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# Satellite Evolution

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January/February 2019



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## Feeling blue? It might be down to climate change, not Christmas

The post-Christmas blues is a well-documented phenomenon, making its presence felt in that time between Christmas and New Years when most people are off work, and no one is really sure what to do next. The excitement of Christmas has worn off, and the only thing to look forward to is losing those extra pounds gained during the festive season, and the arrival of the Christmas shopping credit card bill. This seasonal malaise is felt well into January and February, with spirits typically not lifting until the first signs of Spring are seen.

However, now we can blame our post-Christmas blues on something far more sinister: Climate change. Towards the end of 2018, a landmark report from the United Nations revealed that catastrophic events induced by climate change could become regular occurrences as soon as 2040, should greenhouse gas emissions continue to increase at their current rate. In the report, the previously-held global warming threshold of 2°C, at which point severe consequences would ensue, was lowered to 1.5°C. And, according to the *'Proceedings of the National Academy of sciences'* journal, short-term exposure to extreme weather, multi-year warming, and tropical cyclone exposure (all resulting from global warming) are all associated with worsened mental health.

These were the findings of a team from MIT Media Lab, who claim that climate change may impact everyday human moods to severe outcomes, including suicide. In 2002-2012, around two million participants reported on their mental health for 30 days through the US Centers for Disease Control and Prevention's Behavioural Risk Factor Surveillance System. The responses were charted against meteorological data by the research team, who found that, on average, monthly temperatures hotter than 30°C were associated with more reports of mental health challenges compared with temperatures in the 10-15°C range. The team also discovered that months with more precipitation days (a common result of climate warming) increased the chances of low mental health reports.

After so many years of climate change arguments, of the back-and-forth between the deniers and harbingers of doom, it's good to hear about some fresh research looking beyond the environmental and socioeconomic impacts. And let's not forget that, while the satellite sector can't make any notable impact on global climate change, we can help collect data and inform on the latest changes to oceans, atmospheric, wind patterns and temperature variations through the use of today's powerful new Earth observation satellites. That data can be used by governments, NGOs and associations the world over in deciding on the next steps in tackling climate change – and according to recent research, we'll be all the happier for it. 🌈



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Measuring cyclones - Aeolus ●●●

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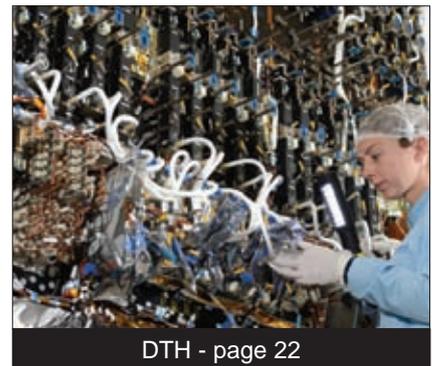
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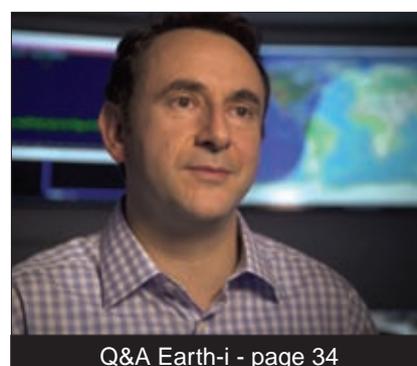
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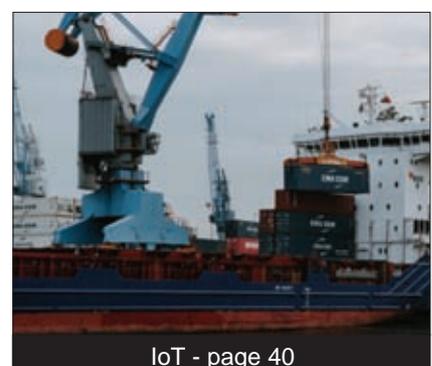
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Multi-Rx Satellite IP Demodulator, the NovelSat NS HUB4000 ●●●

### NovelSat introduces a compact multi-receiver for satellite IP data hubs offering up to 2Gbps per unit

NovelSat has announced the availability of the new Multi-Rx Satellite IP Demodulator, the NovelSat NS HUB4000. The NS HUB4000 is a multi-receiver satellite transmission IP unit designed for mobile backhauling and enterprise satellite data transmission network operators, who want to optimize their hub CAPEX and achieve high transfer rates for inbound data traffic.

The NS-HUB4000 houses four internal Rx cards, each with eight satellite receivers, packing up to 32 high-efficiency receivers into a single 1U rack-mounted unit. The compact NovelSat NS-HUB4000 is the ideal choice for Point-to-Multipoint satellite network data applications in which a single NS-HUB4000 hub unit can receive data at an aggregate inbound rate of up to 2Gbps. Each of the 32 NS-HUB4000 carriers can simultaneously receive at up to 120Mbps per carrier, saving rack space and reducing equipment and operating expenses.

The NS-HUB4000 supports automated hot-standby redundancy plans that eliminate any single point of failure without any external equipment. In addition to multiple receivers, the NS-HUB4000 is equipped with dual power units and dual external interfaces.

The cost-effective NS-HUB4000 includes built-in IP processing features to improve data transmission efficiency. NS HUB4000 interfaces include Ethernet 1G/10G, dual power supply ports, and M&C interfaces such as USB ports and an SD card slot for data import/export, software upgrade and many other uses.

The NS-HUB4000 is a member of the NovelSat Professional Satellite Demodulator family. It is a major element in the NovelSat line of Point-to-Multipoint network solutions. Combined with the NovelSat NS300X or NS3000 modem series, the NovelNet NMS (Network Management System), and NovelSat LIBRA (Dynamic Resource Allocation Solution), the NS-HUB4000 contributes to an optimized and highly efficient Point-to-Multipoint network.

According to Ronen Sadan, NovelSat AVP Marketing, "The one thing we hear most from our customers is, 'How can we optimize satellite hub costs?'. "Between superior bandwidth efficiency and the many signal optimization features offered by NovelSat, and now up to 32 receivers in a single box, the NS HUB4000 is a perfect space saving, cost saving satellite transmission solution for enterprise satellite IP data service providers." ■

### Orbex unveils Prime rocket at new facility in Scotland

Orbex has publicly unveiled its Prime rocket for the first time at the opening of its new headquarters and rocket design facility in Forres in the Scottish Highlands. Designed to deliver

small satellites into Earth's orbit, the rocket was unveiled at an opening ceremony attended by VIPs from the UK and European space community as well as local community stakeholders.

The completed engineering prototype of the Stage 2 rocket (the stage that will transit into orbital flight after launch) is made from a specially-formulated lightweight carbon fibre and aluminium composite and includes the world's largest 3-D printed rocket engine. Orbex Prime is a completely re-thought and re-engineered two-stage rocket, designed by Orbex aerospace engineers with professional experience from organisations including NASA, ESA and Ariane, as well as other commercial spaceflight companies.

Thanks to its novel architecture, Prime launchers are up to 30 percent lighter and 20 percent more efficient than any other vehicle in the small launcher category, packing more power per cubic litre than many heavy launchers. Seen for the first time, the 3-D printed rocket engine was uniquely manufactured in a single piece without joins in partnership with additive manufacturer SLM Solutions. Given the extreme temperature and pressure fluctuations involved in space flight, this gives the engine an advantage over other rocket engines, which can suffer from weaknesses associated with joining and welding.

It is also the first commercial rocket engine designed to work with biopropane, a clean-burning, renewable fuel source that cuts carbon emissions by 90 percent compared to fossil hydrocarbon fuels, supplied by Orbex's new exclusive BioLPG fuel partner Calor.

Orbex first came into the public eye in July of 2018, when



Prime rocket ●●●



the UK Space Agency announced that Orbex had been chosen to launch from the proposed spaceport in Sutherland in the Scottish Highlands, as part of the main consortium. At that time, the company announced that it had already won £30 million (\$40 million) in private and public backing for the project, making it Europe's best-funded private launch company, straight out of stealth mode.

The company revealed the identities of more customers that would be among the first to launch their satellites from the Sutherland spaceport.

On Orbex Prime's maiden flight from Scotland in 2021, the rocket will carry an experimental payload from UK-based Surrey Satellite Technology Ltd. (SSTL), the world's leading manufacturer of small satellites. This launch will represent an important first for the UK commercial space industry, demonstrating the UK's end-to-end launch capability with a UK rocket launching a UK satellite from a UK spaceport.

Orbex also announced that Swiss-based Astrocast SA, has selected Orbex to launch multiple nanosatellites for the development of a planet-wide Internet of Things (IoT) network. Astrocast's satellite-based IoT network will eventually include 64 nanosatellites, spread across eight strata above the Earth to deliver IoT connectivity across the planet, including regions currently considered remote or inaccessible.

One of the leading companies in the European space sector and strategic investor in Orbex, Elecnor Deimos, has also confirmed that it has contracted with Orbex for up to twenty satellite launches.

The new Headquarters building at Forres is a 2,000 square metre facility. It will combine a rocket design and integration facility, an operations centre as well as executive offices.

It is expected that the facility will help bring over 130 jobs to the Scottish Highlands region, with an intense recruitment drive for the company already underway.

Business Secretary Greg Clark said: "The plans for a spaceport in Sutherland have already attracted significant investment, and Orbex's rocket design facility will bring more than 100 new jobs to the Scottish Highlands region – this is our modern Industrial Strategy in action. The space sector is

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a great British success story and we are working closely with industry to ensure we thrive in the commercial space age. New innovations, capabilities and expertise are driving significant growth, with the sector generating close to £15 billion in income each year."

Graham Turnock, Chief Executive, UK Space Agency said: "Orbex's new rocket design facility brings Britain one step closer to having its own domestic commercial launch capability and firmly positions the UK as Europe's frontrunner for those looking to Earth's orbit and beyond for new opportunities. The new facility and future spaceport operations will help unlock vast economic and societal benefits not just in Scotland but right across the UK."

"Since the announcement in July 2018 that we had been chosen to launch from the Sutherland spaceport, Orbex has been on an incredible journey, largely behind-the-scenes," said Chris Larmour, Orbex CEO. "That is changing today, as we publicly reveal the company's technical and commercial momentum. Not only do we have a full engineering prototype of the complete Stage 2 of the Prime rocket, but also a growing roster of customers hoping to be among the first to launch satellites from Scotland."

Larmour continued: "Today Orbex has taken some big strides forward, creating something unique in Europe – a well-funded, private micro-launch solution supported by excellent facilities, strong industrial partners and an expanding line-up of commercial customers. There are only a handful of private launcher companies globally that have practical experience in the design and production of micro-launch vehicles, and even fewer that have combined those skills with sufficient funding and the commercial contracts to execute on their plans. We are looking forward to the next steps in our development from our new home in Scotland."

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Artist rendering of Telesat's Phase 1 LEO satellite. Photo courtesy of SSTL ●●●

### Gilat demonstrates exceptional maritime connectivity over Telesat's Phase 1 LEO satellite

Gilat Satellite Networks has completed a successful test with a tier-1 maritime service provider for maritime communication over Telesat's low earth orbit Phase 1 LEO satellite. This industry-first milestone exemplified exceptionally low latency and high bit-rate essential for multiple maritime applications.

The remarkable performance with latency as low as 16 msec was achieved in the tier-1 maritime service provider's teleport in Northern Europe.

The test was performed with Gilat's LEO modem and a one-metre small maritime Ka-band antenna, demonstrating direct real-time communication. Outstanding performance was achieved in testing video conferencing, over-the-top (OTT) video such as YouTube and massive data communication on a symmetric link.

"Telesat is pleased to be collaborating with innovative companies such as Gilat that recognize the potential of Telesat's LEO system to transform the maritime broadband communication experience, delivering very high bit-rate services for large leisure vessels and supporting applications with critical latency requirements," said Michel Forest, Director of Engineering, Telesat. "This demonstration confirms that Telesat's state-of-the-art LEO architecture delivers on tier-1 maritime service provider's requirements and opens the door for latency sensitive and high bit rate applications."

"Gilat is proud to demonstrate outstanding results for next generation maritime communication over Telesat's phase 1 LEO Satellite," said Amir Yafe, Head of Global Accounts at Gilat. "This maritime test further strengthens Gilat's strategic partnership with Telesat and follows the recent collaboration on the industry's first inflight communication over LEO satellite." ■

### Terrasat ramps up presence worldwide with new EMEA Director

With the new year comes new changes within Terrasat Communications. To jump-start the 2019 year, the company recently surpassed shipping of 20K IBUCs worldwide, and it continues to charge forward by expanding its sales team.

Terrasat welcomes Paul Gorton to the team as Director of Sales, EMEA who will be combining forces with Ron Merritt, Regional VP of EMEA. Paul Gorton arrives primed from

Comtech Xicom Technology and brings with him over 20+ years of combined experience in both application engineering & sales. Paul's extensive knowledge will enable Terrasat Communications to be even more responsive to the needs of the ever-diversifying Satcom market.

Bob Hansen, Global Sales & Marketing, said: "What has endeared customers to Paul is his broad reaching knowledge and empathy towards their requirements, this matches perfectly with Terrasat Communications' customer focused approach." Gorton commented on his role saying, "It is an exciting time to be working in the industry with Satellite Communications playing such a huge role in Aero, Maritime, Government & Military as well as the more traditional VSAT and Broadcast verticals."

Paul Gorton will be attending CABSAT 2019 in Dubai along with Ron Merritt & Bob Hansen this March. ■

### Hughes engineering executive, Dr. Lin-Nan Lee, honoured with distinguished service award for contributions to satellite communications

Hughes Network Systems has announced that the IEEE has honoured Dr. Lin-Nan Lee, Vice President of Advanced Development at Hughes and Life Fellow at IEEE, with its "Distinguished Contributions to Satellite Communications" award. The IEEE, the world's largest professional organization for the advancement of technology, presents this prestigious award to commend one industry leader for outstanding contributions to the advancement of science, technology and applications in communications.

"Dr. Lin-Nan Lee has had a profound impact on the field of satellite communications for many years," said Dr. Matthew Valenti, IEEE Fellow and Professor in the Lane Department of Computer Science and Electrical Engineering at West Virginia University. "He has been a pioneer in the use of several ground-breaking technologies, including turbo and low-density parity-check (LDPC) coding, interference cancellation, adaptive modulation and faster-than-Nyquist signalling. Dr. Lee's work has shaped many of the most commonly used satellite and cellular standards we use today."

In his over 25-year career at Hughes, Dr. Lee has played a prominent role at both a company and an industry level in developing international satellite communications standards. He contributed to over 30 published journal and conference papers, while helping secure more than 60 US patents of the 300+ held by Hughes, including development of the DVB-S2 and DVB-S2X global satellite standards. ■

### O3b satellites arrive at Kourou for March launch

Four new O3b Medium Earth Orbit (MEO) satellites have arrived safely at the Guiana Space Centre in Kourou, French Guiana, in preparation for launch by a Soyuz rocket from Arianespace in late March 2019, SES announced.

The new Ka-band satellites will join SES's existing constellation of 16 MEO satellites manufactured by Thales Alenia Space, orbiting at approximately 8,000 km from Earth and serving customers based in more than 40 countries. By increasing the size of the constellation from 16 to 20 satellites, SES Networks will offer enhanced coverage while providing greater service availability and reliability to cater to the increasing demand for bandwidth in the government, telecom, cloud, maritime and energy markets.

The O3b fleet of MEO satellites is the only proven non-geostationary (NGSO) constellation to provide carrier-grade commercial broadband services today. O3b is the only



Four new O3b Medium Earth Orbit (MEO) satellites have arrived safely at the Guiana Space Centre in Kourou ●●●

satellite-based system capable of delivering MEF Carrier Ethernet 2.0 (CE2.0) certified services, which meet the same stringent functional and performance requirements of CE2.0-certified terrestrial fibre services. The combination of O3b's fibre-equivalent performance and massive geographic reach means the system can deliver high-performance data solutions – including cloud services and applications – across

the globe. Enabled by the O3b system, SES Networks is the only satellite-based provider to be certified as an IBM Cloud Direct Link Service Provider.

With these four new satellites, SES completes the first generation of a unique high-power, high-throughput fleet of 20 satellites operating in MEO. Each satellite has a mass of approximately 700 kilograms at lift-off and provides capacity of more than 10 Gigabits per second. Additionally, the MEO system's next generation, O3b mPOWER, is the only fully-funded NGSO broadband system in development and will be fully-integrated and backward compatible with the existing O3b system starting in 2021.

“Since becoming operational in 2014, the unique offering of the O3b MEO system has transformed communities and disrupted industries by empowering people with new opportunities,” said Ruy Pinto, Chief Technology Officer at SES. “Expanding the O3b constellation enables us to continue elevating the connectivity experience, driving digital transformation and increasing cloud-scale adoption, by seamlessly integrating satellite-based services into the broader global terrestrial network.”

**Ukraine's first 4K channel on AMOS-7**

Spacecom has announced its AMOS-7 communication satellite is broadcasting the Ukraine's first ever 4K TV channel. Nashe Media Group's #NASHE HDR channel is being broadcast throughout the entire country by Ukrainian operator UkrKosmos. Following on the new channel's success, Nashe



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- \*Working for IoT and Broadband Access





is planning a Spring 2019 launch of a second 4K channel, ETNO.

According to Andriy Verkholyak, Director Nashe Media Group, “The success and positive reception by consumers of our 4K channel #NASHE HDR is exciting. As a relatively new player in the Ukrainian market, we are here to prove that we are market movers and by investing in 4K TV, we have proved that viewers are ready for this new technology. Working together with UkrKosmos and Spacecom is the correct decision and we are already planning for more 4K channels. We look forward to more growth with Spacecom as our satellite communications partner.”

Jehuda Amir, VP Sales CIS at Spacecom: “4K television is a growth point for TV business and a must-have feature in the premium segment. I am very pleased that the first Ukrainian 4K channel is now broadcasting from our satellite. One factor holding back 4K growth is that they require large capacity, which has been expensive. Spacecom’s intensified efforts in developing satellite technologies to provide TV channels with sufficient capacity at a reasonable price have succeeded. Nashe Media Group’s channel on AMOS-7 proves this.”

#### Newtec partners with Paradigm to host new high-throughput modem board

Newtec, a specialist in the design, development and manufacture of equipment for satellite communications, has partnered with satellite communications solution provider Paradigm, which has become the first company to host its Newtec Dialog® SMB3310 high-throughput modem board.

The two-way, high-throughput SMB3310 satellite modem board is now successfully embedded into Paradigm’s field-proven Paradigm Interface Module (PIM) terminal controller, which provides a common terminal interface for fixed and quick deploy terminals operating on all major satellite networks. Through the PIM, the Newtec SMB3310 can interoperate with on-the-pause and on-the-move satcom terminals for Government, Defense, Broadcast and Mobility markets. The PIM is renowned for being easy-to-use and working seamlessly with compliant antennas and has a long track record in integrating a range of terminals.

“The SMB3310-based PIM combines the efficiency and flexibility of the Newtec Dialog platform with the versatility and reliability of the PIM,” said Bart Baekelandt, Product Manager at Newtec. “The range of PIM-based terminals will allow Newtec Dialog users to roll-out a multitude of high-throughput fast-deploy applications on their Newtec Dialog platform, achieving the highest efficiency over satellite, wherever they may be.”

The integration of SMB3310 and the PIM instantly gives customers access to the Newtec Dialog VSAT platform via Paradigm’s range of high-performance multiband terminals including the lightweight, rugged and ultra-portable SWARM, the HORNET flyaway terminal, the Communications on the Move (COTM) solution MANTA, and the cost-effective CONNECT100T tripod terminal.

The Newtec Dialog VSAT platform provides robust and resilient links which are both efficient and affordable thanks to the wideband DVB-S2X forward and the government-grade frequency hopping waveform Newtec Mx-DMA®, which includes features such as spread spectrum and randomization of carriers.

“As an established provider of end-to-end solutions to address the evolving requirements of network providers, we

are always looking to form new partnerships with other industry leaders,” said Ulf Sandberg, Managing Director at Paradigm. “Newtec’s new modem board is not only innovative, but flexible enough to provide tailored services to our customers, powering a range of applications from mobile Internet access, cellular backhauling and disaster recovery right through to news gathering and video/audio streaming.”

#### YahClick to showcase one-stop-shop satellite enabled solutions at CABSAT

On 12-14th March, industries will converge beneath one roof at the Dubai World Trade Center, where YahClick will host live demonstrations of its e-Learning and e-Health solutions. These technologies are unlocking human potential by facilitating access to education and health services in several unserved and underserved communities across Africa, Middle East, Central and South West Asia.

YahClick, the recently formed joint venture between Yahsat, the UAE-based global satellite operator, and Hughes Network Systems, utilizes the Ka-band satellite frequency and powered by High Throughput Satellite (HTS) spot beam technology, to deliver its broadband internet service. By using the latest technology currently available in satellite communications, YahClick, has been able to provide dependable, affordable and high-performance satellite broadband services across its growing footprint.

The satellite broadband provider will be showcasing its services alongside two key partners: Integrated Technology Group (ITG) and Tech4Life.

The ITG partnership offers a full ecosystem of digital learning tools and resources to schools and education ministries across YahClick’s serviced markets. ITG will be present alongside YahClick at the event to showcase live demos of the platform. E-Learning is a critical social and economic enabler given that more than 57 million children remain out of school in developing nations, without access to quality education.

Tech4Life will also exhibit with YahClick, bringing its e-Health and telemedicine services to the event floor. The e-Health provider’s primary objective of improving access to the healthcare services in remote areas of the world aligns perfectly with some of the event’s key themes, as well as YahClick’s broader vision. By teaming with YahClick, Tech4Life is able to provide consistent, affordable and stable broadband links between major hospitals and remote villages that require professional consultation and diagnosis.



YahClick e-learning demo during AfricaCom ●●●

# Proven Performance Onboard

Service providers and end users are leveraging **Comtech onboard** to build out premier satellite-based networks for a variety of mobility applications. Our VSAT networking platforms, satellite modems and rugged frequency converters/amplifiers are entrusted in the most demanding environments and are in use on thousands of vessels, trailers and vehicles around the globe. Whether utilized for energy on land or offshore, cargo, cruise, rail transport or land mobility, our solutions provide unmatched efficiencies and flexibility. Let's discuss how the proven performance of **Comtech onboard** can help you meet your customers' throughput demands, improve your bottom line and provide first-rate quality of experience. Contact us today.



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Bernd Lehr, Director of Sales  
ND SatCom ●●●

# Q&A

## Premier supplier and integrator

ND SatCom has more than 30 years of experience as a premier supplier of and integrator for innovative satellite communication equipment systems, supporting critical operations throughout the world. ND SatCom has customers in more than 130 countries and delivers efficient and secure turnkey and custom communications solutions from its base in Immenstaad, Germany. Bernd Lehr, Director of Sales, outlines ND SatCom's recent achievements and outlook for the future.

**Question: 2018 was a busy year for ND SatCom. What can you tell us about the highlights and key milestones achieved over the year?**

**Bernd Lehr:** We've achieved a lot in all three of our business sections. We are very active in the defence market, the broadcast sector, and the government and enterprise market.

In the defence market, we finalised the modification of terminals for the German armed forces, and we've been awarded a contract for the Polish Army. In the government market, we've rolled out two significant Air Traffic Control (ATC) networks, one in Bolivia via Thales, and one with Atech/Brazil. In the

broadcast sector, meanwhile, we've been happy to deliver our satcom on-the-move system to ten video news vehicles for SABC, which are transmitting all types of services.

**Question: The satellite industry is in a major state of change; we're moving from high throughput satellites (HTS) to extreme throughput satellites (XTS), and small satellites and mega-constellations. What kind of opportunities does all this change provide ND SatCom?**

**Bernd Lehr:** There is a close cooperation with the Intelsat engineering team for the Epic<sup>NG</sup> satellites with SKYWAN. We've done intensive testing with partners at different ground stations, utilising different flyaway, land, and maritime terminals.

The unique features of our SKYWAN technology can be used in any operation. Regarding the XTS developments, this is under investigation by ND SatCom for future technologies.

One of the challenges is that we must always be ready for these new technologies and be prepared for the future. We've increased our sales staff in reaction to the changing markets, as well as our engineering personnel in Africa and in Asia. We see good demand in our core markets, defence, broadcast and governmental, while these changes are going on. Satcom on-the-move, which is required by all three of our markets, is growing strongly.



Ten video news vehicles for SABC. Photo courtesy of ND SatCom ●●●

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**Question: In a rapidly-changing industry, geographic and end user markets are being impacted significantly. How have ND SatCom's key markets been developing?**

**Bernd Lehr:** We think there is big demand for mobile satellite communications, especially in Africa and Latin America. The reason for that demand is that they have poor terrestrial connectivity. It's different in Europe, where we need to concentrate more on the broadcast market, which is also rapidly changing, and where we're seeing more Ka-band transmissions. We're still building our SNG trucks, so this is something we need to react to. We're also now trying to focus on the Asian market.

We have a lot of capability in the broadcast market, such as our Ka2Go terminal, which is very well-known in the market. There's still a very strong demand for SNG and uplink stations, and we're establishing better pick-up stations for the broadcast markets which increases reliability and signal availability. The newer IP and OTT markets are bringing in a great deal of change for broadcasters, and we're reacting to that with our SKYWAN 5G modem, which transmits any service over IP in one hop to the destination. We clearly see that DTH is falling and OTT is going up.

Defence is our strongest business sector where we have long-term contracts with different military institutions, including the German armed forces and much of the rest of Europe.

Our reach in the governmental markets is mostly around ATC networks, but we also see now through the satcom on-the-move business possibilities in the first responder and police market. We've been performing demonstrations for this market; we did one in April in South Africa, where we have welcomed several companies and institutions, including the police and military police, to witness a live demonstration. The attendees were convinced that our system is excellent for their needs, especially in situations where reliable service is a must.

**Question: We hear you have a new satcom on the move solution, which is already being used by SABC in South Africa. What can you tell us about the solution, and how it compares with others on the market?**

**Bernd Lehr:** The solution comprises our SOTM enhanced SKYWAN satellite modem, a low-profile antenna, and our media fleet manager software. The satcom on-the-move vehicles are being operated assuming that everyone is using video traffic only, but in parallel,

voice calls, Internet and email traffic is also supported. Data can be sent, which is required by all the different types of customers, including defence, broadcasters, and governmental agencies.

Broadcasters have bandwidth demands up to 7Mbps for HD video that our News-on-the-Move solution can transmit.

The defence customers, on the other hand require maximum bandwidth too but the antenna to be much smaller rendering it invisible to the enemy. That's very important for those customers. With our solution, all customers can choose proper antenna and transmit from the very first second; our SKYWAN modem interfaces to all these SOTM antenna and ultra-fast re-establishes the link after shadowing or tunnels avoiding frozen video images or cut off voice calls. Nothing needs to be adjusted; it's all done automatically with SKYWAN.

What only SKYWAN modems do to reduce OpEx is bandwidth sharing: A bandwidth pool can be used for peak traffic by all the remote sites in a satellite network while enforcing lowest jitter and real-time services. This helps lower the costs for our customers.

**Question: Let's talk about other product development. Does ND SatCom have anything else new in the pipeline?**

**Bernd Lehr:** There are new features and capabilities of our SKYWAN 5G modem that we are developing with respect to mobile and the mobility area. We already released LTE enhancements and encryption modules for SKYWAN. Now, beam switching for mobile terminals in meshed networks using HTS satellites is under development for first responders, police forces, special forces and homeland security customers that bring their own mobile cells.

**Question: What's on the horizon for ND SatCom in 2019 and beyond?**

**Bernd Lehr:** We are mainly focusing on continuation and extension of our current areas. We're also strengthening our regional sales, and enhancing our product portfolio as an independent group with verified solutions of mobile terminals for mobile cells – we have branded it SMART MOBILE<sup>2</sup> NETWORKS.



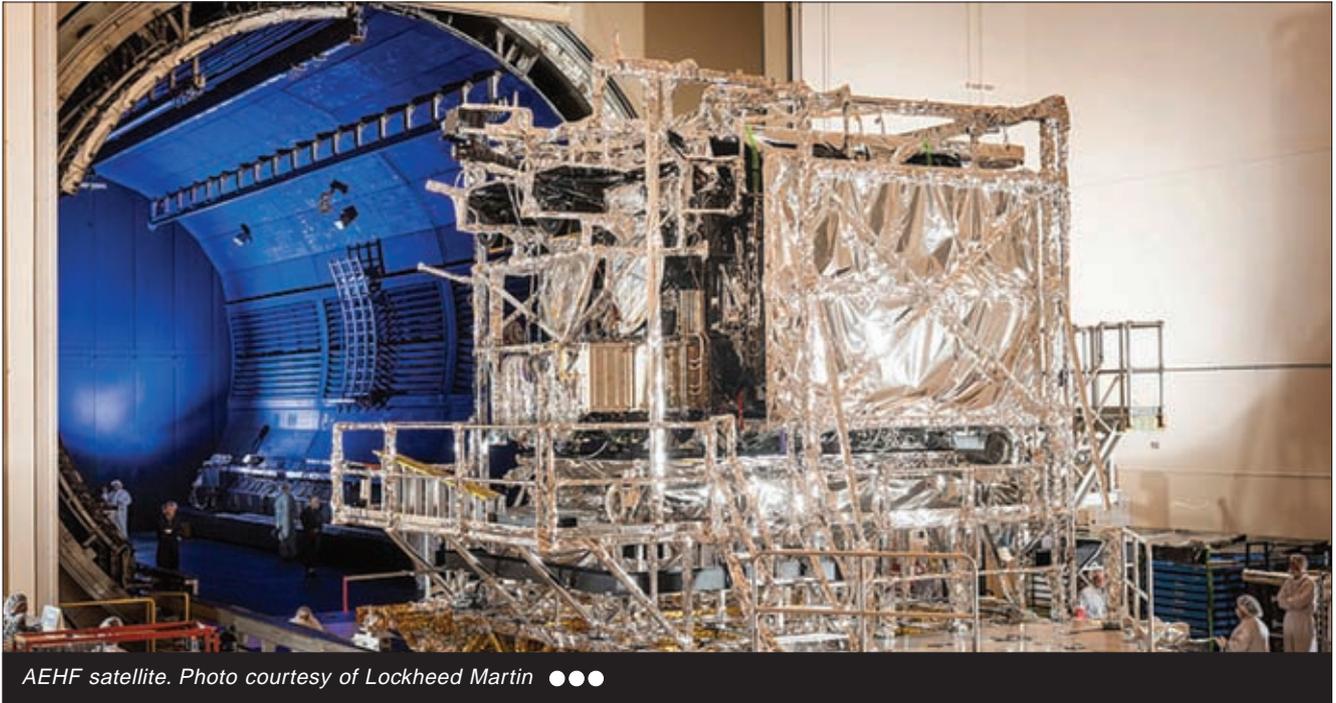


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AEHF satellite. Photo courtesy of Lockheed Martin ●●●

## Tactical satellite-based communications

Delivering secure, timely and effective tactical communications is one of the big challenges in the satellite sector today, as congestion, contestation and competition make the space environment and increasingly difficult place to navigate. However, these communications capabilities are absolutely paramount for the efficient operation of government and military groups the world over. In recent years, the satellite sector has established innovative solutions to meet demand.

**Communications have played a vital role in our** world since the dawn of time. Over the centuries, communications capabilities and preferences have evolved, with human and animal messengers, telegrams, hand and smoke signals, and later, letter-writing and faxes, being replaced with faster, more instantaneous, options. Communications in any form are important, but it's become clear in recent decades that the priority for consumers, governments, non-governmental organisations and military forces alike, is on-demand, real-time communications.

Delivering real-time communications was once a tricky feat. However, since the advent of Smartphones and satellite communications systems, the ability to communicate via text, image or voice whenever, wherever, has become commonplace, and taken for granted. We can call relatives on the other side of the world with the click of a button, become registered to vote with our local authorities within a couple of minutes on our Smartphones, and send photos of meals instantly across a variety of platforms with no extra charge, using WiFi or data packages.

For government and military groups, on the other hand,

there is a wide array of data that needs to be communicated across the world at any one time, including voice and video, situational awareness, battlefield management, etc. Satellite plays a key role in delivering that connectivity, whether it's serving rural areas unserved or underserved by fibre, providing back-up connectivity to terrestrial options, or delivering connectivity on the move for manned or unmanned missions on land, in the air, or at sea. The other advantage of satellite over terrestrial options is, of course, security; when it comes to government and military data, secure transmissions are absolutely vital. This has become ever-more important in recent years as the three Cs become increasingly commonplace in the battlefield environment; never before has space been so contested, congested and competitive.

### Lockheed Martin launches fourth AEHF satellite

The world's most affluent governments and defence forces have been launching their own satellites for decades now, reasoning that wholly-owned assets are a better solution than the hosted payloads model. The Advanced Extremely High



Redefining connectivity. Photo courtesy of Viasat ●●●

Frequency (AEHF) series of communications satellites is one such group of wholly-owned satellites, operated by the United States Air Force Space Command. AEHF provides survivable, global, secure and jam-resistant communications for the Armed Forces of the USA, the UK, Canada, and the Netherlands, on land, in air, or at sea.

Once complete, the series will consist of six satellites in GEO, all backwards compatible with the Milstar system, operating at 44GHz up (the extremely high frequency - EHF - band) and 20GHz down (the super high frequency - SHF - band). AEHF will ultimately replace the Milstar constellation, since user data rates are increased five-fold, enabling vastly improved tactical communications, including real-time video, battlefield maps and targeting data.

The AEHF satellites utilise narrow spot beams to communicate with Earth, and crosslinks between the satellites, enabling space-based relay, which is more secure than hopping via ground hubs. With frequency-hopping radio technology and phased array antennas utilising adaptive radiation patterns, many potential sources of jamming are locked out.

Lockheed Martin is under contract to deliver the six AEHF satellites and the mission control segment, with Northrop Grumman Aerospace Systems providing the payload. In October 2018, the fourth AEHF protected communication satellite was successfully launched from Cape Canaveral Air Force Station on board a United Launch Alliance Atlas V 551

vehicle. The fourth satellite reportedly completes the geostationary ring, providing full global coverage.

“It’s good to return with our mission partners to see the culmination of expertise, skill and partnership that we have worked diligently toward to make this AEHF launch a success,” said Mike Cacheiro, Vice President of Protected Communication Systems at Lockheed Martin. “This is a substantial milestone for AEHF, and as we look ahead, we continue to improve and upgrade this mission to deliver these vital communications capabilities to the Air Force.”

The fifth and sixth AEHF satellites are well underway, as well as the upgraded mission planning ground system.

**Viasat brings artificial intelligence to the stage**

Artificial intelligence (AI) or machine learning may also have a role to play in the tactical communications systems of the future. Indeed, back in 2017, the US DoD described AI as ‘the most disruptive technology of our time,’ in a study in the operational environment and the changing character of future warfare.

In October 2018, Viasat announced the availability of secure cloud-enabled AI and machine learning applications



over its global satellite communications architecture and the line of sight (LOS) tactical network technologies for warfighters on the move. According to Viasat, by offering a secure, integrated network of cloud-enabled solutions, the company can reduce warfighters' cognitive loads in order to make more accurate, informed, life-saving decisions, faster, across the battlespace.

Viasat has completed a successful connectivity demonstration focused on bringing access to advanced cloud capabilities to the tactical edge. The demonstration showed how Viasat's satellite communications architecture and LOS tactical network can provide a holistic communications solution by integrating Link 16, mobile ad-hoc networking, Wi-Fi and LTE technologies to significantly enhance situational awareness at the tactical edge and fulfil emerging US Government Systems concepts of operation. Throughout the demonstration, Viasat's satellite network and LOS technologies provided a secure, high-speed, resilient backbone connection to link connected devices to media-rich AI and machine learning-based applications offered by a number of today's cloud technology providers.

"Viasat is partnering with global cloud computing leaders to bring advanced AI and machine learning-based operational capabilities to the warfighter—from predictive analytics and media rich intelligence, surveillance and reconnaissance data to prescriptive outputs," said Ken Peterman, President of Government Systems at Viasat. "Through Viasat's modernized end-to-end communications network, we will empower warfighters with advanced data-driven insights and operational capabilities that will allow them to make the most informed decisions possible - even in the fog of war. Today's demonstration shows the power of our SATCOM network and LOS innovations to deliver the next-generation Internet of Battlefield Things (IoBT) to significantly improve military readiness and mission effectiveness."

Viasat will provide ubiquitous and secure satellite communications required to access cloud-enabled military applications via its Hybrid Adaptive Network (HAN) concept. The HAN provides access to Viasat's end-to-end satellite innovations such as active cyber-defence, layered resiliency and elite satellite capacity to support a range of operations requiring IoBT and cloud-based applications. The HAN allows users to seamlessly operate across different networks (both government and private sector), creating an end-to-end layered, resilient network that is unique to Viasat and not offered by any other provider today.

### Evolving waveforms

Satellite technologies have come on in leaps and bounds in recent years, with incredible new capabilities being brought to fruition. However, when it comes to the future of tactical communications, the satellites themselves are not the be all and end all. We've been hearing about protected tactical waveforms (PTWs) for some time now, which will protect vital battlefield communications from adversarial jammers that intend to interfere with US satellite communications.

Towards the end of 2018, it was announced that the US Air Force was pressing forwards with the development of a more resilient PTW which enables anti-jamming capabilities within a protected tactical satellite communications system. The Air Force is reportedly expecting responses very soon

to its request for information from the satellite sector for protected satellite communications for use in benign and contested environments alike. As satellite plays an increasingly vital role throughout government and military sectors the world over, disruption of those capabilities has been on the rise.

"Tactical satellite communications are vital to worldwide military operations," the US Air Force told C4ISR net. "Our adversaries know this and desire to disrupt US satellite communications. The Air Force is fielding Protected Tactical SATCOM capabilities to ... ensure warfighters around the globe have access to secure and reliable communications."

We can expect to hear a lot more in the years to come as industry works in partnership with the US Air Force and other government agencies in order to bring this project, and others like it, to fruition. According to recent reports, early-stage trials for PTW capabilities in-flight have proven extremely promising.

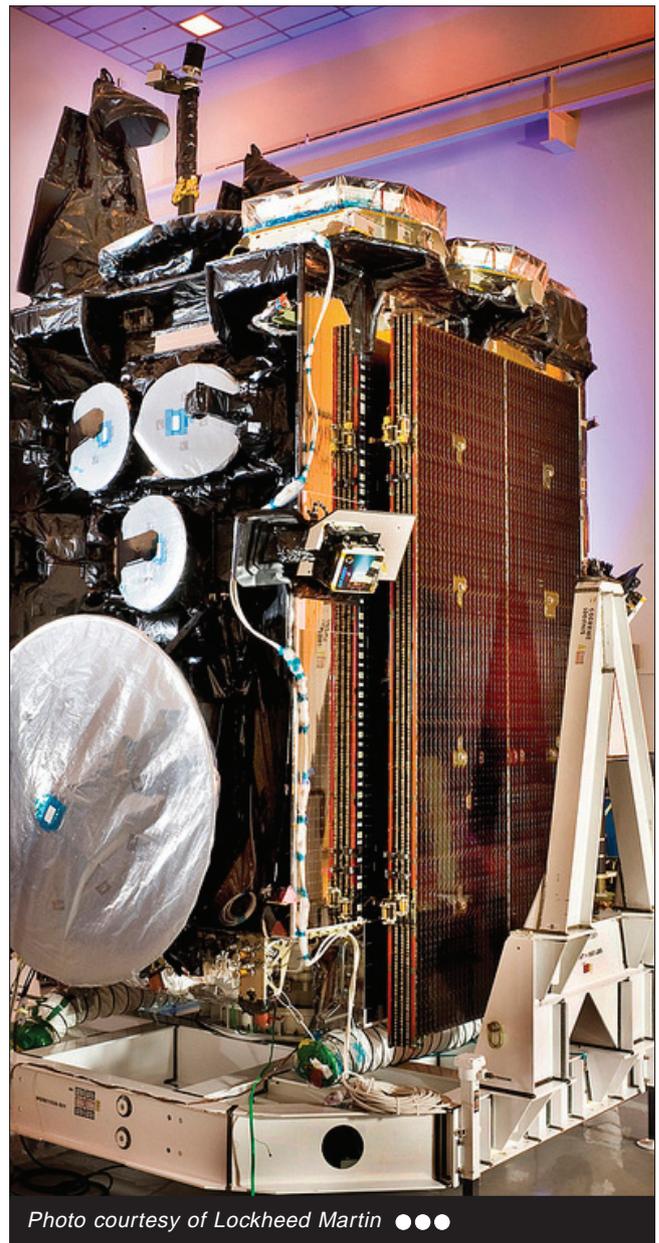


Photo courtesy of Lockheed Martin ●●●

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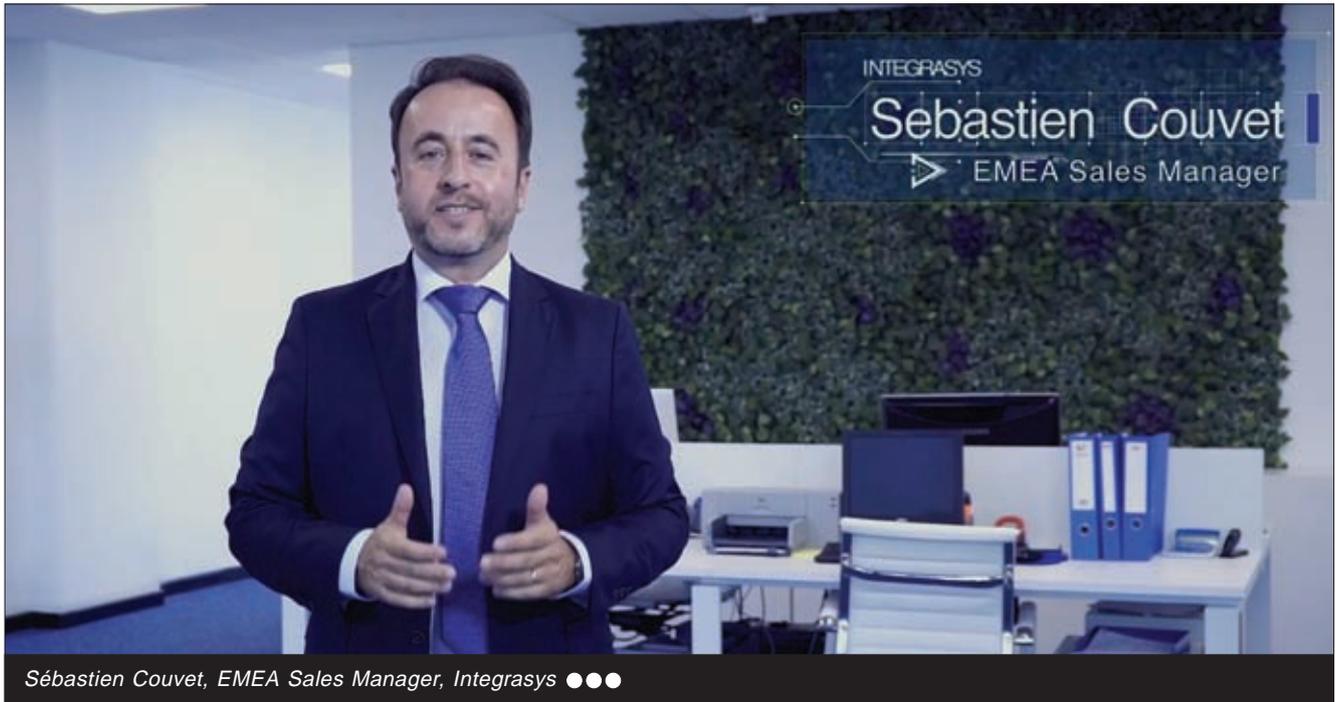


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## Maximizing efficiency in satellite communications

The satellite communications industry is one of the most complex industries, with huge levels of expertise needed throughout the chain. With an ageing workforce and increasing competition from other communications methods, it is clear that the industry needs to make itself more accessible and more efficient to retain customers and maximize return on investment. Sébastien Couvet, EMEA Sales Manager, Integrasys explains.

**Getting satellite communications right is an** involved process. Firstly, you need the right equipment in place to facilitate communication, keep the signal on-air, and watch for anomalies. Secondly, you need well-trained satellite engineers to operate the vast majority of that equipment. This is critical especially when it comes to error resolution as to the untrained eye, it can be nearly impossible to troubleshoot issues.

While satellite operators by their very nature have a large resource of satellite engineers, the business is changing and with it the profile of people within the company is moving towards more IT focused employees. Meanwhile satellite has a real challenge attracting new engineers and there is a gap between experienced satellite engineers close to retirement and potential new recruits fresh out of school or university.

This is going to cause real skills shortage in the coming years.

It becomes even more challenging when it comes to customers. Satellite users will very rarely have satellite engineers on hand. Even if they bring someone in to help with setup, it is unlikely full-time staff will be trained satellite engineers, which makes it much more likely errors will be made and difficult to solve in-house. This puts even more pressure on the satellite operators drafted in to solve network issues which are often easily avoidable.

### **Making satellite more accessible**

We are on a mission to make satellite more accessible and there are several areas of the satcoms workflow where automated tools can have a massive impact.

### **Buying/selling**

Currently when a customer needs to buy satellite capacity, they have to undergo extremely complex link budget calculations. These are really crucial in determining whether a specific satellite will be able to deliver the service needed. Even once that is determined, it is important to know exactly what gains and losses a signal will be subject to so that the right equipment can be put in place to allow for that.

Even with existing systems, this means inputting at least 50 different highly technical parameters. What's more once those have been collated and entered, the results are spewed out in such a format that they can only be read by someone skilled in understanding link budgets. If a company doesn't have anyone in house or has limited resource, this means that these calculations can take a long time to get done. The consequence of them not being done or being done incorrectly can be very detrimental to any ensuing service. Equally if a customer cannot do link budgets effectively,

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perhaps they will simply look at other communications infrastructures if satellite is not the only alternative.

We have developed a tool that simplifies and democratizes link budgets called Beam Budget. It is so easy both to use and to understand the reports generated that literally anyone can do it. Being highly accurate it ensures that the right satellite capacity is selected and will be able to deliver the results needed by the customer.

### Setup

When it comes to setting up a terminal on a satellite network, there are a myriad of things that can go wrong and cause loss or degradation of signal. The biggest mistake often is pointing to the wrong satellite. For someone setting up, especially of not a trained satellite engineer, it is very challenging to be sure the pointing is accurate. However, the repercussions of getting it wrong are huge because you are suddenly sharing frequency and causing satellite interference. This in turn means your signal won't be as good as it should be, and you will also affect others on that satellite. Of course, at some point after setup this is normally discovered due to the poor quality but if the terminal is remote, the cost of getting someone to get out there and correct it can be huge.

One of the first tools we brought to this market was our Satmotion Pocket tool and it is still one of the most popular. It is a really simple way of using an app on your mobile phone to make sure the antenna is pointing to the correct satellite. It makes commissioning so simple that literally anyone can do it, while ensuring perfect accuracy.

Following its huge success, we introduced Satmotion SNG which enables automated and quick line-up for those occasional use services, such as Satellite Newsgathering.

### Monitoring

Even once the correct satellite capacity is purchased and the antenna setup accurately, it is all too easy for things to go wrong with satellite transmissions which in turn can lead to satellite interference or a degradation of signal. This can be caused by a number of varying factors, such as:

- Your terminal is on the move and loses the satellite as it travels;
- Someone else points to your satellite by mistake and causes interference on your service;
- Extremes of weather affect your signal; and
- Someone mistakenly alters parameters at the terminal.

All too often satellite antennas are setup then left to their own devices with errors only spotted when the service becomes affected. Decent monitoring however means that those errors can be spotted before they have any significant impact meaning that for a consumer watching a TV channel or using a broadband service, for example, they will never even know there was a problem. This only works with continual automated monitoring of all networks, either for the satellite operator monitoring all sites on the network or for the uplinker needing to monitor their own terminals and installations.

Our Controlsat solution enables efficient management and operation of NOCs worldwide in real-time. Using Controlsat means fully automated monitoring for multiple satellites and

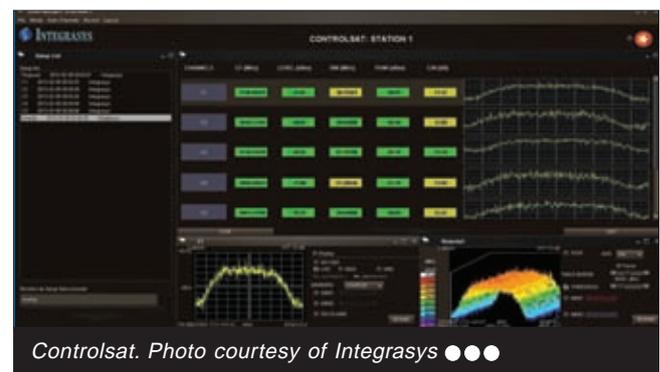
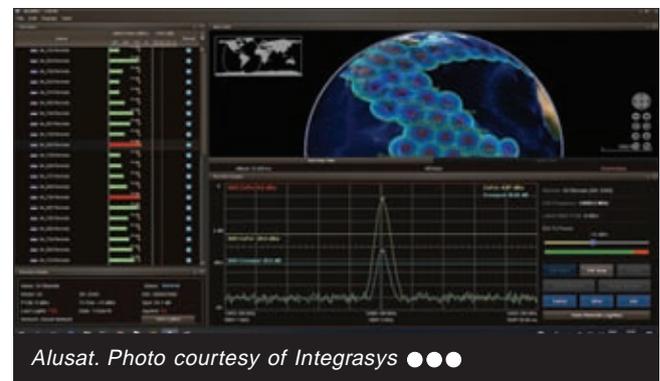
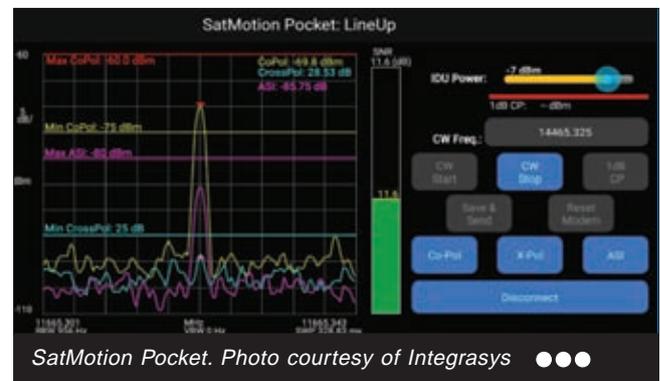
beams remotely from the main NOC. It has an easy-to-use interface and has proven to save our customers OPEX.

For VSAT terminals, we have Alusat which enables continual monitoring of a VSAT site after installation. It reduces the cost of service failures and site re-visits by allowing a virtual visit to every site on the network.

We even have a separate tool to detect, record, and solve any possible satellite interference. Vectorsat is again fully automated and able to detect and solve interference in real-time.

### Efficient satellites

Ultimately, the more we can automate satellite operations, the less room for error, which in turn saves both time and money for satellite operators and their customers. In a world where satellite is under threat from a myriad of other connection possibilities and consumers have no patience for degradation or loss of service, it is more important than ever that we maximise the efficiency and ensure consistent quality in satellite communications. We are continually innovating to find new ways to do just that for the entire satellite industry.



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Azerspace 2. Photo courtesy of Azercosmos ●●●

## Broadcast via satellite: The end of an era?

Satellite TV, whether free or paid for, is one of the oldest and most well-established markets for the satellite sector the world over. This traditional stronghold in an otherwise rapidly-changing environment has, in recent years, seen a great deal of change, as consumer demands change, and linear TV loses out in the popularity battle with video on demand (VoD) services.

**The direct to home (DTH) television market**, which sees content beamed into individual homes by means of a satellite antenna installed on the house, is one of the most traditional and well-established satellite markets in the world. The first public satellite TV signal moving content from Europe to North America over the Telstar satellite was recorded in 1962, but the industry didn't really take off until the 1970s. Early systems were pretty pricey and came complete with large antennas, but both prices and antenna sizes have fallen over the years to reach today's affordable packages.

Anecdotally, some of us even receive free satellite TV. It wasn't until I had already moved into my current property that I was informed that the previous owner had cut all the traditional broadcast TV cables and replaced them with a Freesat antenna; all the same free HD broadcast TV channels available in the UK, but via satellite.

The DTH market has been great for the satellite sector over the years. TV has become commonplace in the vast majority of homes in the Western World, with many of us having anywhere up to four TVs in our house, spread between the living room, bedrooms, kitchens, and even bathrooms. With consumers lapping up free to air and paid for satellite

TV packages alike, each additional channel being broadcast requires more satellite capacity. The move from SD to HD and even 4K, too, has seen a staggering increase in capacity demand for DTH TV, which has only been somewhat mitigated by new compression technologies.

### Down, but not out

We all know that with the advent of over the top (OTT), IPTV and VoD, the TV sector has seen a great deal of change over the last decade. Free-to-air or paid-for broadcast television programming, an essential lifestyle staple in hundreds of millions of homes the world over, has slowly lost market share to incumbent technologies which offer more in the way of choice. The ability to choose from more content than ever before, at a time that is convenient to the individual, rather than scheduled, and on any device of choice, be it laptop, tablet or Smartphone, has proven hugely popular among viewing audiences everywhere. It's said that we're consuming more content than ever before in history, but in newer, more convenient ways.

In a report published in September 2018, Euroconsult stated that it expects satellite operator revenues to move away



Eutelsat QUANTUM - the future of satellites ●●●

from DTH towards telco and data-driven traffic, with telecom applications surpassing video applications by 2021 – just two years away from now. This change has been attributed to the growth of broadband services on NGSO and high throughput satellite (HTS) systems, and the influx of low-cost capacity that has accompanied this. Indeed, total satellite capacity is expected to grow eight-fold from 1.3Tbps in 2017 to almost 10Tbps in 2022.

“Innovations in technology, services and in the ecosystem will make satellite connectivity relevant in the context of the

communication sector of the 2020s, that will see the spread of terrestrial 5G and the rollout of a wider range of communication services, either between humans or driven by IoT exchanges,” said Pacôme Révillon, CEO of Euroconsult. “In the short term, the impact on legacy services and the related pressure on the economic performance of operators could be unfortunately described as a necessary pain and is certainly no different from the cycles observed in other industries navigating a breakthrough innovation period.”

So, it's not necessarily bad news for DTH providers, more of a shift of focus to newer and more exciting applications, such as 5G, IoT and bridging the digital divide. Indeed, there's still a lot of room for expansion in the DTH sector; there remain significantly underserved markets in much of Asia, Africa and the Americas; booming expat communities in many parts of the world desperate for programming from back home; in many areas, the shift from SD to HD, and the accompanying increase in satellite capacity demands, has only just begun, let alone the next move to 4K/UHD and, ultimately, 16K.

Other market reports have also supported this notion. ResearchAndMarkets.com's 'Global Pay TV and SVOD Market 2018-2023' report expects pay-TV and subscription video on demand (SVOD) subscriptions to grow from 1,372 million at the end of 2017 to 1,877 million by 2023, a 37 percent increase. SVOD subscriptions are expected to more than double during this period, while pay-TV subscriptions are only expected to grow by 94 million subscribers. However, in the current age of OTT, IPTV, VoD and the ability to all too

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easily gain access to pirated content, 94 million more pay-TV subscribers must be seen as a win.

Regionally, the USA's pay-TV and SVOD subscriptions will grow from 222 million to 289 million during 2018-2023, with pay-TV subscriptions falling by 10 million to 80 million, and SVOD subscriptions growing from 132 million to 208 million.

During the period, China is expected to add 171 million subscriptions, including 32 million pay-TV and 138 million SVOD. Meanwhile, India is forecast to gain 49 million pay-TV subscribers between 2018 and 2023.

### The evolution of broadcast satellites

For satellite operators, there's still a lot of value in the traditional free to air and pay-TV DTH sectors, with new satellites with payloads dedicated to these markets still being regularly launched. However, due to the market changes, and the drop-off of traditional broadcast TV growth, satellite operators are increasingly looking to hedge their bets.

Some operators are going for mixed application satellite designs that cater to both the broadcast and telecommunications sector, for example, back in September 2018, the Azerspace-2/Intelsat 38 satellite was launched from

French Guiana on board an Ariane 5 launch vehicle. Azerbaijan's third satellite, manufactured by SSL, provides coverage over Europe, Central and South-west Asia, the Middle East and Tropical Africa, and will offer enhanced capabilities, specifically for growing demand in the region for DTH services, as well as government and network services. The US\$190 million satellite is expected to bring around US\$400 million in revenues to Azerbaijan's economy.

On the other hand, other operators are opting for flexible satellites with software-defined payloads that can be reshaped throughout the lifetime of the satellite, from down here on Earth. Eutelsat QUANTUM is one such satellite; created in partnership with Airbus Defence and Space and the European Space Agency (ESA) and due for launch in the second half of 2019, the 'chameleon satellite' marks a revolutionary step forwards with unprecedented customisation and flexibility. While Eutelsat QUANTUM will primarily address markets, which are highly changeable and mobile, such as communications on the move, data networks and government users, with the amount of change we're seeing in the broadcast sector right now, software-defined satellites may soon come into play in the DTH markets as well.



The DTH market has been great for the satellite sector over the years ●●●



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Andy Tafler, President of CPI's Satcom & Medical Products Division ●●●

# Q&A

## Staying at the leading edge

The Satcom & Medical Products Division of Communications & Power Industries (CPI Satcom) is a world leader in uplink amplifier products and systems for satellite communications. The company has played a vital role in the satellite industry since its inception, having supported the first satellite projects, INTELSAT and CONUS. To date, CPI Satcom has shipped more than 50,000 high power amplifiers (HPAs) to more than 150 countries. Andy Tafler, President of CPI's Satcom & Medical Products Division, opines on recent developments in the satellite sector and the company's position looking ahead.

**Question: 2018 was a busy year for CPI Satcom. What can you tell us about the company's key achievements during the year?**

**Andy Tafler:** During 2018 we continued to work hard to stay at the leading edge of both solid state and VED-based satellite amplifiers. This included products at the new V-band frequencies, expanding our portfolio of IFEC KFRUs and transceivers, and expanding and updating our now extensive solid-state product line with GaN technology.

**Question: There's a lot of change in the satellite sector right now, with high throughput satellites (HTS) moving on to extreme throughput**

**satellites (XTS), and new trends in small satellites and mega-constellations. What are the emerging opportunities for CPI Satcom in all of this?**

**Andy Tafler:** New systems, such as those necessitated by the advancement of XTS, small satellites and mega-constellations, often require from their uplink HPAs higher frequencies, higher volume production, more output power, more compact size, less weight, or some combination of the above. In addition, these systems may demand new interfaces and monitor and control capability. While the basic principle remains the same with the new systems as with the existing systems – for HPA manufacturers such as CPI to amplify a signal at a certain frequency for uplinking to a satellite – these stringent requirements for new systems can offer both considerable opportunities and challenges for HPA manufacturers.

CPI Satcom is working diligently in all these areas to take advantage of the opportunities, and we believe we are well-positioned to help our customers succeed. We also benefit from being the only HPA manufacturer able to utilize both GaN solid state and travelling wave tube technologies to fulfil our customers' needs in existing and new market opportunities.

**Question: With so much change in the satellite sector, what can you tell us about the impact on CPI Satcom's existing markets?**

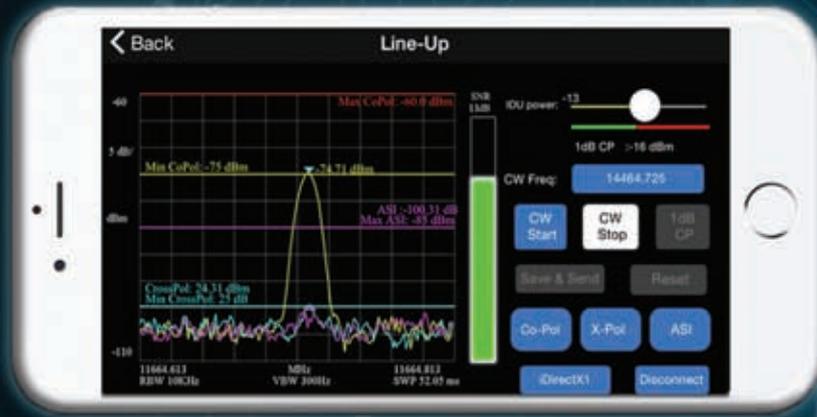


CPI TWTAs come with advanced graphical user interface. Photo courtesy of CPI Satcom ●●●



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**Andy Tafler:** As we have all seen, the amount of change that is going on in the industry has simultaneously created a bit of paralysis in the industry. There are so many divergent new opportunities for transmitting data, that no one opportunity has emerged as a winner yet. We believe that this uncertainty has created pent up demand for satellite communications products, and it seems that the industry is creating an enormous amount of supply, with the reasonable hope that demand will catch up. How quickly demand catches up might depend on the price of transmission, which could potentially drop considerably as investors look for the new constellations to realize their promised revenue. We therefore expect a steady increase in demand for satellite communications products, especially as long as world economies continue to grow.

**Question: The antenna market is moving on in leaps and bounds as electronically steerable and phased array antennas enter production. What's your take on these developments?**

**Andy Tafler:** The GEO satellite Direct-to-Home TV and Internet services, for example, became successful because the customer premises equipment (CPE), including earth station antennas and RF electronics, could be produced very cheaply. This was necessary to

ensure that households could easily afford to absorb the amortized value of their CPE.

The advent of LEO and MEO systems has generated a similar need for low cost user terminals in order to ensure high subscriber penetration levels. However, unlike the GEO scenario, current LEO and MEO systems are in dynamic orbits and require stringent pointing and tracking characteristics for the subscriber terminals. Mechanically steered antennas, such as the antennas produced by CPI, excel at both of these requirements, thus making them very suitable for professional, high capacity use.

That sophistication, however, does not come at a price point that could be considered affordable for consumer offerings. Phased array antennas offer the promise of eliminating the mechanical steering, thus simplifying pointing and tracking challenges, and possibly extending the useful life of CPE systems. While this technology is promising, it is still not fully mature and will likely be unable to match the currently desired price points. However, for niche applications such as in-flight-connectivity (IFC) where the low-profile characteristics and electronic steerability of phased array antennas may offer benefits, these antennas may see significant growth as they continue to mature.

**Question: We're hearing more and more about higher frequency devices, with new V and Q-band products already hitting the shelves. Will CPI Satcom be getting in on this action?**

**Andy Tafler:** Of course. In order to thrive as a company, we must keep up with the latest technology demands so that our customers can retain their technological edge, as well. Although we cannot publicly provide much detail at this time, let me just say that we are already fielding inquiries for these products and are working on solutions. CPI Satcom is well-versed in both solid state and TWT amplifier technology, and we expect both technologies to be in high demand at the new frequencies very soon.

**Question: In terms of new products, what is CPI Satcom working on right now?**

**Andy Tafler:** CPI Satcom is continuing to build out our GaN-based solid state product line, with high power in traditional frequencies, as well as our previously-mentioned forays into Q and V-band for both TWTAs and SSPAs. As technology continues to advance, we are always looking for ways to improve our existing product lines, such as we did when we debuted our patented LifeExtender/LifePredictor technology.

CPI Satcom also continues to look at opportunities for adding value to our amplifier product lines with the incorporation of block upconverters into our HPAs, as well as optional interfaces such as fibre optics for higher frequency applications.

**Question: What's on the cards for CPI Satcom in 2019 and beyond?**

**Andy Tafler:** Industry-wide, the race is on to be the first HPA manufacturer to offer proven, field-tested products in the higher frequency bands, and then to be able to reach high-capacity manufacturing to meet the schedules of the new, large constellations. This may be a daunting task for some companies who are used to job-shop type production, but this is a familiar and welcome challenge for CPI. We have shipped hundreds of SSPAs and TWTAs to individual programs without sacrificing quality, and we know we will be able to continue to do this in the future. Success is in sight. 🌟



*Orbital Systems LLC, a unit of the Antenna Systems Division of Communications & Power Industries LLC (CPI), designs and manufactures high performance antenna systems ranging in size* ●●●





*IUU fishing threatens the food and income supply of roughly 2.6 billion people, particularly those living in coastal communities, and is one of the primary drivers of global overfishing. Photo courtesy of Hexagon Geospatial ●●●*

## Tackling illegal fishing with analytics and geospatial data

Illegal fishing is a major problem in many parts of the world, significantly impacting both the environment and those of us reliant on the fishing industry as a source of income and sustenance. Earth observation satellite data is currently being utilized by a number of companies to tackle this problem, with interesting results. Nele Coghe, Product Marketing Manager at Hexagon Geospatial, outlines the Capgemini solution as a proof of concept for tackling illegal fishing.

**All around the world, governments are facing issues** around illegal, unregulated and unreported (IUU) fishing. Regulations already exist to combat IUU fishing, but authorities have not historically been able to quickly identify instances of the practice. In the age of satellites and the availability of extensive maritime data, regulations and authorities are starting to actually pose a challenge.

Capgemini has created a conceptual solution that could be used to help monitor and combat IUU fishing, but before looking at these detection technologies, it's worth examining the real-world effect of illegal fishing to understand just how seriously the issue should be taken.

### **The human, environmental and economic costs of IUU fishing**

According to the Food and Agriculture Organization of the United Nations (FAO), the livelihoods of 12 percent of the world's population depend directly or indirectly on fisheries and aquaculture. That amounts to roughly 2.6 billion people who depend on fish as an important part of their diet or as a

key source of income. IUU fishing threatens the food and income supply of all these people, particularly those living in coastal communities. For a sense of just how much illegal practices take away from the industry, it is estimated that IUU fishing costs up to US\$36.4 billion each year.

A main reason why this threat is so pressing for large communities around the world is because IUU fishing is one of the primary drivers of global overfishing. Overfishing threatens marine ecosystems along with putting food and regional stability at risk. IUU fishing has also been identified as going hand-in-hand with organized crime in several parts of the world such as Indonesia. In addition to those factors, IUU fishing has well-known ties to human trafficking and other human rights violations. Charities, such as Human Rights At Sea, have been set up in an attempt to raise awareness, implementation and accountability of human rights provisions in the fisheries sector.

The environmental impact of IUU fishing is just as devastating. One example is the Gulf of California, which accounts for nearly 75 percent of Mexico's total annual fish



*The Capgemini solution was created to fight abusive fishing practices and quota bypass when ships transfer fish from one to another before going back to port, a practice known as transshipment. Photo courtesy of Hexagon Geospatial ●●●*

catch. Illegal overfishing is being blamed for severe declines in the number of wildlife such as sharks, rays and other fish in this area. Equally, illegal fishing also includes inhumane methods by which fish are caught and how fish are handled after they are caught. Destructive fishing methods – illegal and heavily regulated in most parts of the world – are still widely practiced. Methods including cyanide poisoning and dynamite fishing make fish easy to catch but destroys their habitats and contributes towards global warming.

These damaging fishing methods are often combined with the transshipment of catch at sea from fishing vessels to refrigerated cargo vessels, which is used to obscure the origin of a catch in order to mask illicit fishing practices. Identifying transshipment is therefore key to tackling IUU fishing. Transshipment can take place anywhere, although recent research suggests that most transshipment events take place on the high seas (35 percent) or in the Russian Exclusive Economic Zone (39 percent).

**Countering transshipment**

There may be laws and regulations in place that outlaw IUU fishing practices but given the size of the maritime industry and international fishing fleets, identifying and disrupting illegal fishing practices appears to be an insurmountable challenge.

Due to the overabundance of data, regulatory control and

*‘Capgemini has created a conceptual solution that could be used to help monitor and combat IUU fishing, but before looking at these detection technologies, it’s worth examining the real-world effect of illegal fishing to understand just how seriously the issue should be taken.’*

monitoring of transshipment is difficult for authorities.

Automatic Identification System (AIS) data services provide access to information on the movements and positions of hundreds of thousands of commercial maritime vessels, especially when supplemented with Satellite AIS data (S-AIS), which can identify vessels without active AIS transponders. At the same time, the rapid growth in satellite imagery coverage, both from traditional and microsat operators, means that a vast amounts of imagery data is now available. When data on national and international fishing policies, navigation rules and past transshipment behaviour is added into the mix, it can become almost impossible for analysts to spot suspicious behaviour unaided.

This overabundance of data is the reason why Capgemini developed a demonstrator solution which deploys algorithmic analysis to help analysts spot suspicious activity. This solution was created to show a European country fishing agency how to fight abusive fishing practices and quota bypass when ships transfer fish from one to another before going back to

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Algorithms are applied taking into account parameters such as distance between ships and operation time intervals. Photo courtesy of Hexagon Geospatial ●●●

port. The solution uses Hexagon Geospatial's Luciad Lightspeed desktop software to provide a base capable of visualizing global AIS data while also providing an interface that allows analysts to navigate through this dataset by moving back and forth in space and time.

The algorithms are rule-based, and can see abnormal behavior based on the distance between ships and the amount of time spent by ships in any one location. Parsing millions of individual positions, the algorithms are able to point out where two ships have been close to one another (less than 'x' km) for an extended period of time (more than 'y' minutes). As commercial ships rarely spend extended periods of time near or alongside each other, these kinds of anomalies are often indicators of transshipment. Additional layers of data can then be used to filter and refine the analysis of suspicious behaviours, such as vessel traffic navigation rules, and national and international fisheries policy zones.

Analysts are then able to add satellite imagery layers through the application to investigate further and provide more detail on the vessels involved. This can have the added benefit of showing if any ships without active AIS transponders are involved in areas without S-AIS coverage. The AIS data, weather data and images are gathered via image provider either as raw files or live web services. Capgemini uses openly available data; however, the solution can use any type of common satellite picture.

**Data in action**

Modern analytical tools should mean that IUU fishing is predictable and preventable, however achieving this successfully still relies on a multitude of human factors. First, authorities need to engage with local fishermen to become a trusted and reliable source of information on suspicious activities. Second and perhaps more challenging, is the interaction between individual states, vessel masters and ship-owners. It is no one individual's sole responsibility for implementing these processes and systems, and all parties must play their part in reporting each incident that occurs. Authorities are unable to predict, counter and prevent crime if they don't know about the crimes that are taking place. Utilizing technology to combat IUU fishing has a proven

'This overabundance of data is the reason why Capgemini developed a demonstrator solution which deploys algorithmic analysis to help analysts spot suspicious activity.

This solution was created to show a European country fishing agency how to fight abusive fishing practices and quota bypass when ships transfer fish from one to another before going back to port.'

record of effectiveness. As highlighted in a paper entitled 'Ending hide and seek at sea,' published in the March 11, 2016 edition of Science, researchers from the University of California at Santa Barbara used AIS data to watch fishing activity in the Phoenix Island Protected Area. The Republic of Kiribati closed the area on January 1 2015, and as fishing vessels fled the sanctuary, the researchers reported one incursion to officials who arrested and fined the vessel. Bearing in mind that these researchers were at a university 4,326 miles away from the site, highlights just how powerful these tools can be when properly optimized. The Capgemini demonstrator works on the same principle, but it pushes the idea globally and adds abnormal behaviour analysis to the mix.

IUU fishing poses a serious threat to the economy, environment and livelihoods of fishermen around the world. When data and algorithms are employed appropriately, alongside efforts to engage all parties involved in the fishing supply chain, there is a greater possibility that IUU fishing could be neutralized.



The robust and powerful LuciadLightspeed interface allows users to navigate through complex data sets moving back and forth in space and time. Photo courtesy of Hexagon Geospatial ●●●



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Las Vegas. Photo courtesy of Earth-i ●●●

# Q&A

## Observing the Earth

Earth-i is one of Europe's most prominent NewSpace companies supplying high resolution image data and analytics services to clients across the globe. The company's vision is to provide Earth Observation based analytics and insights to unlock answers to the most challenging questions - and drive decisions about how we manage our world. Richard Blain, CEO at Earth-i, discusses EO applications in a NewSpace era.

**Question: Can you provide an overview of Earth-i's current capabilities and expertise?**

**Richard Blain:** Earth-i is a NewSpace company at the forefront of the commercialisation of space. We provide an end-to-end service that encompasses data acquisition and processing, and the advanced analytics that deliver meaningful and actionable insights to our clients in government and industry.

The company was set up in 2015 as a leading distributor of very high-resolution data from the DMC3 Constellation. Since then, we've added several other constellations to our portfolio of Earth observation satellites, including KompSat and SuperView, to deliver very high and ultra-high resolution optical and radar data from space.

We work with a wide range of customers worldwide to acquire, process and analyse the image data from these satellites, applying

advanced algorithms, machine learning (ML) and artificial intelligence (AI) to derive the critical insights and solutions that enable better policy and decision making.

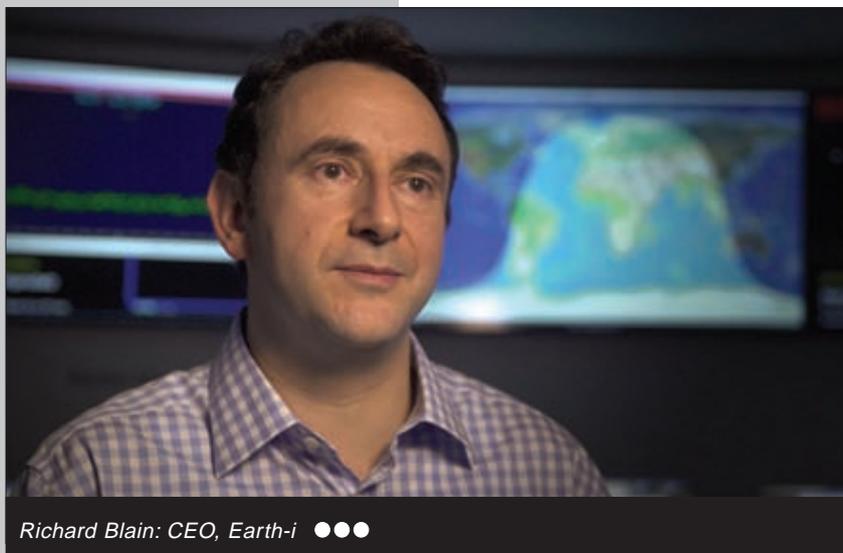
From 2020, we will deploy the first batch of satellites of our own constellation called Vivid-i – the first commercial constellation to provide still imagery and full-colour HD video imagery. This steady stream of high spatial and temporal image data will power even more powerful insights into the impact of human life on planet Earth.

**Question: Earth-i has long-standing plans to deploy its own constellation of small Earth observation satellites, starting in 2020. What can you tell us about this constellation, plans for launch, and how the imagery will be used?**

**Richard Blain:** The view we take is that to fulfil the needs of our clients, it's vitally important we have our own source of high-quality data. That doesn't mean we won't continue using third party sources of data, but, by having our own assured supply of very high-resolution Earth observation data, we can provide levels of assurance in terms of answers to our clients that are valuable to them.

January 2018 saw the successful launch of our VividX2 satellite, a service demonstrator for our constellation, Vivid-i. This new constellation will be the first of its kind to provide full-colour HD video; and the first European-owned constellation able to provide both video and still images.

Vivid-i will be a major leap forward for the Earth observation industry, significantly increasing the ability of companies and institutions to monitor, track and analyze activities, patterns of life and changes at any location on Earth. It will provide a number of



Richard Blain: CEO, Earth-i ●●●



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- Rapid tasking of satellites to take images or video, and fast data download within minutes of acquisition.

Footage will be available for analysis within minutes of being captured and will improve decision-making and response times in a wide variety of scenarios from change detection to object identification, from disaster response to infrastructure monitoring.

Earth-i will initially launch 15 satellites in batches of five in three different polar orbits. Once the constellation is complete, we will be able to visit any location on Earth at three different times of the day, every day. Further batches of five satellites can then be added according to customer demand.

**Question: Earth-i delivered its first full-colour video of Earth from space back in April 2018. What are the challenges in delivering full-colour video from space?**

**Richard Blain:** Capturing video from space isn't easy, otherwise many other companies would probably already be doing it. It is difficult, it is challenging, and I think sometimes we have to pinch ourselves a bit that we are doing something that is truly ground-breaking.

Just considering the physics involved is mind-boggling. VividX2 orbits the Earth at around 7km/s while the planet is rotating 500km below. The satellite needs to constantly adjust its position to stay focussed on the same area to record HD video and transmit it back to mission control over a two-minute period. However, we've got a very precise attitude control system – unusual in a satellite this size – that lets the camera stare very precisely at a target on the ground as it's flying over. This means we've been able to acquire

very stable video sequences of quite precise target areas of interest.

As well as the satellites themselves, Earth-i is also partnering with companies like KSAT to provide ground stations to download our data, and we will be building a new operations centre. The aim is to make the whole system as client-focussed as possible, delivering images of anywhere on Earth on-demand and within minutes of being taken.

**Question: Planetary Big Data is becoming increasingly important the world over. What's your assessment of the market potential, and future applications?**

**Richard Blain:** Earth observation data is becoming a major driver in the so-called 'Fourth Industrial Revolution' – the era of Big Data analytics. Given that everything happens somewhere, location data is the foundation on which many Big Data solutions are being built to drive better decision-making and policy thinking the world over.

We can integrate many, and diverse, data sources with satellite image and video data, from social media analytics to climate data, traffic and trade data, and the plethora of public datasets available on economic and human activities. But the mix of data utilised to create an insightful solution really depends on the customer question –

what kind of third-party data is most helpful in deriving the insights that answers a specific question for our customers?

Utilising ML and AI is fast becoming a critical part of the solution given the potentially enormous size and complexity of the Big Data cloud we have access to. In addition to our own satellite datasets and fast-growing base of free Earth observation data provided by Europe's Copernicus programme and the US Landsat satellites, ML and AI helps us to analyse these Gigabytes (and sometimes Petabytes!) of data within a tight timeframe and using algorithms to organize and analyse the complex datasets to an extent that is not possible by conventional methods. We can train the software with customer specific interests and target the desired insights very specifically to clients needs.

Digital elevation models are often required in analysing the context of the observed landscape/targets in any earth observation data sets. A fly-through is a virtual pathway through a landscape or built-up area where the elevation information is created from a digital elevation model and the colour of the landscape taken from a satellite image. Moving through this digital landscape and seeing colour and elevation in context will help with better, more accurate decision-making and



Earth-i team in the clean room. Photo courtesy of Earth-i



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planning for applications as diverse as urban management, to security planning to disaster response.

Taking motion video from space actually means very high frame-rate acquisition: Multiple images of the same locations from multiple angles as the satellite passes over the target whilst 'staring' at it. From these video sequences we can create our own very detailed digital elevation models (DEM) from the large amount of data, and from the many stereo image pairs (an image of the same feature captured from two different angles) we can collect. This allows us to calculate and model the elevations, depressions and contours within the landscape and height and shape of objects and features - a bit like humans see in 3D by having two images - left and right eye and looking at the objects from two angles.

**Question: In July 2018, an Earth-i led consortium has received a grant from the Centre for Earth Observation Instrumentation (CEOI), funded by the UK Space Agency. What can you tell us about the technologies you plan to develop with the grant?**

**Richard Blain:** This £2.7 million grant will enable us to implement our ACCORD product in Kenya and Rwanda, helping smallholder farmers address the challenges of climate change.

Coffee is the second most traded commodity globally and vitally important to many economies in the developing world. ACCORD was specifically developed to help smallholder coffee farmers in Africa improve crop quality and yield and drive up their incomes as a consequence. It combines satellite imagery with our partner WeatherSafe's local climate forecasting platform to provide alerts of changes in the weather that might then increase the danger of disease or pest occurring in the coffee trees. The alerts are sent directly to local agronomists and farmers via a mobile app.

This information helps farmers to identify the optimal time to apply agricultural inputs (for example, fertiliser, mulch, fungicides or pesticides) based on highly localised climate forecasts. Such timely information can make a critical difference to crop success given the

new levels of unpredictability in the local climate, and the potential impact of a range of consequences such as weather damage, pests, diseases, nutrient depletion or other factors which reduce coffee quality and quantity.

Agriculture is just one of a multitude of sectors where our imagery – and the insights drawn from those images – is improving lives on Earth.

**Question: This isn't the first move Earth-i has made towards developing new technologies in partnership with other companies; there's also the project with commodities broker and research house Marex Spectron, to develop and distribute a range of unique analytical tools. What can you tell us about this project, and progress made to date?**

**Richard Blain:** Earth-i's SAVANT is an information product for commodity traders, developed in collaboration with our partners at Marex Spectron. Very high-resolution satellite data mapping key copper mines around the world is acquired on a regular basis. Using advanced 3D modelling, volumetric analysis and mine activity monitoring, the algorithms unique to SAVANT produce regularly updated indices about the levels of production at each mine.

The results are correlated with other sources of production data to create an accurate measure of outputs and activity ahead of published production data. The goal is to provide traders with timely information and insights to inform critical trading decisions. It's a good

example of how the fusion of advanced image analytics with other data sources, can deliver new insights to help businesses improve decision-making in critical supply chains or strategic locations, anywhere on Earth.

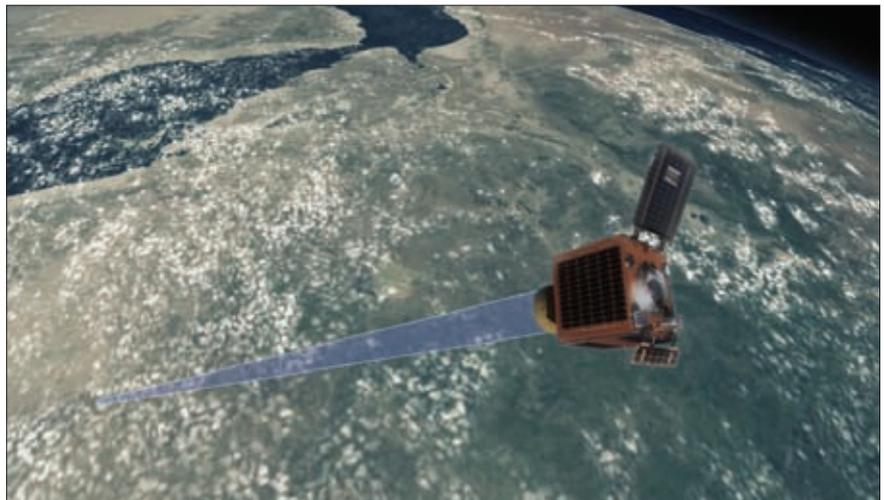
The prototype product is live and in end-user testing phase with our partners Marex Spectron, and a group of other interested companies in the sector.

**Question: Where do you think Earth-i will be this time next year?**

**Richard Blain:** We are now in countdown to the launch of our first batch of the constellation in early 2020. In the meantime, we continue to develop our analytics and insights capabilities and services, targeting a range of different market sectors, or responding to market demand for Earth observation-based big data analytics and information solutions.

As we can literally monitor or investigate any location on Earth on a daily basis, the possibilities are limitless. The challenge is to focus our energies and development on the sectors where Earth observation-based analytics and insights can truly unlock real value for our customers. With the growing recognition of the value of insights from data from space, there is no shortage of interested parties.

We're a well-funded, capable and confident business pioneering new technologies and solutions. The future is extremely bright as we cement our position at the forefront of the commercialization of space.

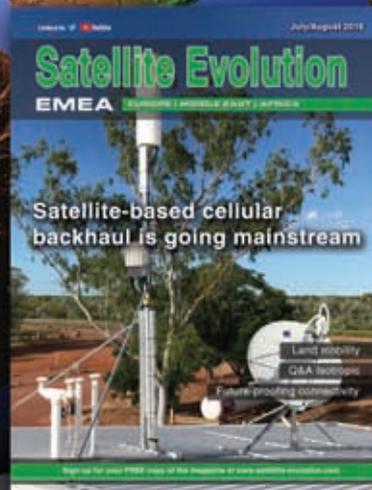
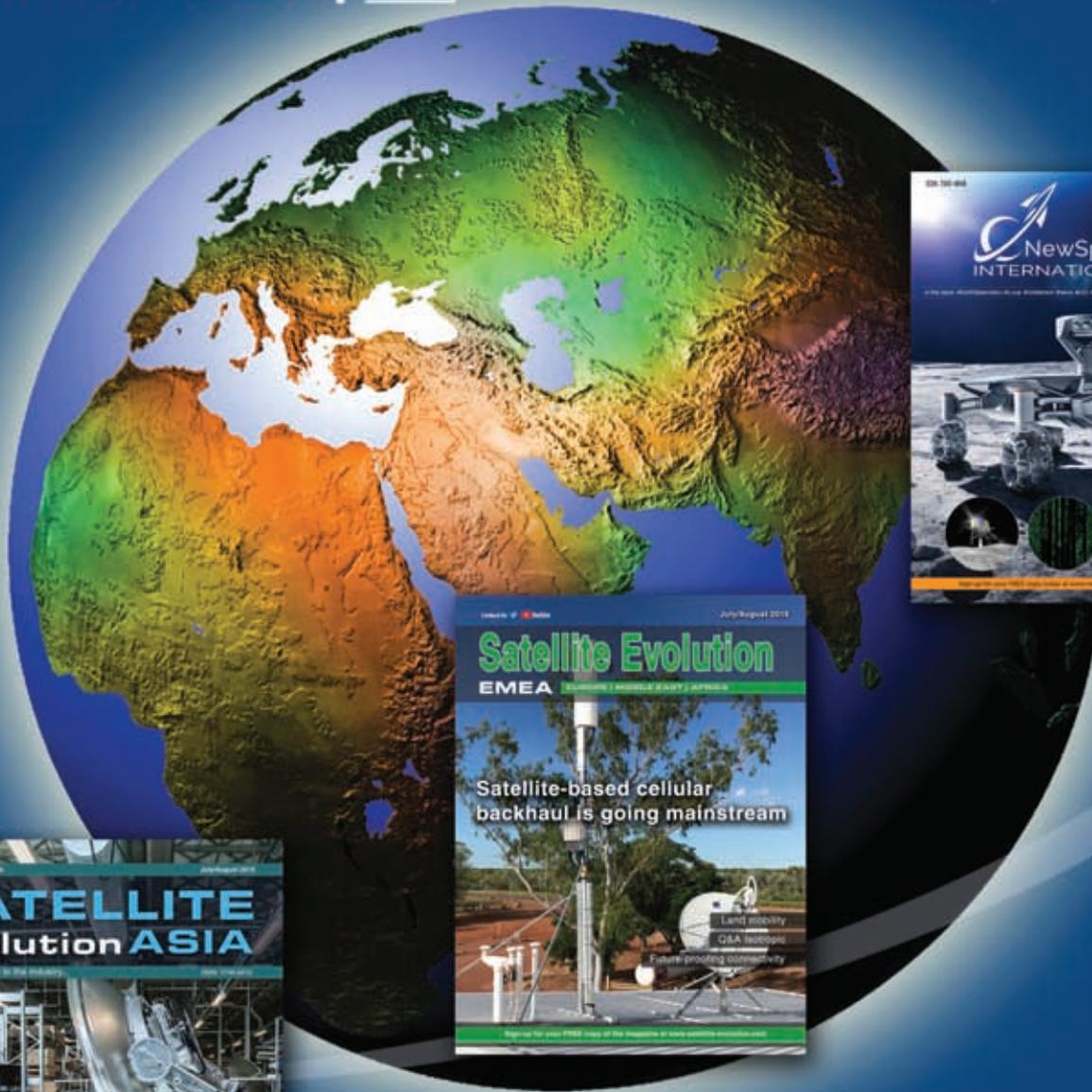


January 2018 saw the successful launch of our VividX2 satellite Photo courtesy of Earth-i ●●●



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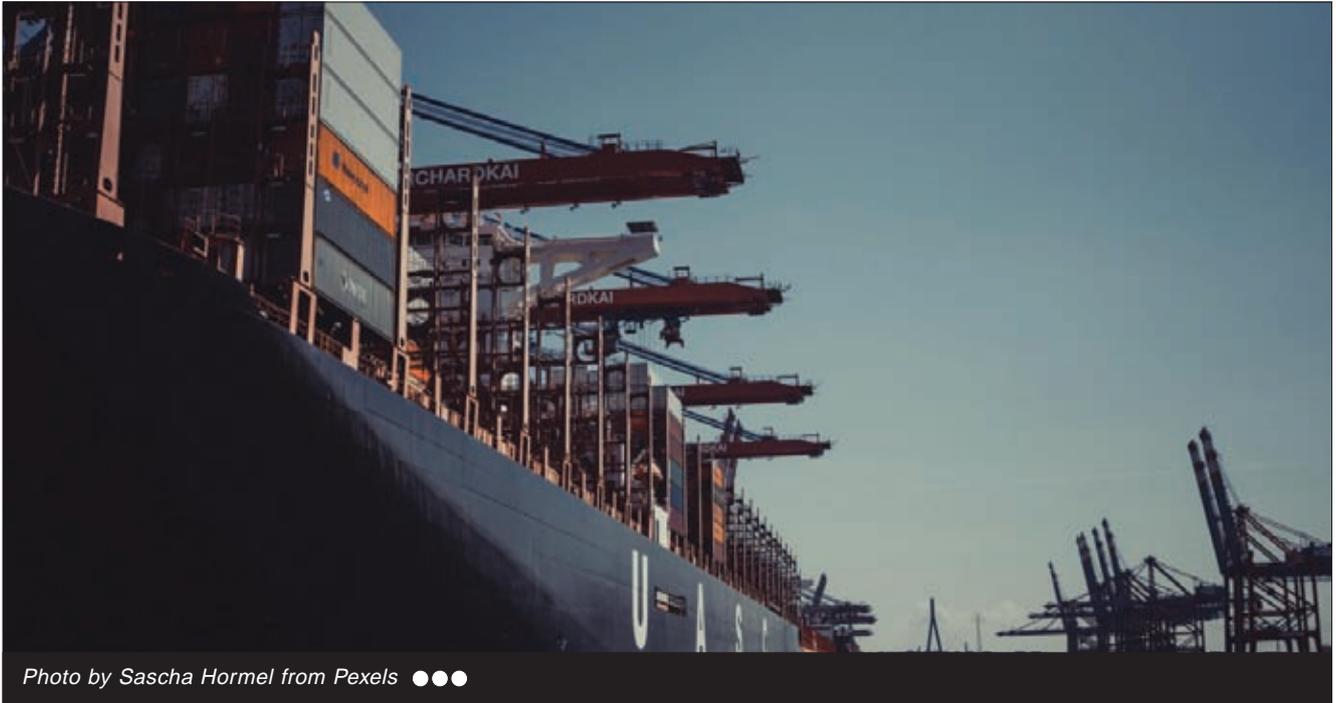


Photo by Sascha Hormel from Pexels ●●●

# Internet of Things tightens on shipping's environmental agenda

The Internet of Things (IoT) is fast rolling out the world over, with greater connectivity enabling new efficiencies in a whole host of areas. Indeed, recent research finds that the IoT may be winning over shipping's trenchant conservatism on new technology by delivering new solutions that ease rather than complicate compliance, as reported by Stefano Poli, VP, Business Development, Inmarsat Maritime.

**With environmental imperatives mounting, shipping's customary** schizophrenia concerning new technology has been laid bare in an Inmarsat Research Programme report that includes hard data on how far the industry sees Internet of Things (IoT)-based solutions as a gateway to sustainability.

In late 2018, shipping faces the need to comply with IMO's 2020 fuel sulphur cap, but also the target set out at the Maritime Environment Protection Committee in April to halve GHG ship emissions by 2050. In customary fashion, in facing the fuel sulphur cap, the industry has appeared split between those seeing advantage in developing an environmental edge and those driven largely by compliance.

## Compliance drivers

As far as 2020 is concerned, compliance is becoming the imperative. Recently-published International Chamber of Shipping (ICS) guidance, *'Compliance with the 2020 Global Sulphur Cap,'* suggests that companies running ships without Exhaust Gas Recovery (scrubbers) will need to order compliant fuels (0.5 percent sulphur content) from mid-2019. ICS also strongly recommends developing ship-specific

Implementation Plans as soon as possible.

Shipping's opinion divide on the environment as technology driver is very evident among 750 respondents to the Inmarsat research report 'Industrial IoT on land and at sea' (2018), which also drew on agriculture, energy, mining, transport and logistics, and fishing industry professionals. The data behind the exhaustive study has been re-visited to isolate prevailing attitudes towards the role of the IoT in achieving environmental goals.

Among shipping respondents, the report shows that environmental monitoring is seen by 46 percent of shipping participants as one of the most important drivers for deploying IoT-based solutions. The figure exactly matches the proportion established for all 750 respondents.

Around 34 percent of organisations across the supply chain already see improvements in sustainability through their use of Industrial Internet of Things (IIoT), and 43 percent expect to do so in future. At first sight, then, experience and outlook of shipping respondents is moderately behind the curve, with 30 percent characterising their organisations as achieving sustainability benefits by deploying IoT-based



Stefano Poli, VP, Business Development, Inmarsat Maritime ●●●

that the maritime industry – like no other constituency – includes a 14 percent rump of respondents who say that sustainability is not even one of their organisation’s aims for IIoT deployment.

In the cost-conscious world of shipping, it is surely more than coincidence that 14 percent of maritime respondents also believe that, even five years out, there will be no savings at all resulting from the adoption of IoT-based solutions. By way of comparison, some 54 percent of peers in the mass transit and inland distribution industries identify improving resource efficiency as a primary driver for IoT adoption.

In fact, left to their own devices, shipping respondents overall cite health and safety more often as an IoT deployment driver (in 54 percent of cases), and they do so in greater numbers than the wider transport group (50 percent) or respondents overall (46 percent).

However, as one of the world’s most heavily regulated industries and as outlined above, shipping is seldom if ever left to its own devices. Perhaps one of the most interesting findings in the new report, therefore, is that it shows environmental regulation working strongly in favour of IoT deployment. Where only 19 percent of respondents overall categorised meeting regulations as a main driver for IoT deployment, shipping respondents cited it as a main motivator in 39 percent of cases – the highest proportion given by any group.

The IIoT at Land and Sea report establishes that, despite its foot draggers, 47 percent of shipping respondents are collecting data for the purpose of environmental monitoring:

solutions, and 42 percent expecting to do so.

However, dig a little deeper, and shipping’s unremarkable level of recognition of the IoT as an enabler for sustainability overall is exposed as disguising its notorious divide between technology ‘progressives’ and ‘laggards.’ The ‘progressives’ are already showing themselves attuned to using IoT-based solutions as strategic tools to improve efficiency and enhancing energy usage. However, the new research shows



Photo by Kai Pilger from Pexels ●●●



This compares to 40 percent of respondents across the supply chain, and the same figure (40 percent) among wider transport industry respondents.

#### A focus on sustainability

With 69 percent of maritime respondents in the current survey counting themselves as reliant on satellite connectivity to support their IIoT-based solutions, Inmarsat has already shown itself as a willing and proactive partner in addressing fuel efficiency.

Notably, the satellite group has been working with Rolls-Royce to make the latter's Energy Management system available via Fleet Xpress. Recently, the satellite group also introduced Fleet Data, whose connectivity via the ship's VDR will enable real-time data analysis and decision-making, addressing a key point of resistance to IoT-based solutions identified in the Inmarsat report.

Nevertheless, shipping's distinctly average enthusiasm overall for sustainability as a driver for IoT deployment

contrasts strongly with the regulatory impetus to monitor fuel consumption that sees 65 percent reporting that they already use IoT-based solutions. An additional nine percent say they will do so within a year while, in an apparent commitment to meet regulatory obligations, deployment is projected as reaching 100 percent by 2023.

The preparedness no doubt reflects the fact that shipping is already required to meet the EU MRV (Monitoring, Reporting and Verification) scheme, while Fuel Consumption Reporting within the IMO Ship *Energy Efficiency* Management Plan is not far behind.

By April 2019, and by the same month in subsequent years, for example, verified annual emission reports must be submitted for every ship above 5,000 gt to the EC and the relevant flag state.

Given that shipping's place in the public consciousness is often limited to criticisms made after things go wrong, IoT tools that the industry itself identifies as easing compliance should be given priority by regulators.



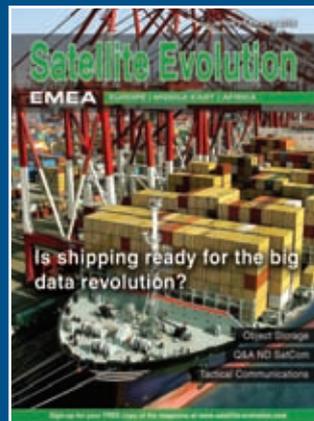
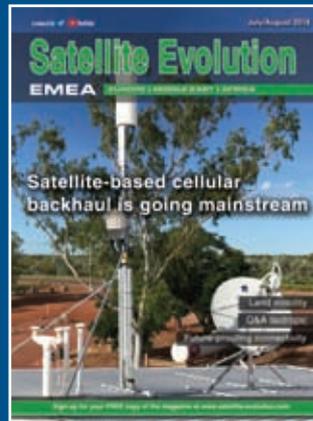
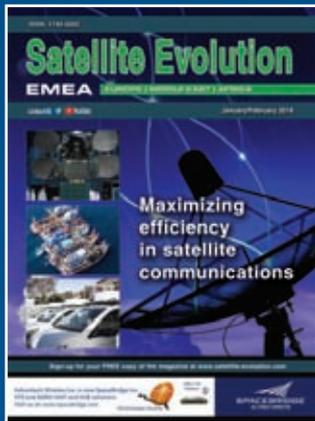
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