurprising that passengers aren’t so fast to take advantage of the service—meaning we haven’t yet seen IFC reach its full potential.” Anecdotally, we’d tend to agree with Buchman here – services on most flights are still so poor that it seems an exercise in futility to hand over cash for such patchy connectivity.

Aditya Chatterjee, SVP of Aero Segment Market Solutions at SES Networks, added: “In a word, the IFC market is booming. IFC is fast becoming a must have for passengers and airlines across the globe.” He went on to discuss regional variations: “North America is certainly leading the market, where the majority of passengers are increasingly selecting airlines based on WiFi availability. As travellers throughout the rest of the world see the types of IFC services being delivered aboard airlines serving North America, more and more airlines in Europe, the Middle East and Africa are being pressed to provide the same levels of capacity and applications. The Middle East and African aeronautical satcom market, for example, will generate US\$320 million in retail revenues by the end of 2026. Demand for more passenger and crew connectivity on routes within the Middle East and Africa is the biggest driver of that revenue jump.”

In such a fast-growing market, where are the best opportunities and what are the greatest driving forces? SES’ Chatterjee outlined the five primary driving forces behind today’s soaring IFC demand:

- The sheer volume of air travel continues to grow at record levels, and this is an indisputable driving force. In fact, IATA projects 7.8 billion people will travel by air in 2036, nearly double the four billion air travellers expected to fly this year, with Asia becoming the biggest driver of that unprecedented growth in air travel.
- The number of connected passengers is driving the number of connected aircraft globally. The number of connected aircraft will triple between 2010 and 2026, offering up an incredible opportunity for SES and the satellite industry to blanket the globe in high-powered capacity to enable IFC services virtually anywhere.
- Increasingly ubiquitous global coverage. SES continues to invest in big quantities of high-powered capacity around the globe, enabling all the leading IFC service providers

	Broadband access	E-commerce	Advertising	Premium content	Total
2018	\$822 million	\$36 million	\$26 million	\$39 million	\$1 billion
2028	\$9 billion	\$3 billion	\$2.9 billion	\$731 million	\$15 billion
2035	\$15.9 billion	\$6.8 billion	\$6 billion	\$1.4 billion	\$30 billion

Forecasted airline share of the US\$30 billion broadband enabled ancillary revenue opportunity. Credit: ‘Sky High Economics: Quantifying the commercial opportunities of passenger connectivity for the global airline industry.’



Aditya Chatterjee, SVP of Aero Segment Market Solutions at SES Networks ● ● ●

then, we will see competition between different technologies and how passengers pay for IFC e.g. does it remain as an additional cost? Is it limited to just messaging and light browsing? Is it part of the ticket price, or only offered to certain passengers? Or will it be paid for by integrated marketing partnerships and sponsorship, leaving it free to the passenger?”

Gilat's Oren agrees that the challenges are far from over, and that capacity remains a threat to growth. “Due to passenger's growing demand for continuous high performance broadband connectivity, delivery of sufficient high throughput capacity to the aircraft continues to be a challenge. To this end, we have seen new aero modems, such as Gilat's Taurus, delivering aggregate rates of 400Mbps, enabling Internet and multimedia applications for all airplane passengers,” said Oren. “In addition, there is a lot of work going on for next-generation Electronically Steered Array (ESA) antennas. Traditional mechanically steered antennas will not be sufficient and efficient enough to address the market transformation. The characteristics of ESA antennas such as very low profile, instantaneous bandwidth, beam agility, multi-beam connectivity, scalability/modularity and longevity – are imperative for unlocking new business opportunities and for the performance of satellite networks.”

“Deciding whether IFC is a free or paid service remains a challenge for many of the airlines today. Ultimately that decision will have a big impact on the delivery of popular video streaming and social media applications aboard some airlines,” observed SES' Chatterjee. “As satellite operators bring more HTS to the aero IFC market, antenna developers are also bringing more effective platforms to market as well. At the same time, Netflix and others are working on software solutions that enable the delivery of HD, even 4K content to passenger devices using a fraction of the bandwidth required today aboard commercial and business aviation flights.”

It seems that everyone is fully-expecting the IFC market to boom in the future, developing into a more mature market in the decades to come. Gilat's Oren agrees: “As the

technology matures and demand increases, the market will evolve to include new business models and additional aircraft types. Mobility applications and NGSO satellites pose major challenges and opportunities to the performance and economics of satellite connectivity.” Oren continued: “Therefore, we see significant industry investments in ESA antennas for the aero market to meet a set of imperative requirements. It is critical to deliver higher antenna gain with lower profile and lower add-on drag.”

Viasat's Buchman is anticipating increasing competition as the IFC market develops: “We are already seeing airlines change their IFC provider as they get a better understanding of which technologies offer the best performance, and the best experience for passengers and in turn deliver the best value to the airline. We are on the cusp of IFC breaking into the mainstream and becoming an expected component of international flight, rather than a nice-to-have extra service. This will mean increasing competition, but also increased collaboration – as satellite providers and airline partners work together to ensure an uninterrupted connection for flights.”

Meanwhile, Chatterjee from SES sees ‘blue skies ahead with capacity demand soaring’ to meet passenger appetite for connectivity in flight that compares with what they expect on the ground. “SES is building a global ubiquitous network, much like the cellular networks on the ground that offer up seamless connectivity virtually anywhere around the world. SES has launched multiple HTS satellites in recent years – much of that capacity tailored to meet the growing passenger IFC demands as well as the airlines' increasing efforts to operate more efficiently on a global basis,” said Chatterjee. “Just look to Europe and you'll get an accurate glimpse of IFC in the near future. There were just short of 550 connected aircraft in Europe a year ago, and forecasters expect there to be more than 6,300 connected aircraft over Europe by 2026. As the number of connected aircraft skyrockets to meet the insatiable appetite for connectivity across a mind-boggling number of air travellers – expected to double from four billion currently to nearly eight billion over the next 18 years, satellite capacity in space combined with antenna, modem and application services innovations will play a huge concerted role in meeting very high expectations for inflight connectivity.” North America continues to set the expectations and drive the demand eastward to Europe, the Middle East, Africa and Asia. “Of the four billion new air travellers expected to take to the skies over the next 18 years, more than half will come from Asia,” added Chatterjee.

Panasonic Avionics upgrades services across the board

Panasonic Avionics Corporation is inarguably a world-leader in delivering inflight entertainment and connectivity (IFEC) solutions across the globe. Today, more than 1,800 aircraft use Panasonic Avionics' global high-speed IFC service, and more than 10,000 aircraft are expected to be connected with Panasonic Avionics by 2025.

Upgraded services

November 2017 was an incredible month for Panasonic Avionics in terms of upgrading its service offerings, with two major developments announced.

Panasonic introduced a major advance in IFC with the start of service of its first HTS capacity over the Pacific Ocean.



Technology Officer of Panasonic Avionics Corporation. “The convergence of enabling technologies has set the stage for transformational data analytics, giving Panasonic the ability to provide airlines with invaluable passenger and operational insights, which in turn allows them to build brand loyalty and increase efficiency.”

Many elements of NEXT Marketplace can be leveraged and enhanced by NEXT Cloud-based data analytics. These include NEXT Theatre, which enables passengers on connected aircraft to access airline content anywhere across the globe, opening up avenues for new business models such as near-real time content licensing and usage-based payment. NEXT Marketplace utilises the secure NEXT Cloud in providing a global secure payment platform, secure reliable and convenient shopping via a dynamically updatable catalogue. It also opens up possibilities for airlines to offer cloud-based services such as music, transportation and more to deliver an enhanced passenger experience and the potential for airline revenue sharing.

During the same month, Panasonic announced the debut of its new airline on board loyalty platform, NEXT Loyalty, with Singapore Airlines as the launch customer. NEXT Loyalty is Panasonic’s new suite of solutions for enabling personalized inflight experiences for passengers and allowing airlines to extend their loyalty programs into their onboard services. It allows passengers to login or to pair their mobile device at the seat via the airline app. Once signed in, passengers will be recognized and provided with a variety of familiar personalized features including: Resuming unfinished movies from previous flights, receiving recommendations based on viewing history, unlocking exclusive content and offers based on loyalty program status, viewing a customized look-and-feel of their interactive associated with their profile, saving settings for language/subtitle preferences, preferred genres and accessibility, and more. Airlines will further benefit from the opportunity to understand usage patterns and activities inflight and utilize those data analytics to better tailor future inflight services.

Airline deals

Panasonic hasn’t slowed down its announcements this year, either, with April being a particularly prominent month for arranging new deals with airlines following the announcements on the NEXT platform.

Panasonic and Turkish Airlines announced a major deal for IFEC solutions to be line-fit installed on 50 wide-bodied aircraft the airline has on order, with options for a further 10. Panasonic’s X-Series IFEC system, along with its rivetMEDIA solution and a suite of connectivity services including inflight Wi-Fi, mobile phone use, and global live TV, will be fitted on 25 Boeing 787-9s and 25 Airbus A350-900s, with the first aircraft due to be delivered to Turkish Airlines in June 2019.

The system will further enhance Turkish Airlines’ passenger experience with a personalized home theatre experience that includes HD screens for each passenger, audio and video entertainment on demand, capacitive multi-touch screens, inflight shopping and hospitality features, route-based IFE, passenger survey functions and USB charging facilities. It will also include Panasonic’s unique Passenger Data Integration (PDI) service, which will allow Turkish Airlines to add higher levels of personalization to its

inflight experience, and to seamlessly recognize the travel preferences of their guests and recommend content, services and amenities specific that will enhance their experience both in flight and in their destination city. PDI will leverage a custom-designed Companion App that will enable passengers to securely pair their mobile device to the IFE system and personalize and enhance their entertainment experience through capabilities that include custom playlists and a ‘second screen’ environment.

rivetMEDIA, which combines one of the aviation industry’s most advanced inflight marketing platform with a dedicated sales and service team, will deliver all the key advertising services needed by Turkish Airlines, their external partners and paying advertisers. The technology enables airlines to target by seat class, route, device, language, and passenger data. This will allow Turkish Airlines to optimize promotions for a wide range of optional services, partnerships, loyalty programs, and paid advertising all within a comprehensive passenger experience. The platform delivers video, native display, and sponsorship options for high-impact, fraud-free marketing with best-in-class targeting and results.

Turkish Airlines’ aircraft also will be fitted with Panasonic’s new satellite modem, which offers bandwidth up to twenty times greater than previously available, enabling a host of next-generation IFC benefits from high quality live TV programming to fast Internet, video streaming, inflight mobile phone service and greater bandwidth for crew applications. The new modem and connectivity solutions are an integral part of Panasonic’s third-generation network, which uses advanced satellites to cover all high air traffic areas across the globe with high throughput and extreme throughput spot beams and wide overlay beams that support Panasonic’s global television service.

As part of the contract, Turkish Airlines has the option to equip the A350 aircraft delivering beyond 2022 with its own direct affiliate’s IFE system, pending line fit offerability. The connectivity for those aircraft will still be equipped by Panasonic.

Panasonic also announced a new deal with EGYPTAIR which will see six Boeing 787-9 aircraft fitted with Panasonic’s eX3 IFE system and its IFEC system. In Business Class, each seat will feature an 18-inch screen, a video touch handset, a USB jack for high power charging in-seat and a noise cancelling audio jack. In Economy Class, passengers will each have a 12-inch screen and shared access to power outlets. Each aircraft will also be fitted with overhead 16-inch screens throughout each cabin. EGYPTAIR has also opted for a range of additional software applications across the fleet that include passenger surveys, onboard shopping, 3D moving map and OneMedia - Panasonic’s advertising platform.

Inmarsat – A truly global player

Inmarsat is another major player in the global IFC arena with its Global Xpress (GX) network of four Ka-band HTS. GX has delivered seamless high-speed broadband connectivity the world over since 2015. GX Aviation is the world’s first IFC solution with seamless, reliable high-speed global coverage provided through a single operator. It is reportedly the only service in the market that guarantees minimum data rates, ensuring that airline passengers can browse the Internet,

stream videos, check social media and more during flights, with an onboard connectivity experience comparable to the mobile broadband services they may receive on the ground.

In April 2018, Inmarsat announced a major milestone for its GX Aviation service after completing the 250th installation worldwide. Within the first year of commercial service, GX Aviation has been installed in a variety of aircraft, including Airbus A320s, Boeing 777s, and Airbus A380s. Customers have included Lufthansa, Austrian Airlines, Eurowings, Qatar Airways, Singapore Airlines, Air New Zealand and Air Astana.

GX Aviation has also won a string of prestigious awards for offering state-of-the-art, uninterrupted, global IFC. The service enables passengers to browse the Internet, stream videos, check social media and more during flights, with connectivity that is comparable to the mobile broadband services they may receive on the ground.

“GX Aviation continues to be a major success story, not only for Inmarsat, but for the global inflight connectivity market. We’re still within our first year of commercial service, so the fact that the service has been installed on 250 aircraft speaks volumes for its acceptance as the gold standard by airlines worldwide,” said Philip Balaam, President of Inmarsat Aviation. “Reaching this milestone so early in the launch of GX Aviation is testament to the industry-leading service levels that airlines

and their passengers are experiencing with the service. We celebrate this milestone with our world-class value-added resellers (VARs), Rockwell Collins, SITAONAIR and Thales, and ecosystem partners such as Honeywell and Zodiac Inflight Innovations. Together, we are committed to keep developing GX Aviation, keeping us ahead of other aviation connectivity solutions in the market.”

Delivering GX Aviation to global airlines

It’s been a busy few months for Inmarsat as its GX Aviation service goes from strength to strength, surging in popularity across the world.

In September 2017, Inmarsat was selected by AirAsia Group to deliver its GX Aviation service to more than 120 aircraft, covering all existing and future Airbus A320 and A330 aircraft operated across the group. The agreement also has the scope to include any additional aircraft types due for delivery in the coming years, such as the Airbus A350. The first installations and the launch of commercial service are scheduled to commence in the first half of 2018, with connectivity enabled by the JetWave terminals produced by Honeywell Aerospace.

In the same month, Air Astana became the first airline in the world to offer GX Aviation to passengers on board a



“In April 2018, Inmarsat announced a major milestone for its GX Aviation service after completing the 250th installation worldwide. Within the first year of commercial service, GX Aviation has been installed in a variety of aircraft.”

Photo courtesy of Pexels ●●●



widebody aircraft after the service went live on the airline's initial Boeing 767. GX Aviation will eventually be available on all three of Air Astana's Boeing 767s. Air Astana passengers will be able to choose from three connectivity packages: The Light option will cover 15Mb, the Business option will cover 50Mb, and the Super option will cover 100Mb. All services are estimated to operate at an average speed of between 2-5Mbps.

In November 2017, Emirates announced plans to install Inmarsat's GX Aviation high-speed inflight broadband service on its Boeing 777X aircraft fleet. The new agreement is part of Emirates' and Thales' plans to develop state-of-the-art IFEC on the airline's new Boeing 777X fleet. Emirates has 150 Boeing 777X aircraft on firm order, with deliveries currently scheduled from 2020.

Meanwhile, in April 2018, Inmarsat signed a Memorandum of Understanding with Turkish Technic and HAVELSAN on integrated IFEC solutions. As part of the collaboration, the three companies will offer a joint solution for emerging markets, which integrates Inmarsat's award-winning GX Aviation inflight broadband solution with the Turkish Technic-HAVELSAN IFE system.

Later in April, Inmarsat's GX Aviation service was reportedly being rolled out to Qatar Airways' Boeing 777 and Airbus A350 aircraft. Qatar Airways is the first airline in the Middle East and North Africa (MENA) region to offer GX Aviation. In total, the service will be equipped on more than 130 of the airline's Boeing 777 and Airbus A350 aircraft. As part of the service offering, passengers will be offered one hour of free access to GX Aviation, after which full-flight access can be purchased.

Jet Connex advancements

In addition to its GX Aviation service, Inmarsat also offers Jet Connex, the only global, high-speed Wi-Fi option available for business jets today, delivering the same fast and reliable onboard connectivity experience comparable to the mobile broadband services they may receive on the ground.

With Jet Connex, business travellers can join a video conference while flying over the Atlantic, catch the latest market reports *en route* to the next business meeting, or download tomorrow's presentation from the company server. The service reportedly offers passengers the highest speed and most extensive coverage of flight routes available to the market and is the first worldwide Ka-band network available to business aviation from a single operator. Operating over Inmarsat's Global Xpress network of Ka-band satellites, Jet Connex provides data speeds capable of supporting video-streaming, Voice over IP (VoIP), live TV, file transfer and VPN.

The service has proved incredibly popular; October 2017 saw the announcement that Inmarsat and Honeywell completed the 100th installation of the JetWave system, which powers Jet Connex. Honeywell, Inmarsat and their installation partners have received more than 25 type certificate and supplemental type certificate (STC) approvals for JetWave from the Federal Aviation Administration (FAA) and European Aviation Safety Agency (EASA) to date across 24 platforms. The two companies are securing an additional nine STCs for five other platforms in the coming months, meaning Jet Connex will be available for installation on over 29 business jet platforms. Platforms currently supported by JetWave and

Jet Connex include Bombardier, Dassault, Embraer, Gulfstream, Boeing and Airbus.

In October 2017, Inmarsat's Jet ConneX business aviation inflight Wi-Fi service received a Supplement Type Certificate (STC) for the popular Gulfstream G550 aircraft. Awarded by the Federal Aviation Administration (FAA), the certificate approves Gulfstream G550 business jets to be equipped with the exclusive JetWave antenna and terminal, produced by Inmarsat partner Honeywell. The system enables seamless access to Jet ConneX high-speed Wi-Fi across major flight routes and islands off the beaten path, allowing passengers to browse the web, stream live television, video conference and more.

Following more than a year of investment in development and testing, initial installations on G550 aircraft are now underway. Gulfstream, in cooperation with Inmarsat and Honeywell, is currently conducting in-service evaluation and final terminal Type Approval activities.

"The Gulfstream G550 community has been eagerly awaiting this Jet ConneX installation approval and has told us about their desire to have a powerful global high-speed Wi-Fi solution for their principals. Many are heavy users of Inmarsat's SwiftBroadband solution and are happy with the service reliability but are now looking to upgrade to a next-generation network that is fast enough to handle the demands of today's applications," said Kurt Weidemeyer, Vice President of Business Aviation at Inmarsat.

In the same month, Inmarsat made additional data plans for its Jet Connex service available on Dassault business jets, providing Dassault customers with five-tiered data plans to choose from using their existing non-Ka-band radomes. The highest data plan offers speeds up to 11Mbps. Business aviation customers are usually required to install the Honeywell JetWave hardware for Jet ConneX with a fully approved Ka-band optimised radome. However, that requirement has been waived while Dassault Aviation finishes development of a fully approved Ka-band radome, which is expected next year. With the installation of an approved Ka-band radome, Dassault customers will become eligible for the entire Jet ConneX data plan catalogue, which currently offers tiered plans up to 15Mbps.

The European Aviation Network

We've been hearing a lot about the European Aviation Network (EAN), the world's first integrated S-band satellite and complementary L-band terrestrial network build for Europe, in the last couple of years. As of 5 February, partners Inmarsat, Deutsche Telekom and Nokia have completed a key technological step in the development of the EAN, readying the network for launch. Some 300 base stations have been established across all 28-member states of the EU, as well as Switzerland and Norway, marking it as the first ever Europe-wide integrated LTE network.

The EAN is a pioneering technological achievement and a truly innovative European project, providing seamless connectivity over land and water, and offering a high bandwidth service to passengers – currently over 75Mbit/s connection speed to the aircraft – as airlines using the service do not share network capacity with any non-aviation customers. Passengers will be able to use social media, share pictures and stream high-bandwidth content at speeds they

are used to experiencing at home. The EAN is also designed to fulfil not only current but also future passenger demand for IFC as the integrated LTE ground network is fully scalable to meet increasing connectivity needs in the coming years.

The EAN is expected to be available for airlines to offer commercially from the first half of 2018. The service has been trialled during several flights to test the integrated satellite and complementary LTE ground network; the test flights have confirmed that the EAN meets its design performance in practice, providing an unmatched low-latency performance of less than 100ms. Airlines will be able to install the small and light-weight EAN equipment quickly and easily, typically during overnight breaks for individual aircraft and turnaround times for entire fleets of just a few months. International Airlines Group (IAG), which includes airlines such as British Airways, Iberia, Aer Lingus and Vueling, is the launch customer for the new service, and has already commenced installations of EAN equipment on aircraft.

"With the completion of the first ever integrated pan-European LTE ground network component we are now able to fully support EAN's satellite connectivity and maximize the performance of the EAN system," said Rolf Nafziger, Senior Vice President, International Wholesale Business at Deutsche Telekom. "The network is specifically designed to meet future capacity demands for connectivity in the European airspace, with passenger volumes expected to double in the next 15 years."

But not everyone is happy about the EAN's impending launch. Shortly after Ofcom granted Inmarsat a licence for its EAN in October 2017, Viasat announced plans to pursue legal action against the deal. According to reports, the relevant radio spectrum was initially awarded to Inmarsat in 2009 to create a mobile satellite system that could be used by the emergency services. As a result, the change of use of the spectrum into a commercial opportunity allegedly creates an unfair competitive advantage and could create a monopoly in the European IFC market. Viasat argues that, ultimately, consumers will be the ones who lose out as they end up restricted to a good-but-not-great service, at best.

Viasat has frequently opposed this claimed misuse and is looking to pursue legal action against Ofcom as a result of its decision. Viasat's President and Chief Operating Officer Rick Baldrige has issued the following statement:

"We are extremely disappointed by Ofcom's decision to grant Inmarsat authorization to operate its EAN. The facts are clear: Inmarsat is abusing the initial grant of the 2GHz spectrum, as set forth by the European Commission (EC) by changing the original tender granted to them with their intent to deploy a Pan-European terrestrial wireless network; and admittedly missing numerous deadlines as related to the original award.

This blatant misuse of spectrum needs to stop now. It establishes precedent for any organization to use spectrum without following the rules. As we've publicly stated: We believe the EAN violates the original decision of the EU legislature that the S-Band be used for mobile satellite systems - not a terrestrial wireless network (also known as an Air-to-Ground or ATG). We remain diligent in our efforts to have the EC halt Inmarsat's ATG deployments in the S-Band; declare Inmarsat's ATG plans as inconsistent with EU law and the original S-Band spectrum award; and retender the

spectrum. And we're not alone. A number of regulators have shared their own frustration with the EC's failure to act, despite requests for the EC to address this critical legal question. If the EC does not do the right thing and make clear that Inmarsat's ATG deployment is not a permitted use of the original granted spectrum, we will be left with no other option: We will fight the decision in each country that authorizes an illegal ATG network deployment.

In recent weeks, Viasat has taken a strong stand in fighting the EAN across Europe. We have advanced our legal actions against Belgium and the European Commission; and filed challenges with German and Italian regulators, making clear that we will take further legal action in Germany and Italy if they allow Inmarsat to implement EAN as advertised. We now fully expect to pursue legal action against Ofcom as a result of their decision this week."

According to the latest news, Viasat is not backing down over the EAN. In December 2017, the company took legal action against Ofcom over its decision to approve the network. Since then, Inmarsat has received permission to intervene, and on 24 January, the Honourable Mr Justice Roth, President of the Competition Appeal Tribunal, has made a further order establishing an interim confidentiality ring in the proceedings. Inmarsat has commented that it believes Viasat's claims 'to be entirely without merit.'

There are more recent troubles on the horizon as well. In March, the Market Court of the Brussels Court of Appeal revoked approval for the EAN in Belgium following Viasat's legal challenge. Eutelsat, which is also fighting against the EAN in selected countries, has spoken up in support of the decision. However, Inmarsat has stated that it doesn't believe the court's decision will be a significant problem in the roll-out of the EAN, claiming that the decision was made 'purely on procedural grounds,' and that the complementary ground network will be shown to comply with certain conditions in the EC framework.

Frederik Van Essen, Inmarsat Aviation Vice-President of Strategy and Business Development, made the following statement to *Aviation Week*: "The European Aviation Network is on track, and we believe that these claims are intended solely to undermine Inmarsat's legitimate business interests and strengthen our competitors' positions in the competitive tender processes currently under way with European airlines. Although at this point it is highly speculative to predict time frames against Viasat's legal challenge, we are confident that the courts will ultimately reject Viasat's claims against the regulators, and so we do not expect a knock-on impact on the commercial deployment of EAN."

Viasat deploys IFC with EL AL Israel Airlines and United Airlines

Global communications company Viasat has long delivered IFC solutions to aircraft around the world, increasing its offerings as the mobility market has boomed. The company has specialist products and services dedicated to all aspects of the market; commercial aviation, business aviation and solutions for helicopters and light aircraft.

In addition to its roles as a very active participant in the challenge of Inmarsat's EAN, Viasat has had a pretty busy few months of deals in the IFC arena. In September 2017, EL AL Israel Airlines selected Viasat's inflight Internet system



to power the airlines' onboard Wi-Fi experience across all its new Boeing 787 Dreamliners. Viasat's technology will deliver Ka-band capacity from Viasat-2 to provide coverage across North America, the Atlantic Ocean and Europe, as well as capacity from KA-SAT satellite, jointly-owned between Viasat and Eutelsat, for additional European coverage.

Meanwhile, in February 2018, Viasat signed a new contract with United Airlines to install Viasat's latest IFEC system on more than 70 aircraft, including at least 58 of the airline's new Boeing 737MAX aircraft. Viasat will serve as the direct inflight Internet service provider to United Airlines, deploying its most advanced IFEC system, in order to provide United customers access to fast, reliable Internet connections from the air, utilising capacity from VaiSat-1, ViaSat-2 and ViaSat-3. Passengers will be able to browse the web and connect with key business applications such as a corporate VPN and secure email. Viasat's IFEC system will also power United Airline's Private Screening entertainment option, which offers customers access to hundreds of entertainment titles from its onboard library direct to their own devices.

Yahsat succeeds in 50Mbps inflight test

UAE-based Yahsat provides a variety of satellite capacity and services through its Al Yah 1, Al Yah 2 and Al Yah 3 satellites, as well as a hosted payload on board the IS-32e/SKY-B1 satellite. The company serves the Middle East, Africa, Central and Southwest Asia regions with a range of solutions, including IFC.

In October 2017, Yahsat announced the successful trial of a 50Mbps inflight connection in partnership with du, Etihad Airways Engineering, Hughes Network Systems and Carlisle Interconnect. The high-speed broadband is expected to be available for airlines within the next few months. The test utilised Ka-band capacity on Yahsat's Al Yah 3 satellite in combination with a simulated environment of an Airbus A320 aircraft in Abu Dhabi. Yahsat and partners plan to complete the next key steps in the following 12 months to enable commercial roll-out of the service across the Middle East

and beyond. The new service will deliver the ultimate in IFC – an experience comparable with the service customers receive in their own homes, including streaming HD content, accessing social media, online shopping and messaging apps.

"We are incredibly proud to have brought together leading Emirati and global companies to achieve this milestone. It paves the way for Yahsat to bring further breakthrough technologies to the markets and segments it serves, adding another key pillar to Yahsat's portfolio of market leading services and solutions," said Masood M. Sharif Mahmood, Chief Executive Officer of Yahsat.

SES Networks announces major deal with STECCOM

Global satellite operator SES has, in recent years, become more actively involved in service provisions, utilising capacity from its GEO and relatively new MEO satellite network. From secure cockpit communications to cabin applications such as inflight HD entertainment or virtual office connectivity, SES Networks provides the next-generation, satellite-enabled mobility solutions trusted by industry-leading service providers such as Global Eagle Entertainment, Gogo, Thales and Panasonic Avionics.

In April 2018, Sputnik Telecommunications Entertainment Company (STECCOM) announced plans to elevate the passenger and crew IFC experience across the Commonwealth of Independent States (CIS) region and Europe by utilizing SES satellite capacity and associated services via SES Networks.

Under the agreement, STECCOM will leverage a high-capacity, global managed services platform built on an open architecture. SES Networks' global mobility solution will enable the service provider to customise and efficiently distribute bandwidth, adapting their offerings according to the needs of commercial passenger aircraft and business jets operating on their network. Additionally, STECCOM's customers will benefit from high-speed, high-throughput connectivity. SES Networks and STECCOM will use each other's ground facilities, opening up opportunities for

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THE MAKING OF GOGO'S HIGH-SPEED 2KU IFC NETWORK

Gogo's 2Ku IFC service performance was significantly enhanced by upgrading from the existing platform to Gilat's aero modem and satellite ground segment, according to Timor Blau, Director Commercial Aviation, Gilat Satellite Networks. With this new technology, Gogo now has the best-performing IFC system delivering seamless high-speed connectivity from take-off to landing. Driving Gogo's demonstrated achievements in the areas of user experience and performance is Gilat's SkyEdge II-c satellite system and its aero modem – known as the 'Taurus' modem manager (MODMAN).

The high-speed IFC challenge

Today, airline passengers want more than simply staying connected to the Internet during their flights. Recent surveys show that passengers expect their online experience at 30,000 feet to be the same as what they have on the ground. This has put the pressure on airlines to improve the performance of their IFC systems in order to offer passengers a flawless gate-to-gate online experience.

The main challenge for IFC service providers such as Gogo is to enable a best in class broadband Internet service to passengers on global commercial flights who seek uninterrupted connectivity on international, trans-oceanic flights. Modem performance was the key to enabling an outstanding passenger experience for global passengers.

Gilat's high-performance IFC solution selected by Gogo

To enhance the 2Ku service experience for hundreds of concurrent passengers, Gogo decided to replace its existing iDirect Evolution platform with Gilat's IFC solution. The components of this solution include a high-performance aero modem (MODMAN) and the SkyEdge II-c multi-service hub platform, which was deployed in 15 locations worldwide and utilizes bandwidth capacity from over 25 satellites.

Reflecting the success of its new service, the majority of Gogo's fleet was already upgraded to Gilat's modem during the past year, with the remainder expected to be completed by the end of 2018. Gogo announced that the modem is capable of delivering more than 16 times the throughput of its previous modem, thus easily supporting the increased capacity of next generation HTS as they come online.

Speed, coverage and availability

Gogo advertises three numbers that define its high-quality standard for inflight Internet: 15/98/98. These numbers correspond to three essential elements of IFC - speed, coverage and availability. With respect to speed, Gilat's solution enables delivery of minimum throughput of 15Mbps per passenger device on the airplane. The 98 percent coverage of flight routes means virtually nonstop Internet service across the globe. The other 98 percent relates to constant uninterrupted service availability. Gilat's newest satellite technology, featuring seamless satellite and beam switching, ensures the continuous service operation under complex and changing conditions.

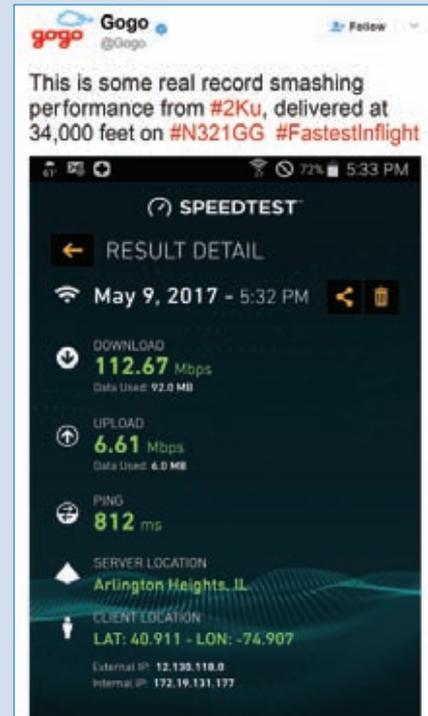
Key differentiators of Gilat's IFC solution

With support for HTS and wide beam satellites, Gilat's next-generation modem has enabled it to optimize the performance and efficiency of Gogo's 2Ku service while maintaining full interoperability with existing avionics IFE systems. The data signal to and from the aircraft is received and transmitted via a flat panel satellite antenna, processed by Gilat's modem and the data traffic is then distributed via Wi-Fi inside the cabin, allowing passengers to connect via their personal devices such as laptops, tablets and phones. The speeds supported allow for a diverse variety of applications, such as

“With the upgraded modem, we're able to take advantage of the new generation HTS satellites, increase the connection speed between the aircraft and the satellite, and open up additional bandwidth for new services like Gogo TV,” said Gogo spokesperson.

live TV and special services for the flight crew. Particularly on long flights, streaming video (e.g., Netflix) is a favourite passenger pastime, now made available with high quality broadband.

As the plane travels along its route, Gilat's IFC solution uses advanced algorithms to perform beam load balancing and beam prioritization, thus ensuring transparent switchover between beams, satellites and gateways while maintaining user application sessions. This provides a seamless coverage regardless of the plane's location, enabling passengers to enjoy the





highest quality experience throughout their journey.

Gilat's IFC solution ensures the excellent proven user experience from gate-to-gate, providing passengers with connectivity as soon as they board and until arrival at the gate of their destination.

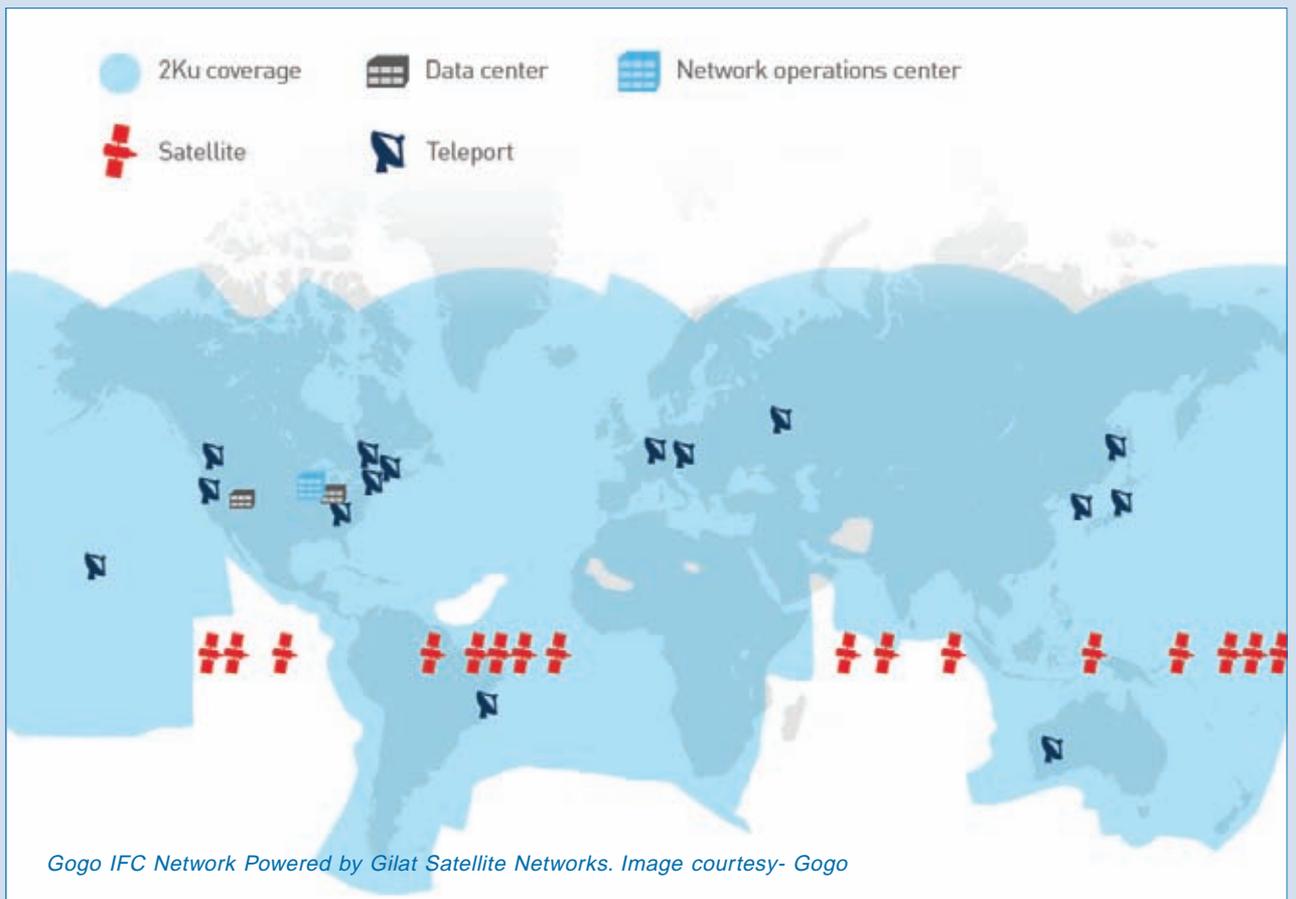
More improvements on the way

As Gilat's R&D labs continue to develop new features and technologies for its airborne VSAT equipment; new capabilities and functionality will become available.

For example, via a simple software upgrade the forward and return waveforms can be optimized to improve spectral efficiency and dynamic allocation of carriers, making the network the most advanced global DVB-S2X network. Gilat's modem can further be enhanced to process passenger traffic in concurrence with live TV broadcast via a dual-demodulator capability, enabling the modem to process two carriers at the same time. These industry leading technologies and capabilities will enable to achieve the highest efficiency and space segment utilization.

Today, Gogo operates the largest of its kind global satellite network for IFC, built with Gilat's ground system and aero modems. The network's open architecture allows working with any satellite network operator, while a central global management system and QoS features enable it to provision and manage bandwidth across multiple teleports, satellites and user beams.

Looking ahead, with current backlog for 2Ku installations, over 2,000 aircrafts are expected to fly with Gilat's aero modem.



enhanced connectivity across Europe, Russia and Central Asia. This ground infrastructure is key in ensuring efficient delivery of bandwidth to meet the rising demand for high-quality IFC services.

"Passengers today expect to have quality connectivity when they are up in the air, just like they do when they are at home," said Elias Zaccack, Executive Vice President, Global Sales, at SES Networks. "SES Networks is delighted to be supporting STECCOM in its ambition to reliably deliver the

highest quality of connectivity and elevate the travel experience for air passengers in Russia and adjoining markets, and to help airlines in the region expand their number of connected aircraft."

Gilat readies new IFC terminals

End-to-end solutions provider Gilat Satellite Networks is also ramping up its presence in the IFC market as demand booms the world over.

In February 2018, Gilat's dual-band Ku/Ka aero terminal achieved unprecedented performance during a live demonstration in China. The terminal reached speeds of 130Mbps with dozens of concurrent users browsing, video streaming, video and voice calls as well as various chat applications. The demonstration took place in a cabin user environment together with Air Esurfing, operating with Gilat's fully integrated dual-band antenna terminal as well as the Taurus Modman. Gilat's high-performance Modman as well as the high-gain antenna panel in Ka-band were key factors in the outstanding results of the demonstration.

Gilat's fully deployed mobility baseband is already operational and in use on China's first domestic HTS Ka-band satellite. The deployed network not only improved end-to-end results, but also significantly reduced the complete IFC system deployment time. Gilat's Ku/Ka antenna will be undergoing supplemental type certificate (STC) in the coming months.

Meanwhile, March 2018 saw Gilat launch AeroEdge 6000, a highly efficient, high-performance terminal for commercial IFC. The dual-band terminal includes Gilat's Ku/Ka band antenna, MODMAN, and Wavestream transceivers. The AeroEdge 6000 high performance terminal operates in both Ka and Ku-band, providing aeronautical broadband satellite communication for high-speed Internet and multimedia applications. The terminal includes Gilat's ER 6000-A Ku/Ka antenna, SkyEdge II-c Taurus MODMAN, Ku/Ka Antenna Networking Data Unit (KANDU) and Wavestream's Ku/Ka Radio Frequency Unit (KRFU).

The terminal allows seamless transition between Ka-band and Ku-band coverage, thus utilizing the best available satellite resources for cost-efficiency and performance. In support of a high-quality passenger experience, the Taurus MODMAN is equipped with a full set of embedded protocol optimization and application acceleration features. High spectral efficiency is delivered via wideband DVB-S2X carriers in the forward direction and fast adaptive and spread-spectrum LDPC transmission in the return direction. Operated over Gilat's SkyEdge II-c multi-service platform, AeroEdge 6000 is a new addition to the family of SkyEdge terminals.

Gogo amps up its service offerings

Gogo specializes, quite simply, in delivering IFC services across the world. The company designs and sources innovative network solutions that connect aircraft to the Internet and develops software and platforms that enable customizable solutions for and by its aviation partners.

Gogo's 2Ku solution, which utilizes two Ku-band antennas to deliver high-speed IFC, has proven effective in the years since its launch. As of December 2017, more than 500 aircraft are flying with its 2Ku technology, while total awards for 2Ku inflight connectivity solution have now surpassed 2,000 aircraft. Gogo added more than 550 aircraft awards in 2017 alone. Meanwhile, install times have been reduced down to 30 hours, less than half the time it typically takes to install a broadband satellite connectivity solution.

By February, more than 200 aircraft were equipped with Gogo's 2Ku solution utilizing HTS capacity delivered by SES-15. Due to SES-15's high-powered HTS beams, all Gogo aircraft outfitted with its next generation modem will experience an even better customer experience with

improved economics. All new 2Ku installations enter service with the upgraded modem, and all 2Ku equipped aircraft are expected to have the new modem by the end of this year.

"Gogo's 2Ku technology is delivering industry leading performance today, but we designed the technology with an open architecture, so it could take advantage of numerous enhancements over time," said Anand Chari, Gogo's Chief Technology Officer. "As we layer in more HTS capacity from satellites like SES-15, 2Ku's performance will get even stronger without having to touch the aircraft."

Indeed, the 2Ku service has proven popular across the world: Cathay Group selected Gogo's 2Ku solution for its wide-body fleet of Airbus A330 and Boeing 777 aircraft in November 2017. 2Ku will give Cathay Pacific and Cathay Dragon's customers a seamless experience across their existing fleet of aircraft once it goes live in mid-2018. Later in February, Aeromexico opted to install 2Ku on an additional nine Boeing 737-800NGs, on top of its 20 Boeing 737-800NGs the solution is already installed on. Air Canada, meanwhile, has more than 170 narrow and widebody aircraft committed to the 2Ku technology, and in April, the airline selected Gogo's 2Ku solution for its Bombardier CS300 aircraft. The technology will be installed as a line-fit option at Bombardier. Air Canada has 45 CS300 aircraft on order with an option for an additional 30 aircraft.

Developing new solutions

Always developing the next generation of services, October 2017 saw Gogo successfully complete its first test flight and begin nationwide rollout of its new regional air-to-ground (ATG) inflight network.

The next-generation ATG network combined with Gogo's proprietary aero antenna, in-cabin network and software platform will bring up to 30 times more bandwidth to an aircraft than its original ATG solution. Once the network upgrades are complete, Gogo will have a North American ATG solution that will deliver performance on the aircraft that is comparable to Gogo's 2Ku global satellite solution. Gogo's ATG network will have peak network capacity of more than 100Gbps. When combined with Gogo's global satellite network, Gogo will reportedly have the highest capacity network ever built that's dedicated to serving aviation.

The ATG network utilizes unlicensed spectrum in the 2.4GHz band as well as the licensed spectrum from Gogo's original ATG network to provide greater bandwidth and reliability. It also leverages Gogo's existing ATG network backhaul and infrastructure of more than 250 cell towers. On the aircraft, Gogo has developed a proprietary new antenna and modem that will produce peak speeds of more than 100Mbps per aircraft.

Gogo advances AVANCE

In January, Gogo unveiled Gogo AVANCE L3, an innovative new IFC system that delivers the benefits of the Gogo AVANCE platform to passengers in a small, lightweight form factor, with (reportedly) the most affordable pricing options in business aviation. Gogo's breakthrough technology platform lets users customize their inflight experience based on their unique needs and can be installed on business aircraft of all types and sizes but is an ideal solution for smaller aircraft including turboprops and light jets. Later in February,



AVANCE L3 received Supplemental Type Certification (STC) and Parts Manufacturer Approval (PMA) from the FAA.

The Gogo AVANCE platform integrates a full range of smart cabin features, allowing passengers to simply and reliably access and use all available data, voice, maps, entertainment and cabin management system (CMS) services. The new system includes a built-in smart router and allows for a variety of service offerings to best fit a customer's needs. It's a new level of flexibility not seen before in business aviation that allows operators to tailor their passengers' experience. With AVANCE L3, they can control and manage the number of devices they allow to connect and can scale their configuration up or down seamlessly as needs change.

Using AVANCE L3, anyone onboard the aircraft can stay connected to email; send text messages and make voice calls with Gogo Text & Talk (service plan required); access their favourite flight apps such as moving maps, weather and flight information; or watch movies and TV shows using Gogo Vision (service plan required). For customers looking for full Internet connectivity, AVANCE L3 can be enabled to connect to the Gogo Biz data network delivering a 3G experience.

Global Eagle Entertainment augments HTS capacity

Global Eagle Entertainment (GEE) is a leading provider of media, content, connectivity and data analytics to markets across air, sea and land with a fully integrated suite of rich media content and seamless connectivity solutions to airlines,

cruise lines, commercial ships, high-end yachts, ferries and land locations worldwide.

In January, GEE tripled the amount of HTS capacity secured with SES Networks via its SES-15 satellite to enhance IFC for airline passengers travelling across North America. The major increase in Ku-band capacity will enable GEE to deliver high-speed broadband to passengers on board commercial flights throughout the USA, including the increasingly important US mainland to Hawaii routes. The multi-year agreement is the latest contract to be signed by Global Eagle: In the past several years, Global Eagle has doubled its capacity with SES Networks on an average of every eight months to meet the rising demand for high-quality inflight connectivity around the world.

Later in March, GEE agreed to a significant investment from funds managed by global investment firm Searchlight Capital Partners, L.P. Searchlight will invest \$150 million of new capital into GEE and receive \$150 million aggregate principal amount of the company's new second-lien notes due 30 June 2023. Global Eagle expects the net proceeds from the transaction to be approximately \$142 million after payment of fees and expenses, which will significantly strengthen the company's balance sheet and liquidity. It intends to use a portion of the proceeds to repay the full \$78 million principal balance on its revolving credit facility, following which the full \$85 million facility will remain available, potentially for growth initiatives and other general corporate purposes.

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The new opportunities for satellite in 5G telecom networks

5G is one of the hottest topics around right now, with people from all sectors getting in on the action. How will it be rolled out to best effect? What role will satellite play? What about the ground sector? All these key questions and more are addressed by Alex Holvoet, SVP Program Management at LeoSat.

Traditionally satellite services have been used in telecom networks to extend coverage into the more remote areas – where connectivity with local or international carriers with the required capacity was not available. This way satellite operators provide critical services to terrestrial telecom operators for them to meet their customer's demand. However, as bandwidth demand increases and technology in the areas of microwave solutions, optical fibre and satellites further develops, it starts to make sense for telecom operators to evaluate these newly-developed options and potentially look for alternative solutions.

With the ever-increasing demand for data, from enterprise,

end-users and now increasingly by devices, it's not just bandwidth that is required, but there is a new element – the demand for density. Mobile Network Operators (MNOs) have been at the forefront of these developments in the past decade and their requirements have grown significantly as a result, with low latency rapidly advancing to the forefront, eloquently captured in the simple catchphrase: Latency matters!

In the last two decades, we have seen a steady evolution in the mobile industry: 2G – 3G – 4G and now soon 5G. The first steps toward 4G have predominantly been driven by the need for data applications and video services on mobile

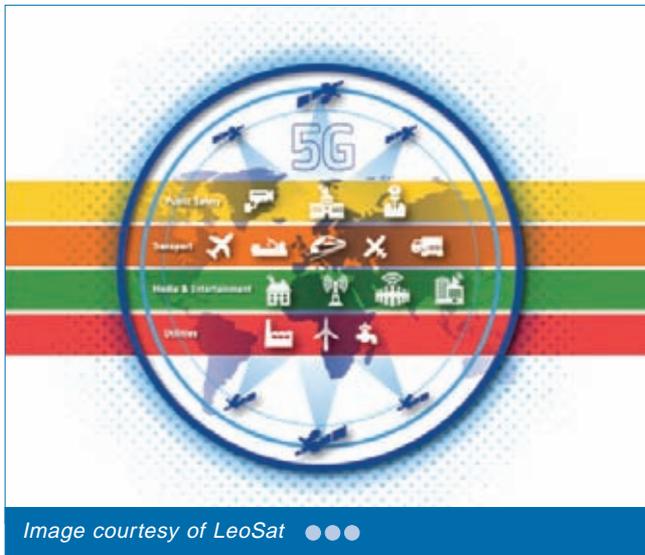


Image courtesy of LeoSat ● ● ●

devices. The last step in the evolution towards 5G is largely driven by a requirement to connect more devices in support of the Internet of Things (IoT), and with these devices as part of mission critical networks, new requirements in terms of command and control for remote sites, fuelling the need for the earlier mentioned low latency.

With these new requirements now clearly developing, one can argue that the move towards 5G signifies a trend that mobile networks are becoming more and more an extension of the wide area and local area networks that are in use today. After all, it is not only about adding more users and supporting more bandwidth for (data!) applications on more devices, it is increasingly about developing enterprise grade services and an expectation that its performance will be driven by seamless integration of different networks, provided by terrestrial telecom operators, mobile and fixed, and satellite operators.

Who is doing what on the road to 5G

MNOs are preparing to upgrade their networks to the new 5G standards, including the set-up of pilot sites with suppliers to test the capabilities and promote them to their customers; all very similar to what they have done for 4G. New features in the 5G standard however make this a larger endeavor than before. More use cases and more service types need to be developed and tested in support of high speed, fast moving customers as well as servicing dense footprints with many IoT devices. Equipment manufacturers are also planning roadmaps for new features and are working together with operators to prepare more pilot environments and are preparing business cases to upgrade to the new standards while staying profitable.

For satellite operators, ideally positioned as a 'network of networks' service provider, these developments provide a clear opportunity to expand their backhaul services and adopt the technology to seamlessly integrate these mobile networks into terrestrial the network configurations. All this supports the business case to proceed with expanding HTS capacity in space.

LEO operators are in a more unique position when it comes to 5G. First of all, it provides them with a unique

opportunity to position their services characterized by very low latency. Their lower orbits put them in a unique position within the mobile 5G developments, where low latency is at the very heart of the new standards development. Secondly, in leveraging these unique low latency capabilities, there seem to be different go-to-market approaches among LEO operators. Some are looking to provide 5G services directly to end customers in a business model to 'Connect the Unconnected.' Others envision a reseller model, supporting terrestrial and mobile telecom operators in expanding their infrastructure into maritime or more remote areas.

On the technical side, there are a number of initiatives to bring players closer together in developing the satellite infrastructure aspect of 5G. In Europe, the European Space Agency (ESA) has set up a satellite industry working group to develop a stronger integration of 5G between terrestrial and satellite telecom operators. Through the 'Satellite for 5G Initiative,' ESA and the European space industry are joining forces to develop and showcase the added value that satellite brings in the context of 5G. They will collaborate on 5G service trials using satellite, with a focus on those vertical sectors for which 5G will be highly relevant, such as transport, media and entertainment, and public safety. While focusing on these markets, there are activities in the areas of application development, standardization, resource management, interoperability and other supporting technologies.

As such, the ESA led initiative supports a seamless integration of satellite and terrestrial networks as an integral part of the 5G system.

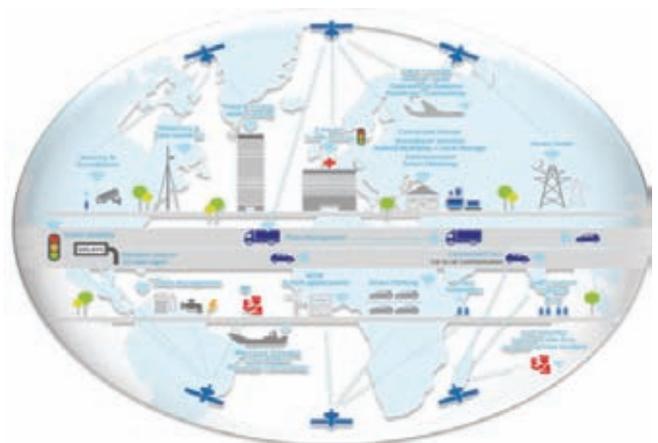
What are the relevant 5G use cases for satellite operators?

Backhaul for telecom operators

Expanding MNOs' service area into territories where terrestrial services are not available will continue to be an important use case in the 5G area. These requirements for mobile backhauling will continue to increase as the 5G platform is expected to carry a lot more traffic than 3G and 4G. Current satellite technology focusing on higher throughput (HTS) and/or lower latency (MEO/LEO constellations) are better suited to address this requirement than the traditional satellites.

Public safety

Public safety or red and blue light service operators have



traditionally operated with voice-based communication systems and narrowband data services. However, it has become evident that these operators are able to provide a much improved service level and are able to respond faster using high-speed broadband data services and applications. These requirements are starting to come to the forefront and we're already seeing national procurement/implementation projects active in this area. This use case also requires its services to be expanded into remote areas which makes it an ideal application for satellite services to be fully integrated into terrestrial networks to provide the best solution.

Communications on the move

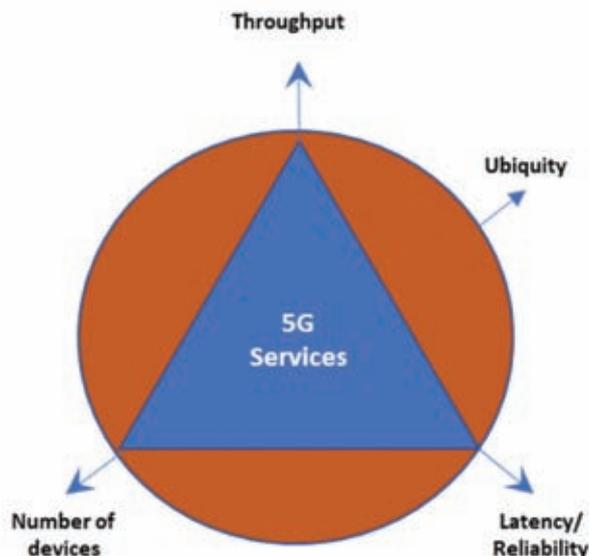
Cruise vessels, aircraft and trains offer WiFi services to their customers to satisfy their requirement for connectivity. For remote, maritime or scarcely populated areas, satellite services are looked upon as one of few, if not the only, platform that can provide these services. 5G will not only bring the required additional bandwidth, using low latency features it can now also support more applications and allow all devices to be operated as part of a network with similar performance characteristics as its wired equivalent.

Cars

Cars have their own specific use case. On board entertainment, remote monitoring and control and remote updates for maintenance purposes are similar when compared other transportation use cases. What is very different though is the advent of the driverless car in an effort to optimize traffic and increase safety. Those applications will come with requirements of a higher priority, possibly requiring the use of a much larger seamless network beyond the size of traditional 5G network. For satellite as a 'Network of Networks' this may create a unique opportunity to combine its global reach with its technical attributes regarding throughput and in the case of LEO, latency.

What are the requirements for satellite services in the 5G environment?

5G is promising ubiquity, high throughput, high density (where needed) and low latency. Not all aspects can be offered



through existing infrastructure, and therefore a network of networks is not merely an option to facilitate the roll-out of 5G, it will become a requirement.

As such, satellite operators can support the roll out of 5G in many ways. The one that always has been at the forefront is the ability of satellites to cover large territories and water. In being able to do that, satellite is recognized for supporting MNOs to expand their footprint. With the advent of 5G and new satellite systems at the same time, there is now both the requirement and the option to bring more value to the MNO: More capacity and, in the case of LEO, much lower latency, both desperately required by 5G.

As much as these developments are underway via the expansion of HTS satellites and the new capabilities offered through LEO constellations, there is an additional aspect that is worth a closer look: The integration of all space elements with terrestrial infrastructure. A critical component of that integration is the satellite ground segment. To be able to bring the services to the customers, there is a need to continue to develop that equipment, particularly in the area of antenna systems. Flat panel, phased array antennas (FPAs) are widely recognized as the preferred solution. Lacking any moving parts and the software-based installation process are both helping to bring down the operational costs, and the industry is working very hard to also bring down the price of these FPAs such that the total cost of ownership of these systems is competitive with traditional antenna systems. An added advantage in using these FPAs is the ability to integrate a lot of hardware and software into these systems, facilitating 'self-installation,' but also allowing it to be much better integrated with terrestrial infrastructure.

Based on these advantages and due to their more elegant form factor and improved performance capabilities presented by some manufacturers, the terrestrial telecom providers are looking to use these systems to increase the capacity to end users and cut down significantly on implementation time, relative to a roll-out of terrestrial infrastructure. In the transportation use case, the FPA form factor allows for a much better integration with the car, train, cruise ship and particularly airplane. Lastly, from a LEO/MEO perspective, FPAs provide a robust platform that is easier to install and maintain and is expected to be economically much more



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attractive than the traditional dual steerable antenna systems.

Conclusion

There is an increasing number of opportunities for satellite operators to find ways to integrate and provide connectivity to their customers.

With data traffic predicted to increase almost four-fold by 2020 to 4ZB per year, one of the key challenges for the mobility sector in the 5G environment is achieving scalable,

flexible solutions for their expanding networks.

5G will bring a next generation of standardization for telecom services and the end customers will benefit from higher throughput and access to more services in more places. Not all of that can be provided by terrestrial networking and a single network type. Satellite has the opportunity to play a key role in the development of 5G, provided it does a better job in seamlessly integrating its satellite services into these developments focusing on protocols, latency and capacity. Successfully doing so will allow satellites to vastly expand the number of locations where 5G can be offered. For that to happen, satellite operators need to understand the needs of their customers and develop solutions to satisfy that demand. Backhaul for mobile networks is crucial to ensure speed and capacity for data transportation from distributed network sites to the network core.

With the new developments in satellite constellations, next generation low earth orbit systems such as LeoSat are seen as key for 5G development. By providing a guaranteed level of connectivity, resilience and security required by 5G for significant sectors of industry, LeoSat can offer a clear path for telecom operators in search of growth.

And finally, with further innovation and development on ground segment equipment and more specifically antenna systems, we can look forward to a next generation communication network that harnesses all the components for success and will ultimately enable a fully connected digital society.

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Connectivity comes with challenges

The world is becoming an ever-more connected place to live. From phones, homes, cars and planes, people are even connecting to their pets with smart collars. All that connectivity comes with a lot of challenges; financial, technical, and regulatory. Amy Saunders reports from the Global VSAT Forum's (GVF) Connectivity 2018 event.

Maria Kalama, Lead Satellite Communications at Innovate UK, described the results of market research coordinated by Satellite Applications Catapult and sponsored by Innovate UK. "Connectivity is a vast subject, and the market can be looked at in many ways," said Kalama.

Kalama went on to discuss the 'new' verticals for satcom. "Broadband to aircraft and air traffic management are seeing growing demand, but the key in this market is to be customer-focused and offer an integrated communications solution," she said. "There are still opportunities to offer specialised content to this market. Maritime opportunities include operations, crew welfare, IoT, eNavigation and secure broadband." Meanwhile, the rail market is very segmented from one country to another, and it's difficult for an SME to enter this market, according to Kalama – "They would be better to partner with a larger company, and the focus is on security rather than customer solutions."

City needs aren't evolving that much, according to Kalama. "Local authorities will always be interested in improving accessibility and accessibility, and in the future that will be possible with integrated systems and services. Air pollution management and urban planning will also be important," said Kalama. Mobility will be the biggest revenue in the near future, followed by healthy cities and urban planning. "Connectivity from constellations is expected to boom in demand."

It's been difficult for satellite players to break into the 5G backhaul market, and there a lot of barriers in place: "Technology, cost, lack of awareness, launch, lack of standardisation, skills shortage, and the need to reinforce IT solutions. The market for secure communications is growing by around half a billion dollars each year," added Kalama.

Space and the ground segment

The space and ground segment markets are moving on rapidly as mobility applications become increasingly advanced and 5G edges closer to roll-out; it's vital that the satellite sector stay relevant.

"In the next 10 years, the market is going to almost double, with mobility, especially aero, being the biggest driver," stated Deepukrishnan Pillai, Senior Analyst - Strategy & Market Intelligence at SES. "We need to increase our capabilities to increase our share of the global telecom market. Right now, they're at US\$2 trillion, and we're only seeing around 0.5 percent of that." Flexibility is also key: "We don't know what demand will be in the next 10 years in geographical terms, so we need systems with dynamic capacity allocations," added Pillai.

"Mobile applications are driven by throughput," opined Bart Van Poucke, Vice President Products at Newtec. "The more throughput we can get to planes, boats, etc., the better." But, according to Van Poucke, it's not always about high throughput satellite (HTS) capac-



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ity: “Bandwidth intensity is important, as is antenna type; we have massive antennas, small antennas, flat panel antennas, and they all have to work together in the same network.”

Van Poucke identified service differentiation as key to continuing operations. “We need to service our most demanding customers while not allowing our smaller clients to make things difficult, especially when it comes to beam hopping.”

People expect speed, reliability, and home-like performance while they’re on the move. “Users don’t care that satellite is different, and nor should they have to. It’s all about user perception, and response time to web pages is everything,” said Andy Lucas, Senior Vice President (Satellite Operators) at Comtech EF Data.

According to Mark Lambert, Vice President Business Development at Kratos Communications Ltd, the dramatic growth in satellites, including 129 launches of HTS in the next 10 years, is going to bring problems as well as opportunities. “We need a different way of doing things... Things are going to get obsolete more and more quickly, it’s a vicious circle,” said Lambert. “We need an equilibrium where satellite operators can make money out of the systems and have the end users benefit as well. We need to be more efficient in the ways we’re building gateways and antennas: IP has a major role to play.”

5G, too, is going to bring a great deal of change to the satellite community on many fronts. Greg Quiggle, Vice President Emerging Products at VT iDirect, sees 5G as an opportunity for satellite companies to come together with other technologies, for example, to provide the connectivity required for the connected car. “Latency-tolerant services such as software updates can be performed with higher latency connectivity options, while latency-intolerant services can be achieved with LEO constellations or terrestrial services,” Quiggle observed.

Anver Anderson, Director at Anver Ltd, outlined how new applications would open up new opportunities within the satellite sector. “There’s always going to be a place for satellite, whether it’s GEO, MEO or LEO,” said Anderson. He introduced QuadSat, a Denmark-based start-up company which plans to use a drone as a satellite simulator for antenna evaluation on maritime vessels in port. “Satellite operators, antenna manufacturers, maritime VSAT service operators and others can all make good use of the equipment,” he said.

The varied connectivity ecosystem

The connectivity ecosystem is hugely varied right now as new technologies make new applications possible that were difficult to pre-

dict even 10 years ago. As Robert Novak, Expert for Cellular Backhaul Solutions at ND SatCom, put it: “Why should we limit ourselves with a topology restriction?”

John Finney, Founder of Isotropic Systems, emphasised the importance of bridging the digital divide in aeromobility applications. “If we’re not careful, we’ll either be too slow to respond to some market forces, or the predicted growth won’t happen.”

Finney envisages a pyramid with high value segments (airlines, superyachts, business jets, etc.) at the top, traditional segments (mobility, enterprise broadband, government, etc.) in the middle, followed by lower value/higher volume segments (connected car, 5G), and finally, mass market (consumer broadband, IoT) at the bottom. “There are a few areas of this pyramid that are very digital. Within land transport, there’s a very large predicted growth with the connected car – but we don’t believe we’ll see that growth in the next 5-7 years. The aero area, meanwhile, we’ve trimmed back in the belief that there needs to be a lot more progress in innovation across the board before we see the growth figures that have been projected,” said Finney. “There’s a very real digital divide. The service providers are focusing on the more lucrative routes, which means there are many countries with no inflight connectivity. Only 67 of an estimated 5,000 airlines offer broadband connectivity.”

Hispasat’s Manager of Products and Services, Luisa Fernandez, approached the digital divide topic on a geographic rather than vertical level, focusing on Latin America. “Around 3.9 billion people are unconnected, 69 percent in rural areas. More than half of households in Latin America have no Internet access,” Fernandez told the delegates. “Connectivity brings equal opportunities and enhances education. It’s not only a question of quality of life, it’s also to improve development in these areas. Satellite is the economic solution compared with terrestrial options.”

But regulations make delivering high-speed global connectivity a major challenge. Vadim Doronin, Senior Consultant at Access Partnership, stated: “Global connectivity is very important. But we never ask how it’s regulated. Frequencies are a scarce resource, so they’re regulated all over the world. During aviation, you fly through various jurisdictions, so how do we make it simple for operators to comply with each jurisdiction? ECC Decision 12(01) has made free circulation and exemption from individual licensing of ESIMS, which allows for gate-to-gate services.”

Of course, as we frequently highlight in *Satellite Evolution*, satellite isn’t only limited to delivering services and solutions for essential day-to-day services and innovative new applications; it’s also about responding to disaster situations. Javier Santos, Business Development Engineer at Inster, outlined a case study from when Nepal was struck by an earthquake which killed almost 9,000 people and injured around 22,000 in 2015. “After the earthquake, people were left under the debris. Communications were damaged and inoperable,” said Santos. “Reliable satellite communications equipment was required on ground for search and rescue, prepared for off-road conditions and severe climatology. The Spanish UME (Military Emergency Unit) was sent to Nepal after the Earthquake to collaborate in rescue activities. Hundreds of lives were saved, and areas were made safe.”

Mobile connectivity, the Cloud and the IoT

As people, we often like to look at one topic, such as the Cloud, as a standalone element to be considered separately from everything else. For most of us, it’s just how we’re wired. However, as we move into the future, different elements are becoming increasingly interconnected. It’s impossible, for example, to speak about 5G without also speaking about both terrestrial and satellite connectivity options.

Jack Buechler, VP Business & Product Development at Talia Group, presented Talia’s Quika service, which aims to connect the unconnected for free to overcome digital inequality and create a better world to everyone. “We’ve found there are plenty of places

John Chambers, Regional Director OEM Partner Sales, EMEA-India at Thingworx, stated: “The intersection between the physical and digital world is key. IoT and augmented reality are wedded to each other as the bridge between digital and physical.”

that have 2G or even 3G, and that's today: Never mind 5G!” said Buechler. There's major issue of investment, and operators are keen to expand 5G to gain new subscribers. “It's all about affordability – that means something very different here in the UK than in the countries we're targeting first with Quika, in the Middle East and Africa,” explained Buechler. “When we go from 4G to 5G, the number of base stations required are an order of magnitude higher. It's a problem, especially because voice is no longer a cash cow. Telecoms needs data to stay in the game, while voice is a penny business for them now, and they're not keen to invest.”

So much of the innovation going on right now is down to start-ups rather than the established industry giants. As such, there are very real problems hindering innovation beyond finance and experience, as Velipekka Kuoppala, Vice President, Sales and Business Development at Soracom, outlined: “It's important to be easily-accessible for start-ups as well as big companies, because that's where the innovation is. For the IoT to succeed, we need secure and swift service which is affordable and available to all.” He continued: “98 percent of our clients are IoT start-ups. Those start-ups approach mobile network operators (MNOs) for services, but they're not geared up to serve the IoT market; they can't help start-ups who need a very small number of sim cards to test their service, since they're used to selling in the thousands.” What is needed to enable those start-ups are; no contracts or commitment; publicly-available services; pay-as-you-go pricing; self-service capability.

Start-up companies such as Phasor, Kymeta and Isotropic are all making significant progress in antenna and terminal innovation alongside the well-established companies, despite the well-documented challenges in bringing brand new and unique technologies to market. Striving for this goal is a must, as: “New terminals are necessary to address these new markets, with new constellations and new capabilities,” said David Garood, Senior Vice President Business Development at PHASOR Inc.

John Chambers, Regional Director OEM Partner Sales, EMEA-India at Thingworx, stated: “The intersection between the physical and digital world is key. IoT and augmented reality are wedded to each other as the bridge between digital and physical.” The power of partnerships in the IoT Ecosystem is invaluable, and something we all need to be thinking about more. “When we speak to our customers about their journey into IoT, they typically have a lot of problems, questions, or are lacking confidence. There are lots of different elements in the IoT support chain,” said Chambers. It's vital that the industry continues to collaborate, so we can continue to advance.

Automation is becoming increasingly important for everything from the connected car to in-orbit satellite servicing; some believe that automation is key in our next digital transformation. However, “machine learning isn't accurate enough yet; it can't distinguish between a Chihuahua and a muffin,” commented Alvaro Sanchez, Director Sales & Marketing at Integrasy. “But I believe it'll get there in the future...”

Cybersecurity is, of course, key to enabling secure and safe IoT applications, especially when it comes to automated cities and transportation. “There's no one solution that fits all,” said Robert Brown, Executive Chairman at RazorSecure. “Cybersecurity is all about layers, and what's happening at the moment is that the hackers are

finding new ways to fight and gain access to our networks that we've never thought of before. Secure today is not secure tomorrow.”

Building user-vertical applications - Development and deployment environments

The connectivity market is undergoing a radical change: “We're trying to sell connectivity, which is pointless, because they don't want connectivity, they want services,” observed Kieran Arnold, Head of Networks & Systems at Satellite Applications Catapult.

Alessandro Caranci, Senior Vice President Satellite Communication at Telespazio, agrees: “More and more, mobility means satellite connectivity... The highest level of value creation is when you have a customer that is able to plan what they're doing.”

Shipping is one of the biggest sectors right now entering the digital age. “The shipping industry is just emerging from the largest downturn in living memory. There are too many ships, chasing too few cargos... Overcapacity is a big issue at the moment,” said Roger Adamson, CEO at Futureautics. “It's difficult to look at long-term digital transformation when you're concentrating on the next quarter results. The maritime sector is talking about digitalisation and digitisation. It's about cost-saving. What they should be looking at is digital transformation, or digital reimagination.”

According to Adamson, it's all leading to radical transparency, a first for the maritime sector. “Data is being collected, aggregated, and we can move to a position where we can regulate in real-time. We can check how a vessel is operated, whether its compliant, and that benefits shop operators, insurers, lenders, etc. We can assess risk better,” said Adamson. “For the ship operator, that results in lower premiums. It also brings hyper-rationality. We can now make evidence-based decisions. This all requires heavy data lifting. The maritime sector has been pretty adept at trying not to send data over satellite for 30 years, but that's beginning to change. It's about the opportunity for satellite operators and getting on board with the ecosystems forming around those platforms and becoming a part of that intelligent digital mesh.”

“One of the most disruptive meta trends is autonomous vehicles, and maritime won't escape that. We're going to redesign how ships work and what they look like. They'll be simplified, become autonomous, and finally unmanned. The Yara Birkeland, the world's first fully electric and autonomous container ship, is starting that next year,” said Adamson. “75 percent of all maritime data traffic is created by crew, so with unmanned ships, that data usage is going to disappear. The IoT, an intelligent digital mesh, is where it's important for satellite operators to concentrate down the line.”



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Picture (from left to right): John Whalley, Richard Peckham, Rt Hon the Lord McNally, Christopher Newman, Farhana Amin ●●●

Priorities for the UK space industry

The UK space sector is in a period of upheaval. Policy is changing, which effects everything from launch capabilities to manufacturing methods and applications. With Brexit on the horizon, it's imperative that the UK remains at the forefront of space industry in an uncertain future. Amy Saunders reports from the Westminster Business Forum Keynote Seminar: Priorities for the UK space industry - Investment, infrastructure and international competitiveness.

There's been a lot of news out of the UK space sector in recent months, but one thing is for sure; we're in a time of great change, and no one is sure what's coming next.

"From a space agency perspective in growing the sector, we're very conscious that we have to focus not just on economy, but also on space and science," said Catherine Mealing-Jones, Director of Growth at the UK Space Agency. "But what is the space sector? It's hard to pin down; it's an enabling infrastructure, and also about the services and applications. As policy makers, finding that easy explanation of what it is can be quite difficult."

It's been estimated that the space sector is worth £250 billion to the wider UK economy. "But, there are clouds on the horizon. The sector is changing dramatically in all areas, from telecoms to Earth observation," observed Mealing-Jones. "The era of sector deals is upon us. We're wrestling with Brexit and the drive for an ever more global Britain. We're looking at new partnerships, and a new way of working. There's a feeling of opportunity for some, and challenge for others."

Disruptive innovation including new manufacturing methods, services and applications, along with the low Earth orbit (LEO) and medium Earth orbit (MEO) constellations, are changing the way we see space. "There's a narrative of commercial space, the feeling that the private sector is taking over. But is that real? Could, for example, Elon Musk have

succeeded with government support?" asked Mealing-Jones.

Indeed, the space sector of the future is going to look very different to what we've seen up to this point, and it's vital that the UK stays in the game. "Growing the UK£250 billion to the whole UK economy is essential; we've got to work out how space solutions can get in there earlier. We need to be making common platforms instead of bespoke solutions," observed Mealing-Jones. "The government has a great role to play. We're working on the next version of the Civil Space Strategy, and we want to lead this new space age. Investment is important, as are partnerships. UK-friendly standards at the start of process are crucial. Government could also be doing more of its own research."

Mealing-Jones concluded: "There are a lot more ideas out there, and we need to go after them as a nation. The inspiration and impact of this sector flow into every home in the UK."

Policy priorities for the UK space sector - Infrastructure, regulation and the Industrial Strategy

The Space Industry Act 2018, part of the UK Government's Industrial Strategy, received royal assent on 15 March 2018. The Act aims to develop the UK's satellite industry into a global hub for satellite operations, with developments in small satellite manufacturing capabilities and investment into the UK's first spaceport. It also includes legislation that will include



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Catherine Mealing-Jones, Director of Growth at the UK Space Agency

the deployment of drones that will battle marine waste.

Commenting on the Act, Christopher Newman, Professor of Space Law and Policy at Northumbria University, stated: "There's always that little bit of fear that it might not going according to plan."

Launch capabilities are growing worldwide; there were 91 attempts in 2017, and 170 attempts are expected in 2018. "There's this new imperative for a sovereign launch capacity. The new framework is designed to embolden the small satellite market. The market is becoming ever more competitive," observed Newman.

"A good regulatory framework ensures certainty for investors. The Outer Space Treaty requires the UK to regulate space activity and provides for the operation of spaceports in the UK. The Outer Space Act 1986 will continue to apply for activities outside the UK," said Newman. "The new Act intends to be future-proof; outer space law is where Internet law was 25 years ago, where there were difficulties that were never anticipated."

Richard Peckham, Strategy and Business Development Director at Airbus Defence & Space and Chairman at UKspace, commented: "Space applications are driving growth. We've had impressive growth since 2000, and the 2010 Innovation and Growth Strategy (ISG) has been fantastically successful, but it was getting a little bit long in the tooth." He continued: "Now, you can really feel the buzz. There's more private investment. But we can't stand still: We have to get back on the front foot and be thought leaders. It's not just about money, we must be smart. The size and cost of satellites has come down, barriers to entry are falling, and constellations are being enabled."

The EU is a big customer in its own right, but, according to Peckham, we're already being pushed out, and feeling the impact of Brexit. "Space for many remains a strategic thing," observed Peckham. "It's not an open market. There are opportunities, including the government's establishment of a national space programme. One of the big things we think is necessary is to fund a national space programme, a long-

term plan which would stimulate inwards investment and help grow international partnerships."

John Whalley, Chief Executive at Aerospace Wales, stated: "In Wales, we need to up our game. We have an existing space industry, and with five percent of the UK's population, we account for 10 percent of the UK's aerospace industry. We have a lot of relevant strengths, but in space, we're not punching above our weight." He continued: "We established a space strategy back in 2015 which mirrors the UK space strategy, and we are now established in the space game. We have the Arc of Innovation, which emphasises the need for collaboration, especially with the UK Space Agency. Wales can make a significant contribution in test and evaluation, rural economy opportunities, and exposure to opportunities."

Dr Farhana Amin, Innovation Program Lead of Earth Observation at Defra, the Department for Environment, Food and Rural Affairs, wants to make Earth observation data as open as possible for everyone in the future. "In the past three years, Defra has been under pressure to reduce budgets for evidence and deliver efficiency. We've been increasingly reliant on Earth observation data to deliver that. We've made an effective effort to join us with policy and delivery bodies, but every one of us is under pressure to do with resources," said Amin. "We want to deliver effective policy."

Driving innovation in UK space

"Commercialising research is one of Innovate UK's key priorities. The entity has designed the Innovation Challenge Fund (ICF) as a rolling programme of a UK£2 billion annual fund, which is applied in three waves. There are competitions and forums which can be applied for to promote disruptive innovation in the UK's space sector," said Tim Just, Head of Space at Innovate UK.

With a combined budget of more than US\$6 billion, UK Research and Innovation (UK RI) brings together the seven research councils, Innovate UK, and a new organisation called Research England. UK RI intends to ensure the UK maintains its world-leading position in research and innovation by creating a system that creates the best environment for research and innovation to flourish.

"The creation of UK RI gives us the opportunity to bring more visibility to research councils," said Just. "We can consider how to bring things to market much earlier in the R&D process now. We talk about the cliff of commercialisation; we quite often take a product to market, and as soon as the R&D is complete, it drops off the radar because we haven't marketed it right or the price isn't right."

Opining on the commercialisation of the space sector, Just commented: "We've heard several definitions regarding NewSpace right now, so I'll give you mine: NewSpace is about new money. It's about bringing other money into the space sector, and ultimately, it's about creating a product that people want to buy." He added: "A lot of Earth observation data is available for free, but there's a bit of quandary with free data – generally, if you're using free data or a free service, then the product is you. You will be exploited for the benefit of the company. If Earth observation data is free, someone has to pay."

Skills are key to expanding the UK space industry. "In the space sector, we immediately go the STEM objectives in

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Nick Appleyard, Head of Downstream Business Applications at the ESA

schools because it's easy, particularly since we have Tim Peake now," said Just. "Our skills agenda at Innovate UK is much broader; it's about lifelong learning, graduate hiring, further education and personal development. We're launching academic fellowships for early stage careers to launch R&D projects."

"We also need to talk about regional clusters," said Just. "The UK isn't that big, and you don't have to be in a space cluster to be in the space sector. We need to recognise the value of a space cluster. It's about a critical mass of people engaging in a specific location, to discuss ideas."

Just also opined on international investment. "About 20 percent of our time is spent supporting inward investment. In the UK, the regulatory environment, support, skills, workforce, is all extremely attractive, and we're seeing a lot of international companies coming in and investing. The time is right for a sector deal."

Ensuring the competitiveness of UK space in an international market - Funding, skills and collaboration in the post-Brexit landscape

With Brexit looming, questions are arising throughout the sector about the UK's place in the global space arena, and its continued involvement with European projects. "We're still going to be part of the European Space Agency (ESA)," confirmed Professor Martin Barstow, Pro-Vice-Chancellor of Strategic Science Projects at the University of Leicester. "People do tend to equate the ESA with the EU, and it's not the case."

"I was very pleased to see the industrial strategy emerge in November 2017, and space is a part of it," said Barstow. "We've also heard about the significant growth opportunities available. We've heard about upstream and downstream, but space-enabled is also important. I think there's going to be more upstream activity as a response of the positive downstream results."

Retaining the UK's position of leadership post-Brexit is going to be important. "We need to build on the things that

are there. We've lost a little momentum in the last year. We need to invest in skills, create new networks across the EU, and bring in people from outside the space industry," opined Barstow. "We are moving too slowly and must accelerate the pace."

In agreement with other speakers, Barstow considers the skills shortage to be a significant challenge. "We need to think about the skills needs. How do we take people from other sectors and re-skill them for the space industry? We can't produce enough STEM graduates for our country, so we need to reskill non-STEM graduates," said Barstow.

"Political changes and changes of market create opportunities, and we need to exploit this," said Mike Lawton, Founder and Chief Executive Officer at Oxford Space Systems. "Getting into space is expensive, anything from 30k/kg to get into orbit today. As a result, we're obsessed with making things as light and cheap as possible."

Oxford Space Systems is designing and generating a new generation of deployable structures using a new generation of materials, because: "You don't get a new generation of downstream data unless someone is working on upstream hardware."

"There are huge opportunities to unlock the technology we can generate in the UK," said Lawton. "We have a unique climate here that doesn't exist anywhere else, because of all the support we have from entities like Innovate UK, and funding mechanisms that can come alongside the venture capital community."

Claire Pidancet, Chief Executive Officer at Actrea Capital and former Managing Director, Space Net Ventures, asked: "How do we finance the innovation ecosystem? The NewSpace economy presents a lot of opportunities, and there are a range of industry verticals that could benefit from financing."

She continued: "Right now, we're financing downstream space applications with grants, business angels, EIS funds, Seraphim Capital, and larger venture capitals. There's a lack of specialist organised capital, and we lack capacity in the bridge rounds. Setting up funds makes things easier. Most of the pipeline is at early stage funding."

Steven Austin, Propulsion Product Manager at Thales Alenia Space UK, holds similar views: "The markets are changing very fast, and growth in traditional markets has changed."

With a changing market, expectations and future actions need to evolve. "The new constellations are characterised by diversity: There's no standardisation," asserted Austin. "We need to get industrial about it. It's about volume manufacturing and faster throughout. My concern is the UK isn't ready for this. Rapid transition for R&D to production is key. We need academia, government, SMEs and industrial players coming together."

Time to market is absolutely critical. "We need to bring cheaper technologies to market faster. We need funding, skills and focus. How do we make this happen as a group? How do we install the infrastructure to match the new market? It needs to be in place soon, not in 10-15 years. If the UK isn't at the forefront of what's going in Europe we will find that our position gets eroded," said Austin.

"Thales Alenia Space really struggles with skills. We can't find people in the UK to bring into the space industry. But if



Tim Just, Head of Space at Innovate UK ●●●

manufacturing and infrastructure is going to grow, so must people and skills,” Austin concluded.

The future for European space policy - Challenges ahead for collaboration and funding

No one knows yet how the UK is going to maintain its position in the global space economy, or how EU and ESA space programmes will be affected by Brexit. Almost half of the ESA

downstream budget is financed from the UK; telecoms and Earth observation are the most commercial parts of the space economy right now.

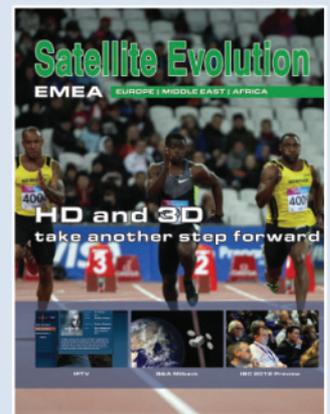
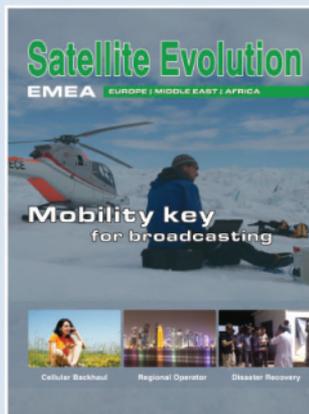
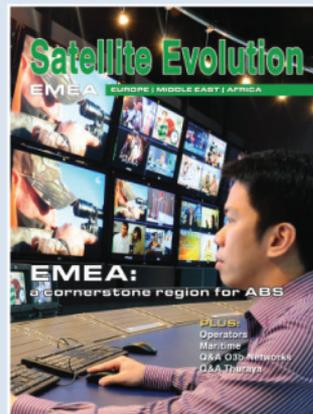
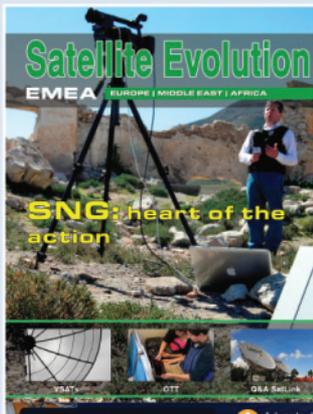
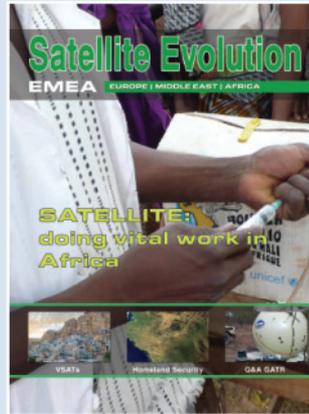
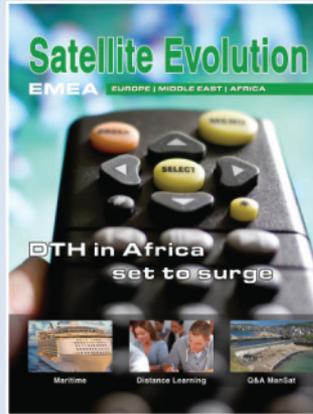
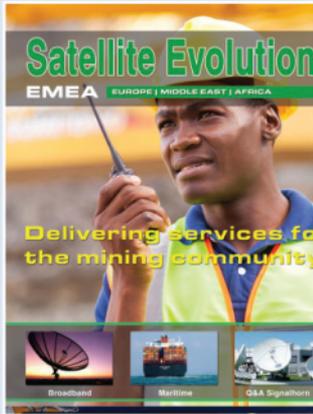
“The money in the space industry is downstream, in applications and services. One of the reasons for that is that the accessible market is pretty much the entire economy. It’s hard to point to a sector which can’t benefit from satellites,” said Nick Appleyard, Head of Downstream Business Applications at the ESA. “Because these are digital services, barriers to entrance are low, so it’s more open and vibrant.”

“When we leave the EU, does that mean we have to part company? No. The ESA is not the EU, and the UK is not leaving the ESA. Were optimistic the UK will renew its commitment to the ESA at the end of next year,” asserted Appleyard. “However, the biggest problem is the ability to transfer personnel and skills and to make working relationships between the EU and the UK. It could be a great setback for both sides. If right to remain and access to public services are affected, our people are going to be affected. We need to protect that.”

“There are questions about our contractual relationships, and we’re seeing people write escape clauses from collaboration contracts now ahead of Brexit. That’s risk management, and maybe those clauses will never be invoked. But if they are, it could be difficult to rebuild,” stated Appleyard. “Supply chains are complex, and criss-cross between countries. Components and subsystems are going in and out of the country all the time and could be subject to delays or tariffs. The real risk and concern is the uncertainty, and we have to live with that for the next few years.”



Picture (from left to right): Martin Barstow, Mike Lawton, Lord Hunt of Chesterton, Claire Pidancet, Steven Austin ●●●



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