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Satellite Evolution

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March/April 2020



2020: The year for custom IoT constellations

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Weather the storm

How time flies when you're in isolation – we're onto the March/April issue of Satellite Evolution EMEA already! It's already been a very newsworthy year for the satellite sector, with notable small satellite launches from SpaceX and OneWeb making history. We've also closed out another Satellite Show, a great event despite the onslaught of COVID-19.

We've got another fantastic issue for our readers, full of the latest industry developments and insight from key players. MathWorks outlines the top five trends in space and satellite technology for 2020, and Intelsat weighs in on the complexities of broadband delivery via satellite. We take a look at satellite-enabled Big Data applications for data-driven farms, greenhouse gas analysis and debris monitoring, and on a connected note, explore the new IoT-supporting satellite constellations in the works.

Also, in this issue are key interviews covering the broadcast sector with Broadpeak, Earth station technologies with Goonhilly, flat panel antenna advancements with start-up company YeehSat, and defence sector news with Viasat.

While all industry events are cancelled for the foreseeable, here at Satellite Evolution Group, we remain optimistic that our sector will weather out this storm and come through it stronger than ever. We may all be working in disparate locations across the UK and US, but we remain committed to bringing you the latest industry news, developments and innovations. So, stay safe, and always remember we will meet again. 🌸



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IoT supporting constellations. Photo courtesy of Eutelsat ●●●

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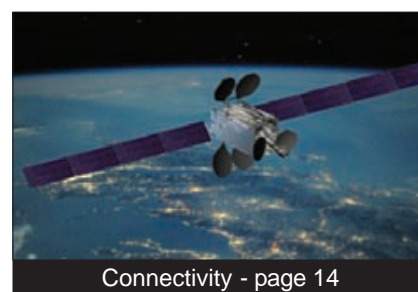
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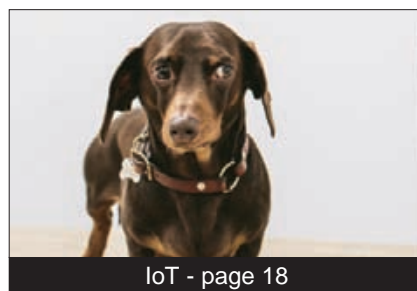
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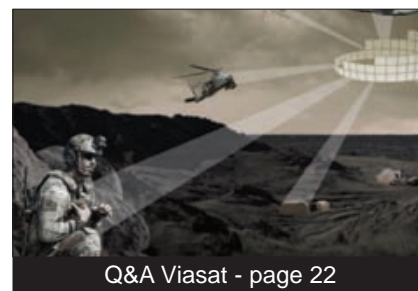
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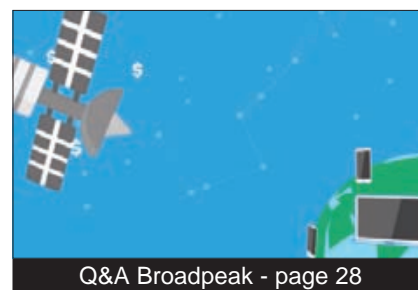
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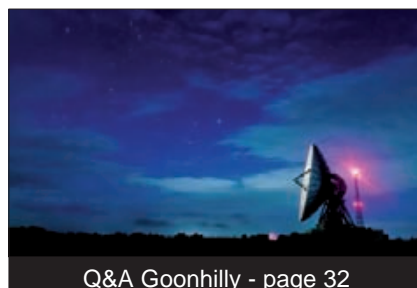
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NEW DATES ANNOUNCED

AUG 10-12, 2020 (AUG 10: INVITE ONLY | AUG 11-12: EXHIBITS & CONFERENCE)



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AAC Clyde Space wins order from Loft Orbital

AAC Clyde Space has won an additional US\$250,000 order from Loft Orbital for power systems for two satellites. The systems will be delivered during 2020, starting with an engineering model in the current quarter to be followed by flight models for two satellites in the latter half of 2020.

AAC Clyde Space will deliver its STARBUCK PCDU (Power Conditioning and Distribution Unit), based on an existing design with flight heritage, enabling very short delivery times. The systems will be used on Loft Orbital's satellites, YAM-3 and YAM-5, to manage power distribution to multiple payloads hosted on the satellite platform. This order for power systems follows a previous order for Sirius on-board data handling systems, that enable the accommodation of different types of payloads on the standardized micro satellites.

"We are proud to be part of Loft Orbital's pioneering venture to offer rapid access to space for payloads. This new order extends our offering to Loft Orbital and shows our ability to deliver advanced subsystems with short delivery times" said AAC Clyde Space CEO Luis Gomes.

Loft Orbital Solutions Inc. is a US company offering affordable, reliable and fast access to space through high-performance and high-reliability satellite platforms by utilizing specific technology for multi-payload interfacing, accommodation and satellite operations. The company is planning to launch missions quarterly. ■

Teledyne e2v HiRel unveils family of high power PIN diode limiter modules

Teledyne e2v HiRel has announced a new addition to its family of high power limiters, the TDLM202402, a quasi-active S-band SMT PIN Diode Limiter that offers 'always on' high power CW and peak protection.

Packaged in a small 8mm x 5mm form factor for demanding electronic warfare and radar applications, the TDLM202402 utilizes proven hybrid assembly technology. It has 50dBm (100W) CW power handling capability and 60dBm (1,000 W) peak power from 2 to 4GHz (25µsec pulse width at 5 percent duty cycle). Parts are screened and qualified for

high reliability applications. These power limiters have an operating temperature range of -65°C to 125°C.

The new limiter also boasts excellent thermal management features, with a proprietary design methodology that minimizes thermal resistance from the PIN Diode junction-to-base plate (RTHJ-A). The limiter design employs a two-stage detector circuit which enables ultra-fast turn-on of the high-power PIN Diodes.

"This is Teledyne e2v HiRel's first high power limiter for military applications, and we have more in the development pipeline," said Erik Everett, VP of Worldwide Sales at Teledyne HiRel. "We support Source Controlled Drawings, and devices are tested and shipped from our certified facility in Milpitas, California, one of the industry's most trusted production locations."

The TDLM202402 is designed for optimal small signal insertion loss, permitting an extremely low receiver noise figure while simultaneously offering excellent large input signal. Other key features and specifications include:

- Low insertion loss (typ): 0.5 dB
- Return loss (typ): 17 dB
- Low flat leakage power (typ): 14 dBm
- Low spike energy leakage (typ): 0.5 ergs
- Input/Output DC blocking capacitors
- RoHS compliant ■

De Boer Marine to deliver managed data services through SES Networks' Skala Global Platform

De Boer Marine, a leading Dutch company specialised in maritime navigation and communication equipment, is now offering seamless, reliable managed data services to its international maritime clients leveraging SES Networks' exceptional connectivity and its Skala Global Platform, the two companies have announced.

De Boer Marine's customers will benefit from a superior customer experience with a cost-effective communications solution that reduces operational risk and cost. Crew and operators will stay connected to their friends and family anytime anywhere, while De Boer Marine and fleet operators will benefit from flexible bandwidth management, advanced automatic beam switching, and a sophisticated network management system to maximise their profitability and efficiency.

The Skala Global Platform offers a combination of next-generation ground system technology, advanced satellite capabilities and service lifecycle expertise that enables scalable, flexible and high-quality managed data services for commercial shipping companies across the world.

"We have a diverse customer base, with complex requirements when it comes to data. This makes SES the natural choice to partner with as its investments in space and ground-based infrastructure offer a reliable solution that ensures our customers will have the capacity, coverage, and performance they need to overcome any future challenges they face," said Johannes Oost, Vice President, Business Development at De Boer Marine.

"De Boer Marine requires the highest quality end-to-end service to support a global customer fleet. Through connectivity and ground system technology powered by SES Networks, they'll be able to enjoy a faster and more reliable end-to-end service than ever before – removing any connectivity barriers for their operations both on vessels and onshore," said Morten Hagland Hansen, Vice President,



Photo courtesy of Teledyne e2v HiRel ●●●

Global Sales for Commercial Maritime & Energy at SES Networks. "We're delighted to partner with De Boer Marine to enable reliable managed data services that have become vital for efficient shipping operations today." ■

GiTy to provide internet services in Africa via Spacecom's AMOS-17

Spacecom, operator of the AMOS satellite fleet, has announced that the company has signed a multi-year contract with GiTy, a.s., a leading telecom service provider based in the Czech Republic, for C-band capacity on the AMOS-17 communication satellite, in order to deliver connectivity to embassies across Africa.

According to Radek Ondras, Network Operations Director at GiTy, "AMOS-17's position over Africa and its unique performance and capabilities provide us with an excellent solution for our very specific needs. Partnering with Spacecom since as early as AMOS-3, we are confident they will provide us with high quality, personalized and reliable satellite communication services. GiTy is happy to contract capacity on the AMOS-17 satellite, which allows us to enter Africa with state of the art technology."

Spacecom VP Sales EU and ME, Eyal Altshuler stated, "We are proud to be GiTy's long-term partner allowing us to support their growing needs of communication in Africa. Spacecom welcomes GiTy on board of our new AMOS-17 satellite and I trust that our long standing partnership will continue to grow further."

AMOS-17 is an HTS satellite designed specifically to meet Africa's fast growing communication demands. The satellite's C-band HTS, Ka-band and Ku-band capabilities, enable the combination of broad regional beams and high throughput spot beams that maximize throughput and spectral efficiency. AMOS-17 supports connectivity between Africa, the Middle East, Europe, India and China. ■

Comtech Telecommunications receives \$1.8 million order for spares relating to its North African country end-customer

Comtech Telecommunications has announced, that during its third quarter of fiscal 2020, its Orlando, Florida-based subsidiary, Comtech Systems, Inc., which is part of Comtech's Government Solutions segment, received a \$1.8 million contract award from its North African country end-customer for additional spares supporting its existing communications systems.

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Fred Kornberg, Chairman of the Board and Chief Executive Officer of Comtech Telecommunications stated, "We are extremely pleased by this order for spares. We look forward to continuing to support and working directly with this customer on this and all future opportunities." ■

Exolaunch signs agreement with SpaceX for launch of small satellites on a Falcon 9 rideshare mission

Exolaunch, a German rideshare launch and deployment solutions provider, has signed a Launch Services Agreement

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- SET-UP BY ONE PERSON IN MINUTES
- LIGHTWEIGHT IATA-COMPLIANT
CHECKABLE CASES

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Photo courtesy of Exolaunch ●●●

with SpaceX to launch small satellites on a Falcon 9 as part of SpaceX's SmallSat Rideshare Program. Under the launch contract, Exolaunch accommodates multiple microsattellites and cubesats on the first Falcon 9 smallsat-dedicated rideshare mission to sun-synchronous orbit, targeted for launch in December 2020.

Exolaunch will provide comprehensive rideshare mission management, deployment and integration services for its customers participating in this launch. Core customers who signed up for this launch through Exolaunch's services will be announced in the coming weeks.

"Participation in this SpaceX launch will allow Exolaunch to meet the industry demand for more rideshare options out of the USA, while also helping our customers meet their mission goals on time and on budget," said Jeanne Medvedeva, Commercial Director at Exolaunch. "This first dedicated rideshare launch will mark an important milestone for Exolaunch. We look forward to a smooth launch campaign and are proud to add Falcon 9 to our launch manifest."

"Exolaunch needs a simple, reliable and cost-effective rideshare launch solution to best serve their customers. SpaceX is proud to earn their business, and we look forward to working with them on our first dedicated rideshare mission targeted for later this year," said Tom Ochirero, Vice President of Commercial Sales at SpaceX.

On this upcoming Falcon 9 mission, Exolaunch will utilize its brand new product, the EXOport, which is a flexible multi-port adapter designed to enable optimal accommodation of microsats and cubesats. The EXOport comes in various configurations and significantly optimizes slot capacity and launch budget for customers. EXOports mount Exolaunch's proprietary separation systems to accommodate multiple payloads on a single Falcon 9 ESPA port. These include the CarboNIX, a shock-free separation system for microsattellites that qualified in space in 2019, and the EXOpod cubesat deployer that was utilized to launch over 80 cubesats and can deploy any cubesat up to 16U. The EXObox sequencer will provide separation signals to multiple payloads to initiate their safe and precise deployment into orbit.

To date, Exolaunch has successfully arranged launch campaigns for nearly one hundred small satellites. The company's unique expertise in rideshare launches, separation systems and sequencers – in combination with the brand new EXOport adapters – will naturally complement the industry's game-changing SpaceX's SmallSat Rideshare Program, allowing smallsat developers to benefit from best-in-class launch services, flexible mission management and launch budget optimization. ■

Omnispace selects Thales Alenia Space to develop satellite infrastructure for its global hybrid network vision

Omnispace, the company that is reinventing mobile communications by building a global hybrid network, has announced it has selected Thales Alenia Space, a joint venture between Thales (67 percent) and Leonardo (33 percent), to develop the initial component of its satellite-based Internet of Things (IoT) infrastructure. This will advance Omnispace's vision to deliver a global hybrid communications network based on 3GPP standards.

Thales Alenia Space will design and build an initial set of two satellites for operation in non-geostationary orbit (NGSO). These initial satellites will support 3GPP-defined (the 3rd Generation Partnership Project telecommunications specifications that unite standard development organizations) Narrow-Band IoT radio interface and will serve to advance the development and implementation of Omnispace's global hybrid network. This announcement marks a key milestone as Omnispace initiates the development of its new generation NGSO satellite constellation which will operate in the S-band.

"Thales Alenia Space has a successful track record of developing NGSO satellite constellations and is well-qualified to support our vision of delivering the world's first global 5G non terrestrial network (NTN)," said Ram Viswanathan, President and CEO of Omnispace LLC. "This investment in our next-generation satellite infrastructure allows us to progress the development of our technology and demonstrate our unique capabilities as we continue to work towards launching our broader vision of a global hybrid network."

"Thales Alenia Space is pleased to be working with Omnispace, which is taking a holistic approach to the design, development and deployment of their next-generation, IoT-based satellite network infrastructure," said Hervé Derrey, CEO of Thales Alenia Space. "Omnispace's selection of Thales Alenia Space reinforces our leadership position as a major industrial partner and our expertise in space-based IoT communications. We look forward to collaborating with Omnispace in delivering this innovative project."

The development of this initial set of satellites will begin immediately and they are scheduled for launch in 2021. Omnispace and Thales Alenia Space, along-side other industry stakeholders, will contribute to the development of the 3GPP NTN friendly standard for global implementation. ■

Thuraya MarineStar becomes a major success story

Thuraya, the mobile satellite services subsidiary of the UAE-based global satellite company, Yahsat, has announced that Thuraya MarineStar, its best in class, affordable maritime voice solution with advanced two-way tracking and monitoring capabilities is a bestseller, especially in the Asian maritime markets. This versatile solution was sold out within a month after its launch and first installations have been made successfully. Due to robust demand from fisheries, Thuraya's Service Partners are now placing new bulk orders for the hardware units.

"When we launched Thuraya MarineStar in late 2019, we were sure we had a winner on our hands. For the cost-conscious user who has to abide by a tight budget, this feature-rich voice solution offers a wide range of value additions at an affordable price," said Shawkat Ahmed, Thuraya's Chief Commercial Officer. He continued, "We have seen products that had ambitious launches, but are still

unfortunately out of reach due to total cost of ownership. Thuraya MarineStar is an unprecedented success, because it meets all the essential requirements in terms of connectivity, safety, flexibility and affordability."

As an entry-level solution, Thuraya MarineStar is built on the same successful voice platform that has sold more than one million Thuraya satellite voice devices. Since it enables tracking and monitoring, in addition to voice communications, vessel operators do not have to invest more in their tracking systems or a brand new tracking application.

Thuraya MarineStar is popular in many Asian markets due to various reasons. In China, users cite the cost-effective voice communications as a key differentiator, while Vietnamese fishermen appreciate its tracking and monitoring capabilities. This solution makes compliance with national and international fish catch reporting regulations simple by bundling essential elements into one affordable package. Moreover, it supports multiple languages, further cementing its appeal among regional users. Thuraya MarineStar enables fishing crews to remain connected on their local GSM numbers, even beyond the coastline. The terminal with its IP67 rated antenna can be deployed to perform condition based, on-board monitoring for maintenance activities. This results in better planning and upkeep that is more efficient.

The hardware and service advantages of Thuraya MarineStar are complemented by the most flexible rate plans for the service. Thuraya has devised bespoke pricing models and bundles that are based on actual usage.

The solution is also available to third-party system integrators who want to integrate their tracking platforms with that of Thuraya. Its terminal has multiple physical interfaces that support external sensors and devices for further customization. ■



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Shu Lu, CEO at YeehSat ●●●

Q&A

Best possible user experience

YeehSat develops and produces high performance flat panel antennas for the government, oil and gas, telecom, resources, broadcasting and emergency services sectors from its base in Beijing. Shu Lu, CEO at YeehSat, opines on the company's products and expertise, and hopes for the future.

Amy Saunders, Editor, Satellite Evolution Group

Question: Can you provide a brief overview of YeehSat's operations, capabilities and expertise?

Shu Lu: YeehSat has focused on the design, manufacture and service of flat panel antennas since back in 2015. The technical and management team have more than 20 years of professional experience in the satellite communication industry. Based on the understanding of our customers' applications and requirements, especially for the mobile applications which are becoming increasingly popular, YeehSat's flat panel antenna series provides high performance and the best possible user experience.

YeehSat began to sell its products in 2018, and now more customers

appreciate our understanding and expertise of satellite sector products, not only in China, but also in Korea, Thailand, Japan, Indonesia and Canada.

There are always a lot of user interaction activities from the beginning to the end of every new product design cycle. The new applications arising in satellite communications present different requirements to satellite equipment than what was used even 10 years ago. Compared with easy-to-use smartphones, people don't understand that satellite devices are very complex and have historically required a great deal of training to use. However, a new generation of user-friendly zero-training satellite products will encourage much greater customer use of satellite communications.

Question: What can you tell us about YeehSat's products, and how they are differentiated from competitor offerings?

Shu Lu: YeehSat's flat panel antenna series now come in three models: Fly-away, drive-away and backpack. These three models have different antenna sizes and different product 'sweet points' to meet the different requirements of mobile satellite applications. There are two points which we talk about almost every day with relation to our products: "Ease of use" and "use for sure".

Ease of use is of course very important. VSATs need an antenna, BUC, LNB, MODEM, CODEC, waveguide, combiners and a mass of different types of cables. Unfortunately, this equipment all comes from different vendors. People have to connect it all for every use, often in difficult locations and without professional engineers to hand. The whole mission can fail on the



Photo courtesy of YeehSat ●●●



Photo courtesy of YeehSat ●●●

back of just one small mistake. YeehSat's product can remove all this work for users with our unique design; we combine all the devices necessary for a VSAT station together into the YeehSat antenna platform, not only the BUC and LNB, but also the modem (we support most mainstream products), router, CODEC and WiFi as well, with all the cables already interconnected. It is not just an antenna that we offer, but the complete VSAT station in one suitcase or backpack, ready for one-button use. Our app lets the customer use their phone to control the antenna without any prior training. For the vehicle-mounted antenna, two people can load or unload the antenna to the luggage rack in 15 minutes.

Ease of use alone is not good enough; the product must also be high performance and feature a strong design. Since the VSAT station will be used as hotspot to support a group of users at a location only available via satellite, the uplink capacity (remote to hub) is a key requirement. As such, YeehSat antennas have excellent gain and can be installed with 16W or 25W BUCs to deliver high speed transmission capabilities, even when using an old satellite or when battling interference. Enhanced structure, drive lock and ground balancing features help

the antenna survive harsh weather conditions such as wind, rain and snow.

Question: YeehSat serves many diverse markets. What can you tell us about your involvement in each?

Shu Lu: Put simply, we focus on mission critical enterprise-level applications. Mission critical situations may occur at any time and any place. Once such an event has occurred, the user will need to arrive at the site to set up the remote station as soon as possible in order to establish a stable satellite channel as

fast as possible. Satellite is the only way people can acquire connectivity in these situations.

One of the unique advantages of VSATs is that they provide satellite communications to stationary or mobile targets, and can be rapidly deployed, making them ideal for emergency recovery, city events, government projects, resource searching and news gathering.

Question: Which markets are key to YeehSat's growth going forwards?

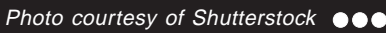
Shu Lu: We have our eyes on a lot of markets, we don't like to limit ourselves to just one area. I think our products offer great advantages for enterprise-level satellite communications which require high speed transmission capabilities in tough conditions. The enterprise market is our priority market for now.

Question: What are your plans for 2020?

Shu Lu: This year, we aim to finish the product line support for high throughput satellite (HTS), which is a strong trend for satcom and is growing very quickly in many regions. We also plan to develop Ka-band products. We'll continue to research the latest technology for flat panel antennas to gain higher performance with limited size. Meanwhile, we are looking for local business partners who may have a shared understanding of satcom products and customer service. We hope to grow with our customers and business partners.



Photo courtesy of YeehSat ●●●



Never before in history has as much data been collected as it is today. There are literally billions of sensors spread across the world, on land, at sea, in the air, and in space, recording anything and everything; data as diverse as traffic patterns, weather formations, remote machine applications on oil rigs and in agriculture, stock room supplies, medicine consumption patterns, etc. The amount of data being collected has seen a new era of Big Data come into being, one which companies and governments the world over are grappling to understand and manage.

way to consider exactly what we're talking about:

- **Volume:** The quantity of generated and stored data, which determines its value.
- **Variety:** The type and nature of the data, which may be text, images, video or audio.
- **Velocity:** The speed at which the data is generated and processed, which for Big Data, is often available continuously and in real time (unlike small data).

Today, Big Data is everywhere. It has become deeply intertwined with machine learning and artificial intelligence, which are expected to be a key enabler of the processing and analysis of data too massive for current processing streams. And while it may sound a lot like inexplicable business jargon – designed to confuse us normal folk about whether or not we're talking about data for data's sake – is

People often refer to the three Vs of Big Data as a useful

expected by many to be key to a whole host of new technologies, services and applications, as well as the continued evolution of the services and industries we know today.

Opportunity knocks

This new Big Data era is opening up some impressive opportunities for companies across the board. According to NSR's 'Big Data Analytics via Satellite, 3rd Edition' report, there exists a cumulative market opportunity of US\$18.4 billion in the next 10 years for satellite-based Big Data analytics. The fastest growing vertical market, the services sector, is expected to help drive the market, in addition to traditionally strong Big Data markets, including energy, transportation, civil government and military.

"The services vertical mainly consists of financial institutions involved in the securitization of commodities and hedge funds, where large risks are at play. While it took up only about seven percent of the market share as of 2018, it is expected to rapidly grow through the next decade to reach nearly US\$640 million (20 percent market share) in revenue opportunity by 2028," said NSR analyst Shivaprakash Muruganandham. The majority of this growth is attributed to the proliferation of Earth observation analytics. "Investment firms looking to gain a competitive edge on the market have driven the use of satellite data across the board: From the counting of cars in parking lots and oil barrels to derived vegetation metrics for crop yield and carbon stocks."

Indeed, Big Data analytics has the potential to really shake up a whole host of markets in the near future - let's take a look at some of the exciting real-world projects going on right now.

Data-driven farms

At the end of 2019, the USDA's Agricultural Research Service partnered with Microsoft and Esri to take the next step towards the data-driven farms of the future. The Data Innovations project incorporates the Internet of Things (IoT) and other technologies to help provide farmers and researchers with real-time data on farm conditions.

The USDA has deployed sensors, drones and IoT-enabled farm equipment for a public-private pilot programme called Farmbeats at a 7,000-acre farm at its Beltsville Area Research Center. The data then gets beamed up to the cloud, where an AI algorithm provides data visualization to farmers and researchers. The pilot could be revolutionary for USDA researchers, who currently record data points in field books before entering them into a central database.

"We're collecting a lot of data manually and that's killing how much research we can actually get done," said Michael Buser, USDA ARS National Program Leader for Engineering. "We want to go through with this Data Innovations effort to reduce the number of data touches that we have. And by reducing those data touches, we can basically free up the time of our scientists and our technicians."

The project is expected to produce better data, and to



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help farms around the country operate more efficiently, sustainably, and profitability. While there are many variables that impact farming conditions, tracking key metrics such as disease, insect levels, weeds, water and nutrient dynamics, can help provide farmers with better, actionable information. Moreover, while this single farm pilot project will prove useful, the real value is expected to stem later down the line, when a big-picture view is enabled by tracking the same data from a planned 200 farms across the country. Going beyond the simple recording and analysis of data, through predictive analytics, Microsoft's AI algorithms can in fact combine satellite and sensor information to train a model that can predict metrics for field areas where there are no sensors in place.

Greenhouse gas monitoring

Last year, Descartes Labs announced the development of a methane-detection model designed to help monitor harmful emissions as a means of implementing New Mexico's strategic mitigation policy. Descartes Labs' Data Refinery will utilise Big Data from satellites and other public and private sources to create modelling and mapping capabilities for the detection of methane.

The Permian Basin, spanning more than 86,000 square miles across Southeastern New Mexico and West Texas, is the highest producing oilfield in the world, and will be the first area that is mapped before the project goes state-wide. Large-scale monitoring of methane is expected to help oil and gas companies improve their management of emissions and guide state inspectors to potential problem areas on an almost real-time basis. It will also help the state meet the environmental benchmark to reduce greenhouse gas emissions by 45 percent between 2005 and 2030. Indeed, methane is a potent greenhouse gas believed to trap 28 times more atmospheric heat than carbon dioxide over 100 years. However, there has been a historical lack of reliable tools for tracking methane detection.

"For New Mexico to reach its methane reduction goals, it's critical to first understand the problem. The Descartes Labs Data Refinery can pull data from satellites, planes, drones, and ground sensors so that inspectors will be able to pinpoint sources and alert well owners to the problem. This is what it looks like when data informs policy," said Mark Johnson, CEO at Descartes Labs.

Protecting the skies

In the summer of 2019, the Canadian Government's contracting arm, Canadian Commercial Corporation (CCC), announced plans to sponsor a new satellite system to provide commercially available data about space to meet growing concerns over debris. NorthStar Earth and Space will utilise Big Data analytics to assess the situation in orbit.

Today, there are around 60,000 pieces of space debris in orbit around the Earth, far more than the number of active satellites in play. With the NewSpace economy valued at an estimated US\$1 trillion each year, demand for real-time, accurate information on the space environment is high. Private investors for the project include Telesystem Space Inc. of Montreal and the Space Alliance of Europe, formed by Telespazio and Thales Alenia Space, a joint partnership formed by France's Thales and Italy's Leonardo.

The proposed small satellite constellation would be launched in 2021, featuring a combination of infrared, hyperspectral and optical sensors to assess the Earth's ecosystems and orbit. The system would also utilize Big Data analytics and AI to find the meaning of the vast amount of data and precisely predict potential collisions with debris and other objects in space.

Big future

All of the available market reports indicate that Big Data is going to be huge going forwards. Of course, once we take a look at the impressive applications and try to get a scope of the seemingly endless possibilities, it seems an obvious conclusion to draw. Enhanced efficiencies, superior predictions and cost savings are all benefits which we should soon begin to reap as Big Data analytics becomes more widely applied across the markets.

However, the big turning point will come when AI and machine learning is advanced enough and affordable enough to really turn things around. Until then, we have massive quantities of data being collected and stored, but inadequately processed and analysed. Indeed, this data is actually hindering many companies today; it takes more than just the right tools to analyse the quantities of data we're seeing now – many businesses lack the knowledge base to conduct a meaningful analysis and are becoming bogged down. That's hardly surprising given the quantities of data we're talking about.

Big Data is a big opportunity for some, a hindrance for others, and a challenge for all.



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In crisis times, providing universal connectivity access takes on greater importance

We're living in unprecedented times, with more people connecting online now than ever before during the coronavirus crisis. However, increased usage on this level has already resulted in highly pressurised networks, which satellite is best served to augment.

Jean-Philippe Gillet, Senior Vice President of Sales and General Manager of Networks BU, Intelsat

Connectivity has long been recognised as an economic-growth enabler. It can help people overcome previously insurmountable barriers, including lack of access to education and healthcare, and it builds digital bridges that connect and empower people around the world.

The importance of connectivity has never been more apparent than it is today, when people around the world are confined to their homes to help stop the spread of the coronavirus and increasingly relying on at-home Internet, video-conferencing and other technologies to stay connected, educated and informed. Routine social interactions have also

moved online, with video medical consultations, online food delivery and entertainment-streaming platforms now the norm in many areas.

While connectivity has become more important than ever to living a 'normal' life these days, increased demands are putting extreme pressure on networks. Already, the Spanish telecoms sector has noted a boom in traffic since the outbreak of coronavirus, with data use increasing 40 percent, mobile phone use 50 percent and WhatsApp use up fivefold. The European Union (EU) has even urged Netflix and other streaming-service providers to stop showing HD content to help prevent Internet outages.

If you live in a city, the majority of which are connected to fibre networks, you should see little disruption or deterioration in your connectivity's performance. Smaller towns risk being



Jean-Philippe Gillet, Senior Vice President of Sales and General Manager of Networks BU, Intelsat ●●●

cut off if they rely on fibre capacity from larger Internet hubs, and remote or rural communities are even more vulnerable. In areas with limited or no access to connectivity, social-distancing measures could isolate people even further, and pose dire local economic implications.

Integrating satellite to respond to the connectivity demand

The increased pressure on networks and the potential risks to disruption that we're seeing today highlight the need for multiple capacity-delivery technologies, which could add much-needed flexibility and help to more efficiently manage unpredictable – and even unprecedented – connectivity demand. The good news is that active discussions are taking place between satellite operators, network operators and the broader telecommunications industry. Intelsat, as a member of GSMA and ATIS, has advocated for integrated, more powerful and resilient land-space-network business models for a decade, and they are now just on the horizon with the build-out of 5G.

Satellites have a long-established record of complementing land-based mobile networks to ubiquitously, seamlessly and cost-effectively deliver connectivity in and around cities, as well as to more remote and rural regions

where land-based solutions aren't available or are simply too costly. By integrating satellite solutions into their mobile networks, operators can dramatically increase their overall network bandwidth, speed and reliability.

The seriousness and pervasiveness of the digital divide in today's hyper-connected and now hyper-virtual world highlights the need to accelerate these types of integration initiatives. We know that digital connectivity enables economic resiliency and advancement; enabling universal, ubiquitous access a broad range of online healthcare, education, government and e-banking services with satellite supports that advancement.

A quick and easy solution to expand broadband coverage

The reach, scalability and fast deployment of space-based connectivity solutions enables network operators to quickly and cost-effectively upgrade and extend their networks to remote and sparsely populated rural areas. For example, we helped one communications provider customer connect 150,000 sites across Indonesia, including 6,000 inhabited islands. In the Democratic Republic of the Congo, we helped connect more than 800 rural sites with small, portable solar-powered base stations and satellite antennas.

As more countries implement coronavirus-confinement measures, satellite technology can provide the essential link to much-needed connectivity that allows people to continue working, learning and staying in touch, no matter where they are. Intelsat is proud to provide this critical communications and connectivity support to people around the world, particularly at a time when it matters most.

A commitment to ubiquitous connectivity for all

Intelsat has connected people in the most remote places on earth for decades, and we remain committed to accelerating the adoption of mobile connectivity throughout the world and helping to close the digital divide. We've invested in Africa Mobile Networks (AMN), for example, to bring mobile coverage – for the first time – to millions of people living in remote communities across Africa, which many previously thought impossible to connect.

Bringing mobile connectivity to the most rural and remote parts of the world – to ensure no one gets left behind in the new digital economy – requires hybrid networks and innovative business models. With the world's largest and most advanced satellite fleet and integrated land-space connectivity infrastructure, Intelsat is uniquely positioned to provide just that for our customers – and the millions of users they support.

Connectivity in the time of coronavirus

It is during times of crises like this that the availability, capacity and speed of delivery of reliable, integrated networks like Intelsat's become most evident. The ubiquity of our fleet, the high power of our Intelsat Epic satellites and the easy and quick deployment of our solutions ensure much-needed connectivity to enable workers, students and business owners to continue to live normal, or close-to-normal, lives during these challenging times.

At Intelsat, we're working overtime right now to quickly scale our customers' existing networks or deploy entirely new ones to meet the increased demand they're seeing. Our

flexible mobility managed services are actively providing emergency and humanitarian personnel with portable connectivity when and where they need it, and we're distributing important TV news, information, education and entertainment to people around the world.

Intelsat has the teams and expertise in place to respond to these challenging times. We worked closely with Team Rubicon to restore connectivity in Haiti after the 2010 earthquake, in Nepal in 2015 and in the aftermath of Hurricane Florence in the United States in 2018. Our team works closely with governments and humanitarian organizations to develop specific solutions adapted to a location's unique needs that enable affordable, uninterrupted

high-speed broadband and internet connectivity to businesses and communities.

As this unprecedented situation continues to unfold, Intelsat remains committed to supporting our customers and partners, making sure they can continue doing the vital work they do. We never forget the important role our company plays in keeping people connected, businesses running and governments operational, no matter the challenge.

Periods of uncertainty are often uncomfortable. However, in order to deliver the benefits of connectivity to all, we must band together, embrace the technological shifts that will define our future, and creatively deliver solutions to our shared challenges.



AMN project. Photo courtesy of Intelsat ●●●

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Fleet's nanosatellite (dog for scale). Photo courtesy of Fleet ●●●

2020: The year for custom IoT constellations

The Internet of Things (IoT) has become a major talking point in the early 21st Century; many people are expecting big things from the technology in the coming years. Billions of devices are expected to come online very soon, as new applications streamline processes and enhance profitability in all walks of life. Naturally, connectivity will be a key component of the future success of the IoT, with many new and existing satellite operators getting in on the ground floor.

Amy Saunders, Editor, Satellite Evolution Group

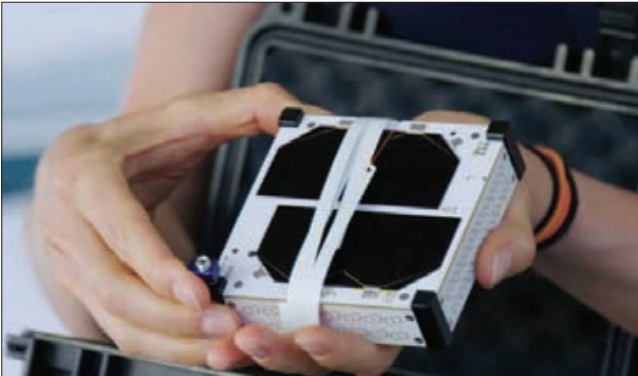
The Internet of Things (IoT) has long been touted as one of the next big things in technology, set to radically change the world and the way we live in it. Defined as a network of physical objects, each with a unique IP address for Internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems, the IoT has (arguably) yet to make the big splash people have been predicting for years, partly due to its ever-evolving nature. Indeed, all these fancy-pants new technologies such as machine learning, artificial intelligence (AI), real-time analytics and embedded systems have complicated matters somewhat.

That's not to say that we haven't made some significant progress in recent years. At the consumer end, smart homes, cities, appliances and security systems are all the rage – even I have the Hive smart thermostat installed now as my first foray into smart home technology – and innovative

companies are making great use of the technology for niche applications, such as PrismaQualityFinland's ReindeerApp, which tracks reindeer herds via Globalstar's IoT satellite constellation.

However, we're not markedly closer to the new era of efficiency promised by IoT devotees, wherein every city is a smart city, every power plant a smart power plant, or indeed every cyber-physical system has been transformed into an efficient, accurate and economic dream state with waste at a minimum and output at maximum. Of course, a transformation of this scale takes time, and we are just beginning to see the very start of it now.

One of the major limiting factors to the widespread roll-out of the IoT will be connectivity; after all, we're talking about billions of connected devices, all communicating automatically without human intervention, necessitating extremely high-quality and high capacity connectivity. While some IoT applications are functioning perfectly well using terrestrial technologies such as fibre, for a great many



Swarm Technologies SpaceBEE. Photo courtesy of Swarm Technologies ●●●

applications, ubiquitous, always-on wireless connectivity is vital, and in many rural and remote regions, this is something that only satellite can deliver.

The roll-out of 5G, again supported by satellite and taking place right now, is expected to mark a major step forwards in delivering the connectivity required for the upcoming billions of IoT devices expected to come online in the next few years.

Custom connectivity

With the march towards a truly connected world ramping up, more and more connectivity providers are launching innovative solutions customised for IoT applications, with

satellite technologies leading the pack.

The Globalstar satellite constellation dates back to the turn of the century and is now well-known for its satellite phone and low-speed data communications capabilities. The company has done well off the back of the new IoT era, enabling new niche applications for innovative IoT start-ups, and serving the oil and gas, maritime, forestry, emergency, construction and utilities sectors with its second-generation LEO constellation of 24 satellites.

Meanwhile, newcomer Fleet Space Technologies has made the first steps towards its small satellite IoT constellation. The satellites, each roughly the size of a shoebox, are designed to meet global IoT applications demand, and four are already in orbit as of 2018. The company has reported unprecedented demand from more than three million devices registered to join its network already, with the constellation still in its infancy. More recently in September 2019, Fleet raised AUD\$7.35 million in a funding round from investors such as Momenta Ventures and Horizon Ventures, following on from an earlier funding round where AUD\$5 million was raised from Blackbird Ventures and the South Australian Government.

Up and comers

The small number of existing IoT satellite constellations noted above hasn't deterred others from getting in on the action; if anything, it seems to have highlighted a massive opportunity, with many new companies planning their own networks.



That's not my reindeer: First published in *Satellite Evolution Asia* November/December

One of the most interesting IoT applications we've seen in recent years is in animal management; across the world, organisations are utilising IoT sensors and satellite connectivity to monitor livestock, ocean creatures, endangered species, pets, and protecting wildlife from poachers. The technology enables tracking and health monitoring, with a whole range of geolocation, environmental and biomedical monitoring available.

As of May 2019, Globalstar Europe Satellite Services Ltd.'s IoT technology is being deployed throughout Finland and Sweden to help track and protect thousands of reindeer. The reindeer app and collar were first trialled in 2018 and have since seen rapid uptake among reindeer herd owners whose livestock roam fence-free in the North.

Reindeer tracking systems based on GSM have been trialled in the past, but such systems were found to be unreliable in remote regions, as well as being very costly and difficult to maintain due to poor battery life. The new ReindeerApp changes everything and enables farmers to track their herds and helps mitigate losses from predators like bears and wolves. The user interface, developed by PrismaQualityFinland, notifies the user when a deer is no longer moving, relayed via Globalstar's satellite constellation. This way, farmers know exactly where and when to check on their livestock. Moreover, the SmartOne C collar's impressive battery life means that the batteries only need changing once a year, during the annual June round-up. Currently monitoring almost half a million deer in Sweden and Finland, ReindeerApp is expected to shortly be rolled out to Norway, Canada, Nepal and Mongolia to track a variety of deer species.



"Satellite IoT is transforming industries of all kinds, and applications are limited only by human imagination," said Robert Clarke, Regional Sales Manager at Globalstar. "Our state-of-the-art IoT technology, combined with our worldwide fleet of satellites in low Earth orbit, is now helping reindeer farmers preserve their livelihoods and their traditional way of life."

On such company is Kinéis, which is working on a constellation of 25 nanosatellites for IoT applications. Thales Alenia Space is set to define the system architecture, build ground stations and payloads, and Hemeria will build platforms and integrate satellites. Satellite production commenced in June 2019, and the constellation will be fully operational in 2022. Kinéis is also already operating the ARGOS system of seven satellites, which offers all leaders of connected object projects the opportunity to test its connectivity with priority access.

Over the summer of 2019, Kinéis announced the signing of strategic partnerships with Objenious by Bouygues Telecom, an IoT terrestrial operator and founding member of the Lora Alliance, Styckr, a designer of embedded IoT systems, and Wisebatt, which offers a unique IoT prototyping platform. Kinéis has also joined major companies such as SUEZ, GRDF, Sagemcom and Accenture as part of the Wize Alliance, which brings together public and private operators, manufacturers of connected objects and electronic components, integrators, start-ups and academics, in order to develop Wize technology for the industrial IoT.

Meanwhile, NanoAvionics and a consortium of partners that includes Kongsberg Satellite Services (KSAT) and Antwerp Space were in June 2019 awarded Euro10 million in funding from the European Commission's Horizon 2020, ESA's ARTES and private investors, in order to fulfil the first demonstration of the precursor stage of the Global Internet of Things (GloT) nanosatellite constellation with one or more IoT service providers as pilot customers. The consortium will offer a GloT constellation-as-a-service in a B2B setup to

existing and emerging IoT operators.

The GloT system combines the core strengths of the consortium's partners in a one-stop-shop offer, giving IoT service providers the means to be economically viable, globally scalable and competitive. NanoAvionics' constellation-as-a-service will give service providers a tenfold reduction in the cost of global IoT communications, lowering the entry barriers for IoT innovators and enabling them to devise new ways of machine-to-machine (M2M) communications.

The GloT consists of NanoAvionics' nanosatellite buses which will play host to multiple IoT communications providers' M2M transceivers. The satellites will feature Antwerp Space's intersatellite links, allowing real-time connectivity with traditional GEO satellites. Antwerp Space and KSAT, through their mission control and data distribution system, will connect the constellation with terrestrial Internet. The GloT constellation will send direct communications from the LEO satellites to KSAT's global network of ground stations. At the end of this year, two or three of the precursor nanosatellites will be launched into LEO, and the final 72-strong satellite constellation with its global real-time coverage is expected to be complete in 2023.

In other news, Kepler Communications has been developing a LEO nanosatellite constellation for IoT applications for some time now. The constellation will feature around 140 satellites, each incorporating a high-capacity Ku-band communications system and a narrowband payload, for both high-speed data transfers and low-power direct-to-satellite IoT connectivity. There are three planned deployment

phases over 2020-2023, and the company envisages its constellation as a space data relay system to serve other constellations with high-speed data backhaul capabilities. Today, Kepler Communications is focused on building the install base for Global Data Service, its pole-to-pole wideband connectivity service for mobile and fixed applications. EverywhereIoT, Kepler's affordable solution for Internet of Things (IoT) devices, will enter user trials in the coming months. The first portion of its satellite constellation is due for launch this year utilising SpaceX's new SmallSat Rideshare Program, which will see the launch of multiple small spacecraft into sun-synchronous orbit (SSO).

More recently, Eutelsat made a big announcement in September 2019, when the company officially unveiled its ELO constellation which will offer global IoT coverage enabling objects to transmit data, irrespective of their location. An initial nanosatellite, ELO Alpha, was acquired from Tyvak International and is due for launch shortly to confirm the technical performance of various waveforms between a satellite in LEO and objects on the ground. The construction of the nanosatellite constellation will begin with a first series of four satellites from Loft Orbital (ELO 1 and 2) and Clyde Space (ELO 3 and 4). Launches are expected over the next two years, with the satellites entering service as soon as they reach orbit. Depending on the success of the satellites, Eutelsat plans a final constellation of 25, all operational by 2022.

Running alongside this new constellation comes Eutelsat's new strategic partnership with IoT company Sigfox, which operates a unique global narrowband network dedicated to this segment across 65 countries. Based on hybrid connected objects, whose data can be captured by both terrestrial networks and satellite, Sigfox will integrate the global coverage provided by the ELO constellation into its existing range of IoT connectivity services.

This enhanced network coverage will open the door to many new use cases in areas like maritime transportation or

logistics, but also the safety of people in emergency situations.

Meanwhile, the FCC granted approval for another IoT satellite constellation in October 2019 following some concern that Swarm Technologies 'sandwich-sized' satellites would be too small to track. Swarm's initial constellation will feature 150 SpaceBEE satellites that will connect smart devices the world over with a low-bandwidth but always-on connectivity. Now that the company has approval, it plans to start launching its constellation very soon.

Finally, Lacuna Space has also designed a unique small satellite constellation featuring 32 satellites that can collect signals from LoRa-standard IoT sensors, thus requiring no new customer user terminals. The company is currently testing out prototypes and plans to select a constellation manufacturer by the end of the year, with a planned 2022 launch date. In November 2019, Lacuna Space signed a collaboration agreement with Miromico for the development and easy provision of 'space ready' and off-the-shelf communications devices using ultra low-power and low-cost satellite links. Ultimately, the partners will develop a global distribution chain giving customers a simple way to buy modems, firmware, antennas and devices that will enable them to use the Lacuna Network.

A new era of satellite constellations

This year is set to be an exciting one for satellite IoT deployments, with Kepler Communications, Eutelsat and Swarm Technologies all expected to take the first steps into space with their dedicated constellations. They'll be closely followed in the coming years by Kinéis, the NanoAvionics consortium and Lacuna Space, and no doubt, other will pop up between now and then.

Unlike the many small satellite constellations for high-speed Internet in the works, the IoT constellations aren't garnering a great deal of attention right now; however, we can expect that to change in the near future as their full potential is realised.



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Steve Beeching, UK Managing Director of Viasat ●●●

Q&A

Transitioning the MoD's networks

Viasat is a provider of high-speed satellite broadband and secure networking systems delivering services to both military and commercial verticals. The company has worked closely with the Skynet 6 programme to transition the Ministry of Defence's networks toward sophisticated new future proofed architecture. Steve Beeching, UK Managing Director of Viasat, outlines the investment that's gone into the programme so far, and what new technologies are on the way.

Laurence Russell, News and Social Editor, Satellite Evolution Group

Question: With SKYNET 5's PFI program ending in 2022, people are focussing more and more on SKYNET 6. Could you introduce it a bit?

Steve Beeching: Skynet 6 is the next evolution after the PFI, it's only called Skynet 6 because that's the government budgeting window. Skynet has two phases, the software delivery wrap which will be the first part of the PFI ending, then moving into what they're called enduring capability.

At Viasat we believe these phases are more merged than they appear, so it's difficult to speak about one without

discussing the other. Nonetheless, software delivery concerns the foundational systems we'll be utilising, whilst enduring capability looks at integrating hybrid adaptive networks, the future of assured resiliency, artificial intelligence and machine learning, the sorts of new technologies we'd like to capitalise upon to remain at the cutting edge.

A lot of the technologies considered a part of the enduring capability phase are currently performing in the commercial sector where there's a lot of financial motivation to innovate and outperform, which offers a strong testbed environment for the technologies the military takes interest in.

Of course, Viasat understands Skynet as a movement on the ground as well as in the stratosphere, it includes network operation centres and ground links. The petabytes of data moved between air and space is an evergreen frontier for us, so it's important to understand how much of that infrastructure we're still looking at.

With so many prospects within our grasp, It's a very exciting time for us.

Question: With military command and control technologies faster and sharper than ever, what are the SKYNET 6 capabilities that allow it to stay ahead of similar systems?

Steve Beeching: Skynet forms part of an assured resilience integrated network; the secret to the MoD deriving value out of it comes from forming a hedge genius network across multiple bearers.

There are two underlying mega



Photo courtesy of Viasat ●●●

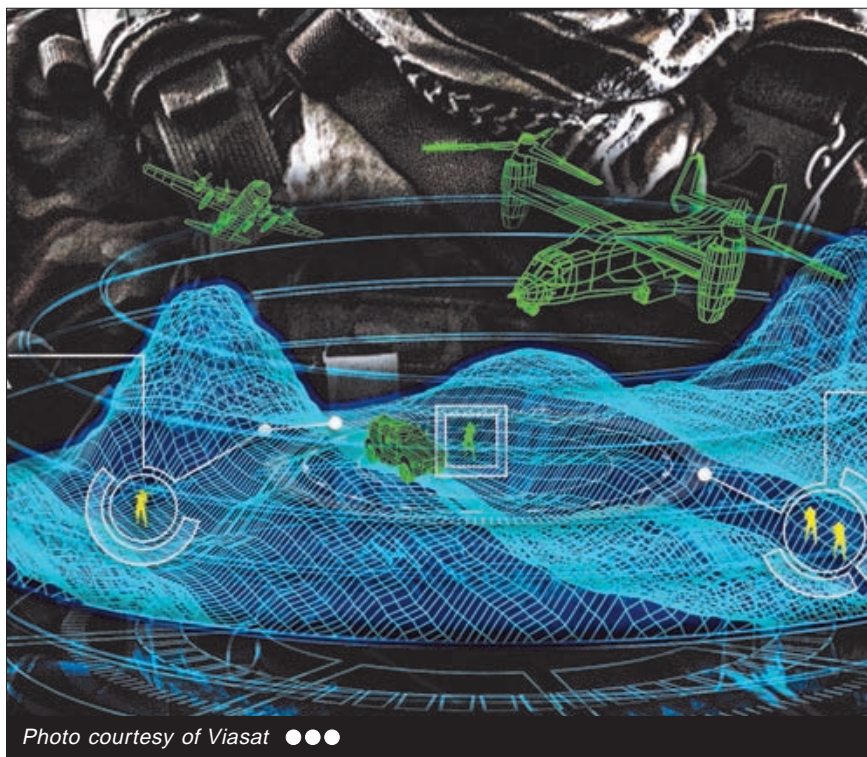


Photo courtesy of Viasat ●●●

trends we're working to implement. Firstly, we need a diversified ground network. You don't want three big centres everyone knows about, you want to hide in plain sight without sacrificing speed or reliability, and you need to be able to bring that into your common operating picture so diverse teams can collaborate on it.

Military satellites are huge targets, which if sabotaged could cause mayhem, but private heterogeneous commercial networks are much safer to utilise. These networks can often employ security to the level of the military, and if cracked wouldn't necessarily surrender much information, since our data can be so extensively spread out through these channels, not to mention that these lines are so much harder to cut because there are so many of them.

You also need to ensure that your architecture is rigidly compatible. If we spread ourselves thin, we need to be able to adapt to everywhere we occupy, to mobilise the same kind of utility and control anywhere we plan to channel data.

We're planning for the future by looking to the past. We're keen to accommodate as many legacy platforms as possible while simultaneously patching what we're

using to incrementally fix and improve our software.

The hardest challenge outside of the technology comes from the legwork involved in buying, implementing, and partnering. Bespoke networks can take a great deal of time to build out tailored to user needs, by which time the grounding technologies that system is based around has been outpaced elsewhere in the industry and the finished product arrives already somewhat out of date.

We plan to use a great deal more flexibility than that and develop our technology as we put it to work. And we certainly anticipate an increasing degree of cooperation between commercial sectors and the Ministry of Defence, and more definitive alliances between militaries and corporations.

Question: The information era has brought about unprecedented capabilities for espionage entities. As emphasis on data protection increases, how are you delivering digital defences that stay ahead?

Steve Beeching: This brings us back to assured, integrated, resilient networks. The battlespace network of the future will be delivered this way.

Military data demands adaptive, ever-evolving security. Technology is

outdoing itself faster today than ever before, and militaries can't afford to follow behind the curve. We need to be at the forefront, driving innovation as we put it to work.

AI and machine learning are proving integral technologies to process our work. We're wading through over forty terabytes of data per day across four billion events with two thousand aircraft in the air at any given point in time. We'd never be able to stay ahead of all that information without strong algorithms, and the more sophisticated their scripts are, the better we can analyse it and assure the resilience of our systems.

Question: We've heard experts theorise that military C4ISR applications may one day run through commercial satellites or civilian networks to make use of their infrastructure and cutting-edge speeds. What will it take to ensure those channels remain secure?

Steve Beeching: The encryption we bring to our data is boilerplate. We integrate it wherever we're channelling information, but as for the networks themselves, we would argue that the data in these myriad networks is inherently assured. That's partly because it's hidden in plain sight via an inconspicuous channel that other players wouldn't necessarily go digging through.

All of the military traffic on Earth is below two percent of all satcom data, so finding that information while sneaking through commercial channels would be like trying to find a needle in a haystack.

The other reason it's secure is because so many channels are available that, you could theoretically split data apart and send them through in fragmented pieces to be put back together again at their destination. In the event these datasets were perfectly intercepted, they'd be incomprehensible.

Even in the extreme case of a hostile eliminating 60 percent of a communications network, the remaining channels would still be effective at the standard we require. This method isn't always realistic when you have a few dedicated military channels, but with civilian networks open to us across satcom, LTE, and fibre it could become commonplace.

Hybridity is a keyword here. With aggregated networks, we can achieve information security, agility, and endurance like never before.

Question: Viasat has recently grown to 80 defence and technology experts across the UK, building upon their existing Five Eyes alliances. How is the company expanding its investment in British defence enterprise?

Steve Beeching: We're just about to expand our sites in the UK. We're building dedicated reference and demo sites and elements like that as part of our current plans. We're also recruiting to support sovereign capabilities around Skynet 6. Of course, we're a very global company that needs to spread ourselves across the Five Eyes nations, to maximise development efficiency. The assured resilience networks require an ecosystem of many providers and innovators to forge toward the cutting edge.

Question: What sort of data demands do you anticipate the defence sector requiring in the next 5-10 years?

Steve Beeching: I believe it will be a tumultuous time. As human quality of life and digital norms continue to rapidly evolve, those comforts and interfaces have to be brought into the military sphere. We could see an exponential growth curve in how we deal with and utilise data.

I believe private, commercial industry has outstripped defence, and we have to address that. There are certain vulnerabilities that the ministry of defence needs to own up to, so that we can address them with the seriousness that they deserve, and this is just one of them.

For instance, some of our battleships possess data speeds comparable to a single civilian home with superfast broadband.

The high end of commercial technology is becoming sophisticated enough to outpace the military sphere,

especially around emergent innovations like artificial intelligence, and we have to act before we're left behind.

We also need younger staff. Digital native generations seem to understand electronic places almost reflexively. They have literally grown to navigate the world through network driven means. This level of natural skill can't be trained into our existing specialists because on some level it's coming from muscle memory more than static knowledge.

These newer generations are absolutely integral to our effective grasp of the cyber domain. The danger of drifting out of touch with electronic fronts is real, and we need these talented minds to lead us forward. They are too valuable an asset to deny.

This is a very challenging time, not least because the extent of the challenge isn't as widely understood as it ought to be, but Viasat is very confident about what we plan to achieve, and we're excited to work toward it.

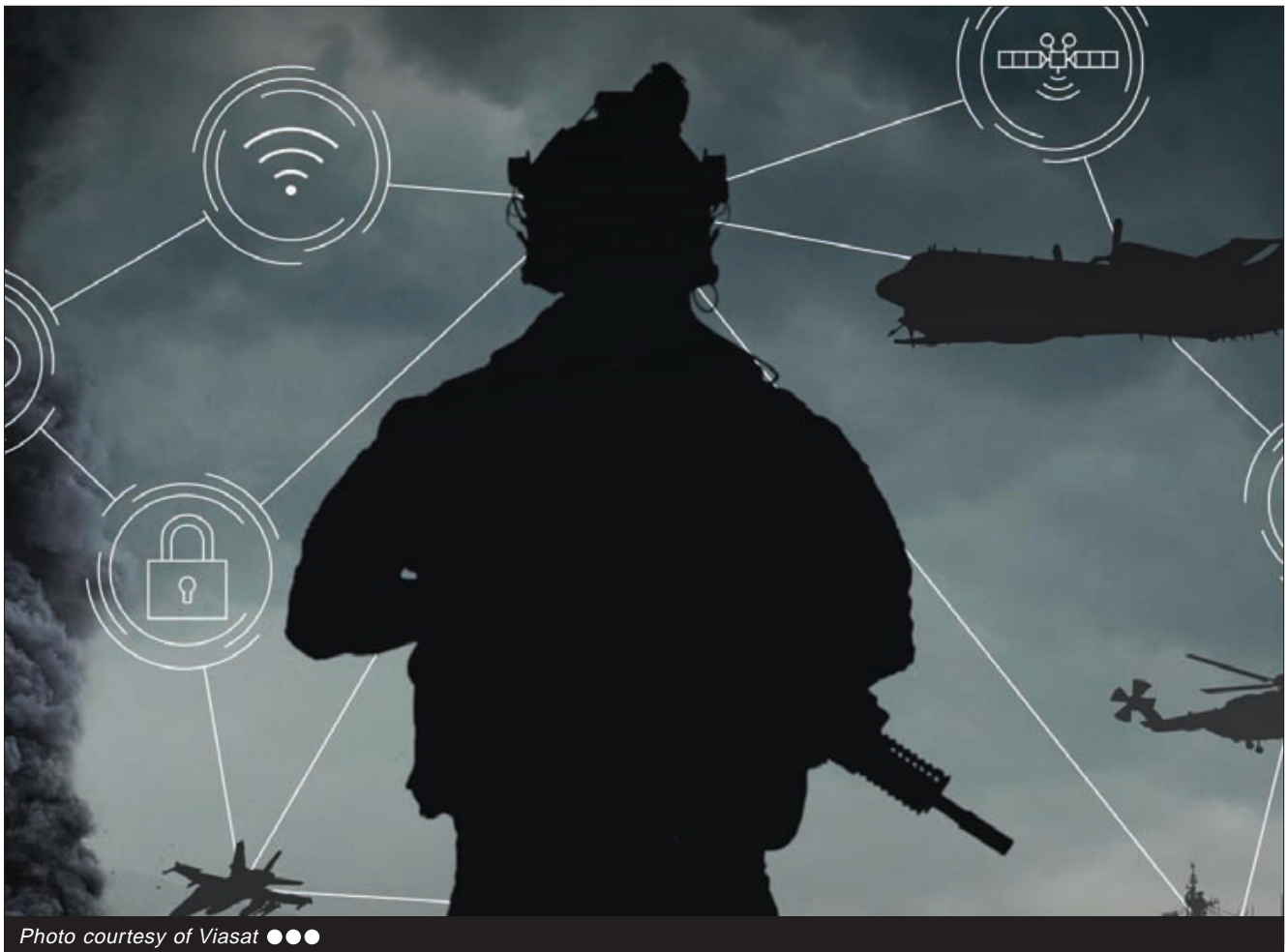


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The New Shape of Solid State



New technologies will improve the overall experience of space-travel for Astronauts. Photo courtesy of NASA ●●●

2020 Space trends

2019 marked the 50th anniversary of the Apollo 11 spaceflight that landed the first two people on the Moon. The progress in space exploration since then has been vast, but what developments can we expect in the industry in 2020?

Ossi Saarela, Space Segment Manager at MathWorks

Autonomy abounding: The next generation of autonomy for crewed spaceflight is nearing certification. In terms of your average space flight, this will mean that humans onboard a spacecraft won't even need to touch the controls. For a normal flight from Earth to the space station the flight will be completely autonomous. In fact, compared to driverless technology that is being developed for use on Earth, it is more likely that we will see it become a reality for space travel first. After all, there are no pedestrians to jump in front of the space station to complicate the situation!

The Mars 2020 mission will launch this year. This spacecraft will also push the boundaries of autonomy. As part of the mission, a precise landing is planned whereby upon entry and descent, the spacecraft will use a technique called Terrain Relative Navigation (TRN) to take pictures of the terrain and compare those to maps it already has access to. By comparing the images and analysing the terrain, the vehicle will be able to compute its position more precisely than ever.

That said, there absolutely needs to be a business case there for autonomous technology and AI to become the norm. There is understandably an attitude that if a mission is possible using traditional techniques then there is no need to change them – by introducing new techniques this will only increase the risk level of a mission, which is already fairly hazardous.

Monster mega-constellations

While some prototypes have already been launched, satellite mega-constellations are due to become common and there are organisations around the world ploughing investment into these projects. The benefits of having these mega-constellations closer to Earth is that it enables lower latency for communications, whereas geostationary satellites don't allow low latency. Furthermore, and although it seems obvious, it is easier to observe the Earth's surface when you are closer to it. For companies selling satellite imagery to analysts and companies in agriculture, mining, finance and other industries, a higher level of image accuracy means that more reliable conclusions can be made off the back of this information.

These constellations will also have a huge role to play in the progression of 5G services. There is a current need to increase the bandwidth to carry data around the globe, and satellites are an excellent way to carry that traffic. However, regulation of this technology will inevitably impact its success as well as technology that can track other satellites and debris that could cause a fatal collision. The risk of a single collision could impact the pollution of lower orbit.

“I’ll have any satellite, as long as it’s black”

With new technologies such as 3D printing and artificial intelligence lending themselves to the improvement of the manufacturing process, we could be about to witness an emergence of a production line-type assembly process for satellites. Historically, satellites were built as a one-off design – customised and handmade. But with whole constellations being planned for launch, space companies are looking at how to stamp out identical satellites using the latest design tools in the same way as Henry Ford did with his cars in at the beginning of the last century.

Re-usable rockets are changing launch vehicle engineering processes as well. Unlike rockets that are used once and then discarded, re-usable spacecraft require maintenance and refurbishing. Techniques for predictive maintenance applied to on-board sensor data from previous flights, potentially using new techniques like machine learning, have a chance for spreading from the aircraft industry into the space industry. Additionally, in the development phase, space companies will use simulated data to test their designs on a more frequent basis. Using this method means reducing the need to do expensive hardware testing. What’s more, ongoing advances to mathematical computing will enable faster design and simulation.

For engineers, that means that they will be able to accomplish more in a narrower period of time, allowing design of more complex systems in a shorter timeframe.

Dedicated small satellite launch

We might see a continued increase in smaller satellites as

more and more small rockets, that have been designed by the likes of Rocket Lab and Virgin Orbit, enter operations increasing the capacity for dedicated small satellite launch. While the initial uses for Earth sensing and communications are clear, it will be interesting to see what other technologies smaller satellites will enable. Some investors believe that these constellations and small affordable satellites have similarities with the birth of Internet. At inception, people in the technology industry knew that the Internet would be a game changer, even without fully understanding all its possible uses, and they are starting to think of small satellites in the same way.

Dashboards get a redesign

The next generation of autonomous spacecraft will also be accompanied by an upgrade of the user interface. In the past, the dashboard consisted of a variety of switches and knobs, but new designs will see a more technology-driven cockpit which is even more computerised, offering a user-friendly experience for today’s astronauts. That said, it cannot be fully digital – there needs to be some manual switches remaining for emergencies, for example, in case the digital system fails! As space tourism becomes a more common, it’s likely that other improvements to the entire ‘space experience’ will follow.

Inspire the next generation

Of course, all of the aforementioned ideas will ultimately rely on the people facilitating them, yet the engineering skills gap persists. Increased autonomy and complexity will leverage higher levels of AI. Fortunately, the creation of new modelling and design tools will make the evolving role of an aerospace engineer more accessible by bringing the latest AI and machine learning capabilities into familiar engineering environments.

Additionally, the flurry of media stories about the space industry this year will hopefully help revive interest in the sector and inspire the next generation of engineers, who may be the ones who can design and build a spacecraft that takes humans to Mars.



In the future, journeys from earth to the space station will be completely autonomous ●●●



Fabrice Bellanger, Vice President of Sales at Broadpeak ●●●

Q&A

Future of the broadcast industry

Broadpeak is a French video delivery components developer serving worldwide content and network service provision markets. Fabrice Bellanger, Vice President of Sales at Broadpeak, opines on the company's recent developments in multicast ABR and global expansions, and the future of the broadcast industry.

Laurence Russell, News and Social Media Editor, Satellite Evolution Group

Question: With the latest broadcast innovations such as multi-screen video delivery, how have consumer demands changed? Have on-demand services become truly synonymous with entertainment?

Fabrice Bellanger: Emergent technologies like on-demand, OTT and multiscreen applications have brought a lot of disruption to the industry, and rapid development to embrace them.

We all know there was some erosion of subscribers in the satellite space, but with these new technologies operators can assume more uptake to meet expansion and gathering demand. This is what Broadpeak is eager to shape.

Regarding the growing trend of on-demand entertainment, we've certainly been seeing traditionally broadcast content take a dip in popularity. However, we anticipate overall content consumption to increase as multiple

devices embrace broadcast technology to tailor and deliver a strong standard of quality content specific to the viewer's needs.

Question: The world seems to be in a transitory phase at the moment, as it steadily transitions from old media forms like scheduled television and films toward subscription-based online streaming and on-demand content. How do you foresee that dichotomy changing over the next few years?

Fabrice Bellanger: This has been a debate of the industry for some time. With Netflix's rampant success, business cases and corporate priorities have seen some rapid redeployments.

It's a tumultuous time for the industry, and we're not sure where exactly things will settle when all is said and done. As the industry changes however, we can help operators work with emergent technologies and stay ahead of where current demand sits.

What we can say is that on-demand and subscription services are demonstratively growing while traditional television remains a relatively healthy industry. When it comes to local content and rural customers, we're still seeing a large market in live TV.

Landmark channels and news services with their foundations in live TV aren't on their last legs, they're merely restructuring as they develop the new paradigms for television and invest in new technologies.

We think there is room for both worlds to coexist, but we cannot deny that the model is shifting, especially as new generations with new content consumption habits come into the world.

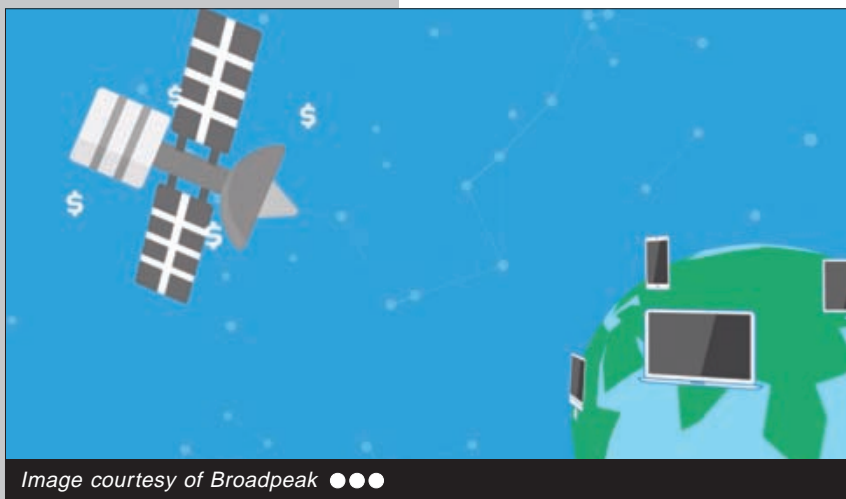


Image courtesy of Broadpeak ●●●



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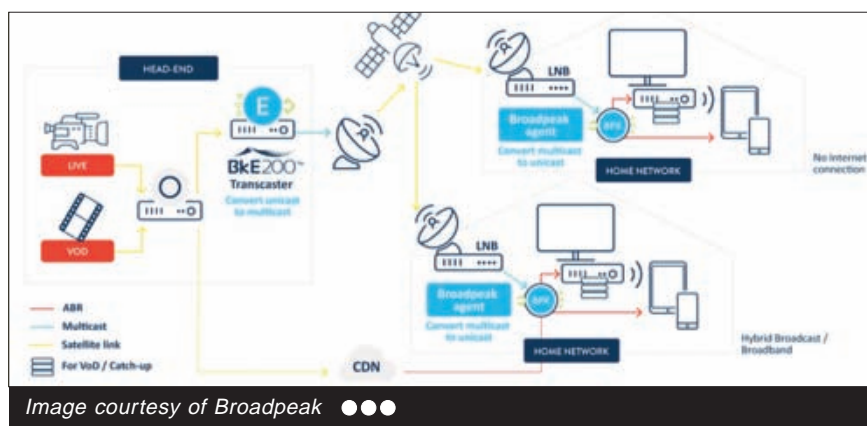
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Making Missions Possible



Question: What can multicast ABR offer that streaming services can't?

Fabrice Bellanger: Multicast ABR technology stands apart from routing schemes like broadcast and unicast, which leave live services with scalability issues. You either over dimension your network for peak traffic, or you use a technology called multicast, the one we bring.

This enables infinite scalability for live services on a native basis. Many of the devices in the video delivery industry don't always accept multicast, but our solutions are developed with versatility and future-proofing in mind. That's our core value proposition.

When you bring multicast to all your tech, the issue of scalability goes away. The only dimension you need to factor after that is the number of channels, you don't have to worry about anything else.

Another asset we pride ourselves on is quality of service delivered through experience. Quantity is important, but reliable partners are always a question of quality also.

Our multicast ABR is a meticulously managed network that can boast a low fragmentation and latency, which is an especially hot topic with live sports events.

Overall, we have designed multicast ABR and other technologies to provide our customers with a system that offers a Netflix-like quality of experience to their subscribers.

Question: Broadpeak has seen accelerated growth across the Middle East in recent months. Is that a region you intend to continue to focus on, or are you interested in spreading your business out more widely?

Fabrice Bellanger: So, we opened an office in Dubai quite recently because we anticipated some incoming growth in the Middle East. We made that expansion by both hiring on the sales side and the operations side to ensure we can accompany our customer in the long run, to see them through the deployment, operation, and their future.

This team in Dubai is there for the long-term, but we didn't wait for the growth to show itself before making the investment. We wanted to make sure we were there with our partners before we saw revenue. Perhaps we're seeing the growth we're enjoying now directly because of that bold decision.

Question: Broadpeak won three awards at the National Association of Broadcasters show 2019 for its ultra-low latency and multicast ABR solutions, among other things. How does Broadpeak manage to lead the curve on an international stage?

Fabrice Bellanger: I think it's part of our culture. It's important to be at the forefront and place an importance on innovation. Revenues and existing products are a big priority and take up a lot of time, but despite those responsibilities, our DNA retains a concerted focus on innovating on top of what is already working. We can't afford to get complacent in a time like this.

We spend a lot in R&D, working with

"We all know there was some erosion of subscribers in the satellite space, but with these new technologies operators can assume more uptake to meet expansion and gathering demand. This is what Broadpeak is eager to shape."

"It's a tumultuous time for the industry, and we're not sure where exactly things will settle when all is said and done."

very talented engineers in Rennes. The evolution of our development to what we think is right for the market. Our strategy is to stick to the specific demands we see from the market and produce them on a rigid timeframe.

We're passionate about sharing our work with our customers by inviting them into our process. The insights they help us to realise informs our work and keeps us on track, as well as ensures our ability to deliver exactly what they're going to need today, and more importantly tomorrow.

Question: You recently partnered with Dish TV India to deliver its OTT service WATCHO; could you tell us a bit about that, and what you expect from the partnership in the future?

Fabrice Bellanger: We worked to prepare video content for the OTT offer. That's been a success to Dish TV's credit as they grow their multiscreen service. That was an important move for us in India; Dish TV is a very important company in the region, and we're honoured to work with them.

Question: What new challenges and milestones do you anticipate Broadpeak tackling in 2020 and beyond?

Fabrice Bellanger: Although we've grown a lot in our past years, we haven't quite plateaued, which means we do find ourselves with growing pains. This means our goals focused on steady expansion. We want to see ourselves represented globally, and to develop our R&D departments, so that we can mobilise our tried and true strategies for innovation across a wider area, in as many markets as we can reach.

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Ian Jones, CEO, Goonhilly Earth Station ●●●

Q&A

Serious space and satellite credentials

Goonhilly Earth Station Ltd is a communications services hub and space gateway founded by CEO Ian Jones, a satellite communications engineer and entrepreneur who purchased the iconic Goonhilly satellite station back in 2014. Headquartered in Cornwall, one of the centres of excellence in the burgeoning UK space sector, Goonhilly is building a multi-faceted space business committed to nurturing UK commercial and scientific opportunities. Here Ian summarises Goonhilly's journey so far, and looks at what is on the horizon for both the company and the UK at large.

Laurence Russell, News and Social Media Editor, Satellite Evolution Group

Question: From your perspective, what's the general state of the UK space industry right now?

Ian Jones: The UK space industry is thriving. It has been growing so fast thanks to the collective will and ambition of an amazing community of people spanning industry, government and academia.

It's clear that the UK is serious about building on its satellite and space credentials and playing a key role in the

New Space business, with public and private funding helping to drive momentum. Here in Cornwall there is a palpable sense of being at the centre of a nascent yet strategically important sector that will help to achieve the UK's growth ambitions.

Question: Goonhilly has announced its intention to begin developing the world's first private global deep space communications network. Could you break that down for us?

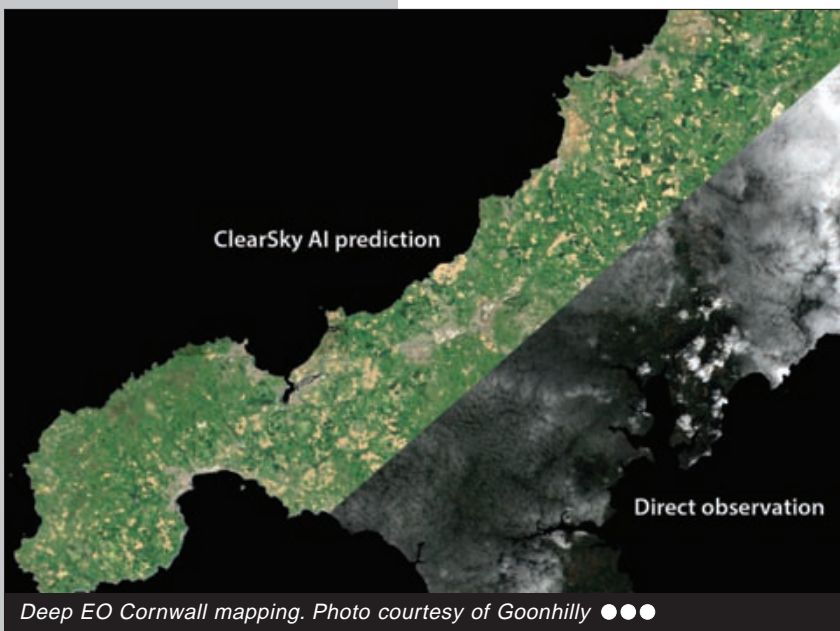
Ian Jones: With my background in ground stations it was obvious that at Goonhilly we would need to find new applications and services for the iconic antennas we acquired from BT.

The New Space approach using private, commercial models is well and truly taking root - and with these changes we are finding many new opportunities that we are starting to capitalise on.

With this in mind, we have upgraded the Goonhilly 6 antenna and added an innovative super-cooled receiver to Goonhilly 3 to make them compatible with NASA & ESA's Deep Space Network.

And we are now gearing up to deploy the world's first private global deep space network, as well as developing a global network simulator facility at Goonhilly.

Question: You're partnering with the Australian Space Agency on a number of projects, including deep space communication, and data



Deep EO Cornwall mapping. Photo courtesy of Goonhilly ●●●

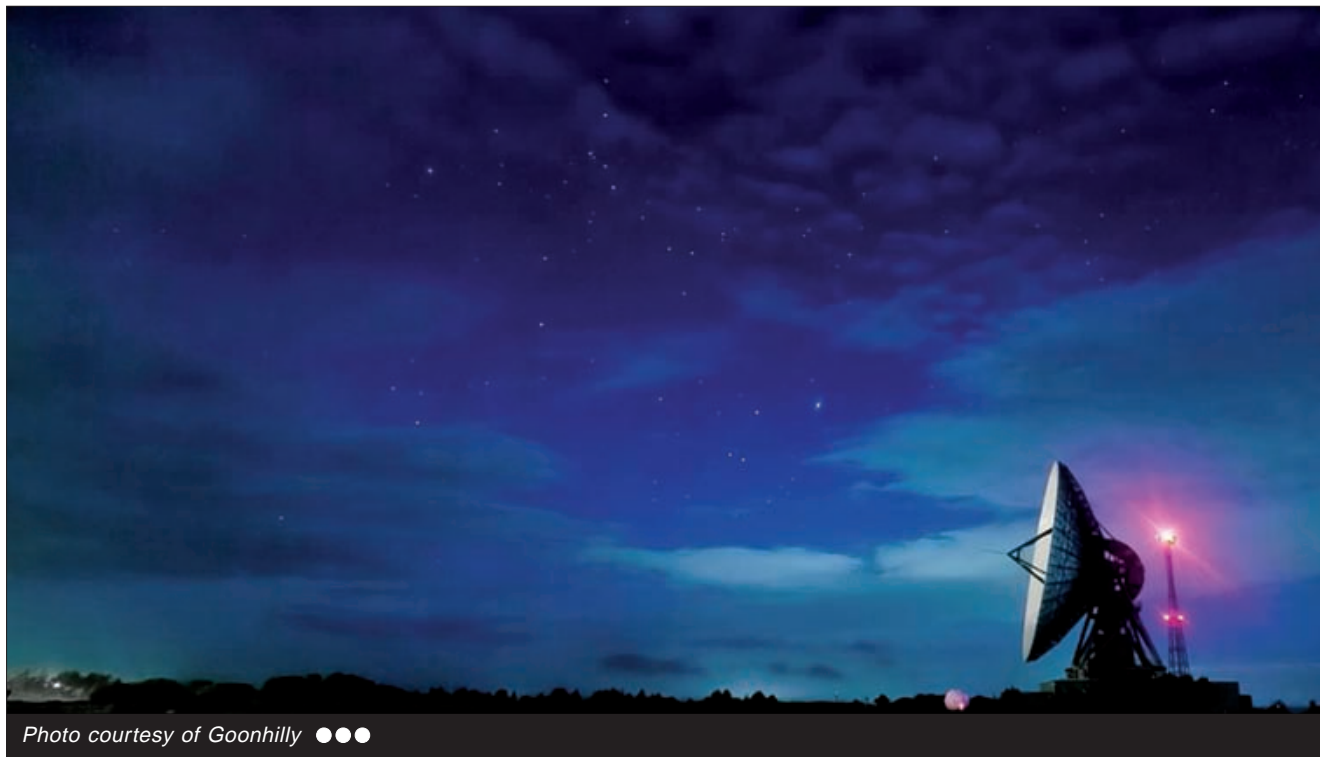


Photo courtesy of Goonhilly ●●●

processing using AI and machine learning algorithms. What are your long-term goals for that partnership?

Ian Jones: The Australian Space Agency (ASA) is very new. It's looking to follow a similar model to the UK Space Agency (UKSA), which is only a few years older. The UKSA is a government body that primarily exists to foster and regulate the private sector's space ambitions, encouraging industry growth and creating the foundations for start-ups to thrive in the sector.

We're confident we can help the ASA find the same success. And this collaboration is a fantastic opportunity for us to expand internationally, making it a win/win for both organisations.

The satellite teleport business is a mature market, which is why we have set our sights instead on changing the paradigm - embracing newer trends and investing in new markets.

One avenue we're pursuing is signal processing and AI/machine learning, underpinned by systems engineering expertise.

Australian academic institutions are producing some outstanding work in this field, which we've been enthusiastic to help make a reality. We're keen to fill in the gaps for Australian organisations looking to commercialise data in new

ways and become a catalyst for emerging sectors in the APAC region that have the potential to change the world.

Question: You've been working with Cornwall space cluster for some time now. How have you helped that community thrive?

Ian Jones: Cornwall has so much to offer the space industry in terms of location and expertise and we are proud to be part of this fast-growing community.

Supported by public funding from the Cornwall & Isles of Scilly Local Enterprise Partnership (LEP) and investment from the European Space Agency (ESA), Cornwall's space cluster and spaceport has the potential to transform the local economy and boost the wider UK economy too.

And the continued collaboration with ESA on their global projects has kept Cornwall embedded in the broader international community, which even rubs shoulders with NASA.

It's been a long and difficult road for us to get established, and the same has been true for Spaceport Cornwall, but it's all paying off now. With Virgin Orbit on board as a partner, and the full backing of the government, we're looking at a very encouraging picture,

and a rosy future for the UK space industry.

Question: Recently, UK research teams developed a deep learning system for piercing cloud cover to map the UK in never before seen detail, using your platform. Can we expect Goonhilly to support more cutting-edge developments like these in the future?

Ian Jones: We have our prospective growth charted out in a ten-year plan. We're as confident as we've ever been about the antenna side of the business but we're very aware that this revenue stream will plateau one day.

One way we are building new applications and revenue streams is by combining radio astronomy and signal processing. We are using the data we're collecting from our antennas to push the technology boundaries here.

Earth observation is just one example. Using our deep learning platform to train its algorithms, a team from the University of Hertfordshire team used satellite radar imaging to generate detailed images of the ground in the more familiar visible and infrared bands. Because radar can pass through clouds, the team were able to map the entire UK as if there was no cloud cover. The first application for the new

venture being spun out of the university will be for mapping crop health.

This demonstrates how interested the radio astronomy community is right now in exploring new scientific principals which the market can unlock. The techniques that academia is theorising is leaps and bounds ahead of what the industry has traditionally been able to provide, but that doesn't mean their work has to remain theoretical.

By putting the innovative methods being proposed by some of the best and brightest minds into practice with the help of cutting-edge technology we can make all sorts of wonderful things a reality, like looking through clouds as the University of Hertfordshire has done. At Goonhilly we believe that new economic models are fertile ground for investment and we're proud to be at the forefront of this emerging sphere.

Question: Several players in the UK space industry are enthusiastic that our developers can produce unique, disruptive technologies to comple-

ment larger scale space faring economies. Do you agree that this will be the UK's role in the market, and if so, what can be done to support it?

Ian Jones: I do agree, and I think that we have an amazing engineering and science community in the UK just waiting to be capitalised upon.

The UK can't necessarily match the economies of scale of the spacefaring giants in the US, India, or China, but as the UK has often proven, being smaller doesn't necessarily mean being any less influential. The agility of our organisations means we can contribute in fundamentally different ways, targeting more critical applications, and honing this further.

Simply put, as America and Europe are drawing up the bigger picture, we're well placed to work at filling in the finer details. I strongly believe that's one of our key strengths, and from what we've seen, the international community agrees.

Goonhilly has a wealth of disruptive ideas waiting in the wings. Each has the

potential to be game changing. Our trajectory remains rooted in investment in research and development across projects with an innovative edge, which will serve as latchkey technologies to the large space agencies.

Question: What do you foresee the UK space industry delivering over the next decade?

Ian Jones: UK spaceport investments are proving to be successful as the cost of engaging with commercial players drops, paving the way for more pioneering and sustainable models.

With some clever thinking, the launch sector has the potential to be a very profitable component of the UK's economy. Another area we believe is promising is the development of both hardware and software.

The UK's space industry is growing faster now than it ever has, and, as our hard work pays off, there's going to be an awful lot more to show over the next 5-10 years. Goonhilly will be a key name in this industry as everything comes together.



Dr Megan Clark AC and Ian Jones - Goonhilly signs agreement with Australian Space Agency●●●

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