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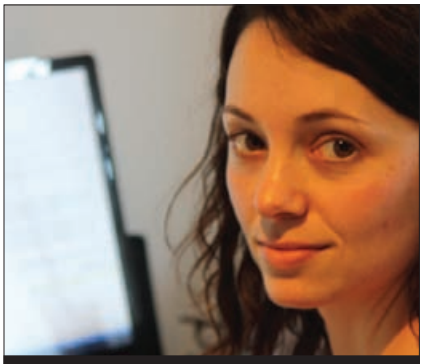

Editor - Amy Saunders

To boldly go where no man has gone before

Amongst the doom and gloom that is the UK-centric news this month – shortages of petrol, consumer goods, food and drink, unmanageable gas price rises, 100,000-strong shortages of HGV drivers, and rampant inflation – we also have some fabulous space-centric good news.

Indeed, Star Trek's infamous Captain James T Kirk, infamous ladies' man and intrepid intergalactic voyager played by William Shatner, has this month gone where no man has gone before in joining Blue Origin's second launch into space. The launch made 90-year-old Shatner the oldest person to travel to space to date. Shatner was accompanied by former NASA Engineer and Co-Founder of Planet, Chris Boshuizen; the co-founder of a software company specializing in clinical research, Glen de Vries; and Blue Origin's own Vice-President of Mission and Flight Operations Audrey Powers.

Earlier in the year, Shatner had gone on record dismissing criticisms of billionaires using their fortunes to go on 'joyrides' in space, stating: "It's their money. They can do what they want with it." After a short three-year tenure (1966-1969) as captain of the USS Enterprise, Shatner garnered a lifelong widespread affection from the general public and is extremely unlikely to face the same backlash as other celebrities and billionaires for daring to venture into space.

Following the successful launch and re-landing, Shatner is quoted as saying: "I hope I never recover from this." A rather more touching sentiment from the now world's oldest astronaut than we usually hear from this new wave of commercial space tourists. "I'm so filled with emotion about what just happened. It's extraordinary, extraordinary. It's so much larger than me and life. It hasn't got anything to do with the little green men and the blue orb. It has to do with the enormity and the quickness and the suddenness of life and death… To see the blue colour whip by you, and now you're staring into blackness … everybody in the world needs to do this. Everybody in the world needs to see this."

In this issue of Satellite Evolution EMEA, we've spoken with; ND SATCOM'S Alexander Mueller-Gastell about the company's new FlyAway terminal MFT 1500, due for debut at CABSAT; Richard Jacklin from ViaLite about the evolution of ground station technologies and the company's roadmap to higher frequency solutions; and Ross Hulbert of Spaceport Cornwall, which recently signed a significant deal with Sierra Space for a potential launch site for the Dream Chaser launcher.

Meanwhile, Telenor Satellite's Jan Hetland opines on selecting the right connectivity solution for vessels at sea, while Mark Steel, Director from Satcoms Innovation Group and Micro-Ant talks about the future of flat panel antennas and their pairing with LEO. Finally, we explore the continued attempts to bridge the digital divide in Africa following a huge number of new projects in 2021. ■

Photo courtesy of Blue Origin

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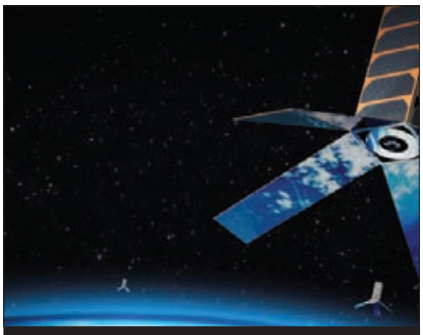
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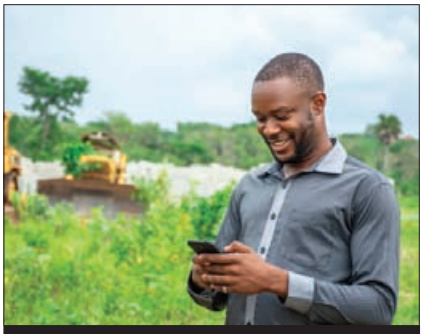
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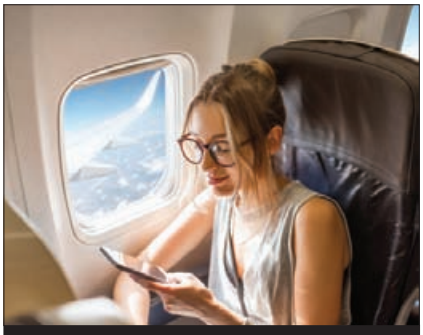
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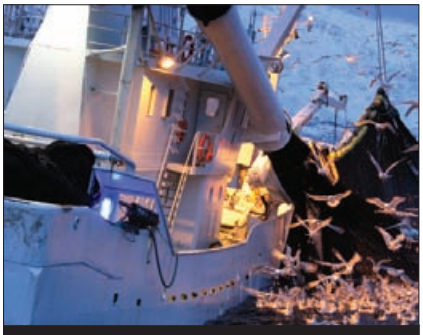
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Kymeta u8 antenna images courtesy of Kymeta Corporation.

Space agencies invest in Methera led low-cost user terminal programme

Methera is delighted to announce, in conjunction with the European, UK and Norwegian space agencies (UKSA, ESA and NOSA), the receipt of a •6.5 million grant towards a major and innovative programme to develop a family of low-cost satellite user terminals. This initiative will directly support the Methera constellation and other MEO, GEO and LEO systems. It will not only make Broadband Internet more accessible for all but also enable more innovative service opportunities through major cost, performance, and availability improvements. Methera has partnered with Global Invacom Ltd, Riverbeck Ltd and TSAT AS to create a strong and experienced consortium to design, develop and deliver the system.

The project will support the growth of a number of UK companies including those directly involved in the project and through the supply chain that will be created once the product goes to market.

Chris McIntosh, CEO Methera said: "Access to affordable and high-speed broadband connectivity anytime and anywhere in the world is a key Methera tenet; dramatically reducing terminal costs is therefore essential to deliver significant competitive and performance benefits to Internet connectivity service providers and, more importantly, to the ever-increasing population who fall on the wrong side of the digital divide.

"The support from ESA, the UKSA and the NOSA is a firm endorsement of our business strategy. This grant will accelerate implementation of the Methera Broadband Service and directly increase the utility of satellite broadband connectivity. In addition to the space agencies and our consortium partners, I must also thank the Seraphim Space Camp team for their excellent strategic advice and support, that directly assisted our grant application and approach."

Fabrizio De Paolis, ESA Technical Officer, added: "Methera's ambitions to play a major role in the satellite communications ecosystem are well justified by their understanding of the user requirements and by their commitment to the user terminal development."

Tony Taylor, Executive Chairman of Global Invacom, commented: "This project is a great opportunity for our business, enabling us to develop our next generation of low-cost tracking terminals for use with data over satellite on NGSO constellations. Collaborating with Methera on such an exciting project is testament to the strength of our partnership that has been in place for many years.

"With our highly experienced RF, mechanical and software teams, we are well-placed to deliver on both the discrete design packages and overall system integration."

Riverbeck's Managing Director, Graham Leach said: "Riverbeck are delighted to announce development of a new generation of broadband satellite transceiver for Methera. The design and application are extremely compelling for us, and we are excited to join this successful and innovative consortium."

Orbex set to launch world's most environmentally friendly space rocket

The carbon footprint of launching the new Orbex Prime space rocket will be up to 96 percent lower than comparable space launch programmes, a new scientific study has revealed.

Prime is poised to become one of the most environmentally friendly orbital launch vehicles ever built, benefiting from the use of renewable, ultra-low-carbon biofuel. It is also designed to be reusable and will not leave any debris on Earth, in the Earth's oceans, or in the Earth's atmosphere.

Orbex is also committing to offsetting all emissions from the rocket and its launch operations, ensuring every launch is carbon neutral. Orbex plans to launch Prime from Space Hub Sutherland, the carbon-neutral Spaceport in the North of Scotland.

The new study by the University of Exeter calculated that a single Orbex Prime launch would produce up to 86 percent less emissions than a similar-sized vertical launch vehicle powered by fossil fuels. This gulf in emissions is primarily due to the similar-sized vehicle emitting high levels of black carbon, the particulate matter formed by the incomplete

Orbex Stage 2 rocket, called Prime

combustion of fuels containing carbon – and a major contributor to climate change when emitted from rocket engines into the stratosphere.

The study also compared the carbon footprint of launching Prime with that of a rocket that is horizontally launched from a carrier aircraft. In this comparison, the direct launch emissions required by Prime was as much as 96 percent lower than the horizontally launched vehicle.

"Orbex will be the first commercial orbital space launch company to use a renewable, carbon-friendly fuel," said Chris Larmour, CEO of Orbex. "We believe it is time to move away from the use of heavily polluting fossil fuels now that more efficient, sustainable alternatives are readily available, and we hope to see much tighter regulations coming into force. As the world prepares to attend the COP26 climate change conference in Glasgow, we have already moved decisively to a fully sustainable solution that avoids the massive carbon emissions profiles of old-fashioned fossil fuelled launch solutions."

According to the study by the University of Exeter, a single launch of the Orbex Prime rocket would result in total emissions of 13.8 tonnes of CO2e. This includes the direct emissions from the launch, the indirect emissions created from the production of the propellent fuels required (biopropane and liquid oxygen), and the radiative forcing (RF) effects of non-CO2 emissions at high altitude.

This carbon footprint is comparable to the average emissions created by one single person in the UK each year.

Orbital space launches using fossil fuels create enormous amounts of black carbon in the upper atmosphere. Annually the amount created by around 120 space launches is equivalent to the black carbon emissions from the entire global aviation industry. Orbex's solution almost entirely eliminates black carbon emissions.

A key factor in the environmental credentials of Prime is its innovative choice of fuel. The BioLPG used by Orbex for Prime is sourced from Calor, the UK's leading BioLPG supplier, that produces the propane as a by-product from the waste and residual material from renewable diesel production. As a result, the greenhouse gas (GHG) factor for BioLPG is 90 percent lower than a fossil-based fuel such as RP-1, the highly refined form of Kerosene typically used as rocket fuel.

"The UK space industry has a key role to play in combating climate change, for example by launching satellites that can monitor environmental changes on Earth – but such benefits must be weighed against the environmental impact of space launches, which by their nature can be highly carbon intensive," said Dr Xiaoyu Yan of the Environment and Sustainability Institute at the University of Exeter. "Our study shows that the launch operation planned by Orbex can result in a significantly lower carbon footprint compared to the other launch scenarios considered in our analysis."

BSNL receives license to operate Inmarsat's world-leading global Xpress satcom services in India

Inmarsat, the world leader in global, mobile satellite communications, has confirmed that its strategic partner BSNL has received the necessary licenses to deliver Inmarsat's world-leading Global Xpress (GX) mobile broadband services in India.

Under BSNL's Inflight and Maritime Connectivity (IFMC) licence from the Department of Telecommunications, GX will be available to Indian customers across government, aviation and maritime.

The announcement means that India's airlines will be able to deploy GX for in-flight connectivity within India and throughout the world, while India's commercial maritime companies will be able to significantly enhance the digitalization of their vessels for more effective ship operations and crew welfare services. BSNL's license will also see the award-winning GX service offered to government and other users.

Rajeev Suri, Inmarsat CEO

There will be a phased introduction of services for customers and partners.

Rajeev Suri, Inmarsat CEO, said: "Today is a significant day for Inmarsat and our valued, long-term partnership with India, which was a signatory to the founding treaty establishing Inmarsat in 1979. Inmarsat is delighted to make the world's only global high-speed mobile broadband Ka-band network available to the Government and businesses in India through our partner BSNL. We are committed to India and the company has been a trusted partner for the Indian government for four decades. Today's announcement, which we share proudly with our friends at BSNL, will help to underpin the further economic growth that we all wish to see in India."

GX, operating in the Ka-band, is the first and only high-speed broadband network designed for mobility and government customers to seamlessly span the world. This market-leading service delivers the high bandwidth, reliability, and security that commercial and government-grade mobility customers' demand. GX is continually evolving to offer even more capacity, capabilities, and operational agility for Inmarsat customers now and well into the future. The company is launching a further seven GX satellites, including its next generation GX satellites, over the coming three years, each of which will add more capacity into a single region than the first four satellites combined. The GX gateway for India is located in Ghaziabad, Uttar Pradesh.

Chairman and Managing Director of BSNL, Mr P.K. Purwar said: "BSNL and Inmarsat are delighted to share this key milestone with our partners and customers in India. Global Xpress is recognised as the world's best high-speed satellite communications service for government and mobility business customers, and we are very pleased to make these capabilities available to users in India. All of us at BSNL appreciate the commitment to excellence shown by the Indian Government as we have worked on approvals to deliver this service to the country. Equally, we thank our partner Inmarsat for their spirit of collaboration in reaching today's milestone to help power forward economic development in India through higher quality connectivity for our customers."

Ajay Singh, Chairman and Managing Director of SpiceJet Ltd, said: "We are delighted that Global Xpress, the world-leading passenger inflight connectivity service, is now coming to India. We are looking forward to offering this ground-breaking connectivity service to our passengers later this year when we introduce our new Boeing 737 MAX aircraft. It will enable our customers to remain connected in the air as they do on the ground."

Gautam Sharma, Inmarsat India Managing Director, said: "Inmarsat is well-positioned to partner with the Indian government to address the ever-growing demand for reliable, mobile satellite communication services across a broad range of commercial and public sectors. Following the successful introduction of Inmarsat's voice and broadband data communication services across India in the past, today we are announcing that Inmarsat's award-winning Global Xpress services has now secured the necessary licenses through our valued partner BSNL. Global Xpress is the gold standard of high-speed satellite mobile broadband communications. It will enable Indian domestic airlines and international airlines flying over India to provide the world's fastest inflight connectivity. It will also speed up the digitalization of Indian-flagged maritime vessels and give an edge to the Indian Government, including its defence forces. We are proud to be led by Rajeev Suri, an Indian-born global leader as we unlock the next phase of commitment to the Indian government and Indian market."

Globalstar partner advanced tracking surpasses milestone of 2,000 SmartOne devices deployed

Globalstar Europe Satellite Services has announced that its SmartOne Solar satellite IoT transmitter is being deployed to provide satellite tracking for leisure boat owners. The announcement comes as Globalstar integrator partner Advanced Tracking achieves the milestone of deploying over 2,000 Globalstar SmartOne C IoT tracking devices for its customers in the marine sector.

Advanced Tracking recently integrated SmartOne Solar into its Konectis platform, a portal designed for leisure marine users. Konectis features multiple capabilities that are manageable via a dedicated dashboard and user interface that includes an anti-theft alarm system. With the addition of SmartOne Solar, Advanced Tracking is now enabling fleet owners and individual boating enthusiasts to benefit from efficient, ubiquitous satellite IoT enabled vessel tracking.

"In the leisure marine sector, when you own boats in the 10-25m range, budgets matter," said Co-Founder and Managing Director of Advanced Tracking, Christophe Allan. "We knew that by integrating SmartOne Solar, we'd have the ideal solution to provide cost-conscious boat owners with an affordable, high-quality solution to track their vessels," Allan noted.

The Globalstar SmartOne Solar monitors assets of any kind, whether fixed or mobile, including shipping containers, transport trailers, construction/farm machinery and vehicle fleets. SmartOne Solar provides a low-maintenance and cost-efficient tracking option that is powered with solar-rechargeable batteries and can deliver multiple years of

serviceable life. The device operates continuously for many months while reporting twice a day without the need for exposure to sunlight.

Allan points out SmartOne Solar's ease-of-use and cable-free flexibility as major benefits. "The advantage of SmartOne Solar is that it doesn't need connection to a power source, so the device can be positioned in many different points on the boat based on preference," he added: "It is small and easy to install, with good performance quality. Because the device is autonomous, you just install it and off you go."

Allan highlights the growing understanding that satellite connectivity is essential for reliable, ubiquitous coverage, saying: "The user could try other technologies, such as VHF or GSM, but as soon as you are out of range, you've lost track of the boat."

The partnership between Globalstar and Advanced Tracking dates back to 2010. At that time, Advanced Tracking introduced Globalstar SmartOne C to its platform to replace/supplement its incumbent satcoms provider. One reason, Allan explains, was the need for a back-up satellite system to reduce exclusive reliance on one provider. "Price was also a big factor," he adds: "SmartOne, and also Globalstar's airtime packages, enable a really reasonably priced, quality solution for customers."

Established in 2004, Advanced Tracking provides satellite tracking solutions and communication systems. Its comprehensive Konectis portal, whose features and communications preferences can be custom configured, is dedicated to meeting the needs of its marine customers, mainly owners of leisure sailing craft and motorboats.

"We're delighted that SmartOne Solar is helping leisure craft owners cost-effectively track their valued boats," said Globalstar EMEA General Manager Mark O'Connell. "We congratulate Advanced Tracking for providing the fast-growing leisure marine market with a highly effective solution that aids in tracking, improves safety and security and prevents potential failures."

Intellian and Inmarsat launch industry's newest FleetBroadband terminals

Intellian has received type approval from Inmarsat for its new FB250 and Fleet One L-band terminals, making it one of the first to market with user terminals for operation on Inmarsat's innovation catalyst L-band network, ELERA. The FB250 is a multi-functional terminal, either acting as a stand-alone primary communications terminal or combining with Intellian's market leading GX60NX and GX100NX to create the perfect Fleet Xpress (FX) solution. The Fleet One terminal provides an easy-to-install, reliable voice and data solution, ideal for smaller fishing and leisure vessels.

Intellian's FB250 User Terminal is a compact, best-of-both-worlds solution for vessel operations, safety, and crew welfare, and is the most innovative and feature-rich FleetBroadband 250 terminal on the market. Enabling simultaneous voice and data connectivity up to 284kbps, the FB250's class-leading features and future-proofed technology deliver a far more cost-effective long-term investment than competing systems using terminal designs that, in many cases, are now many years old. The FB250's features include a built-in firewall, analogue and digital voice lines, soft PABX and a WAN port, which will support existing and future terrestrial networks such as 3G/LTE/5G and more.

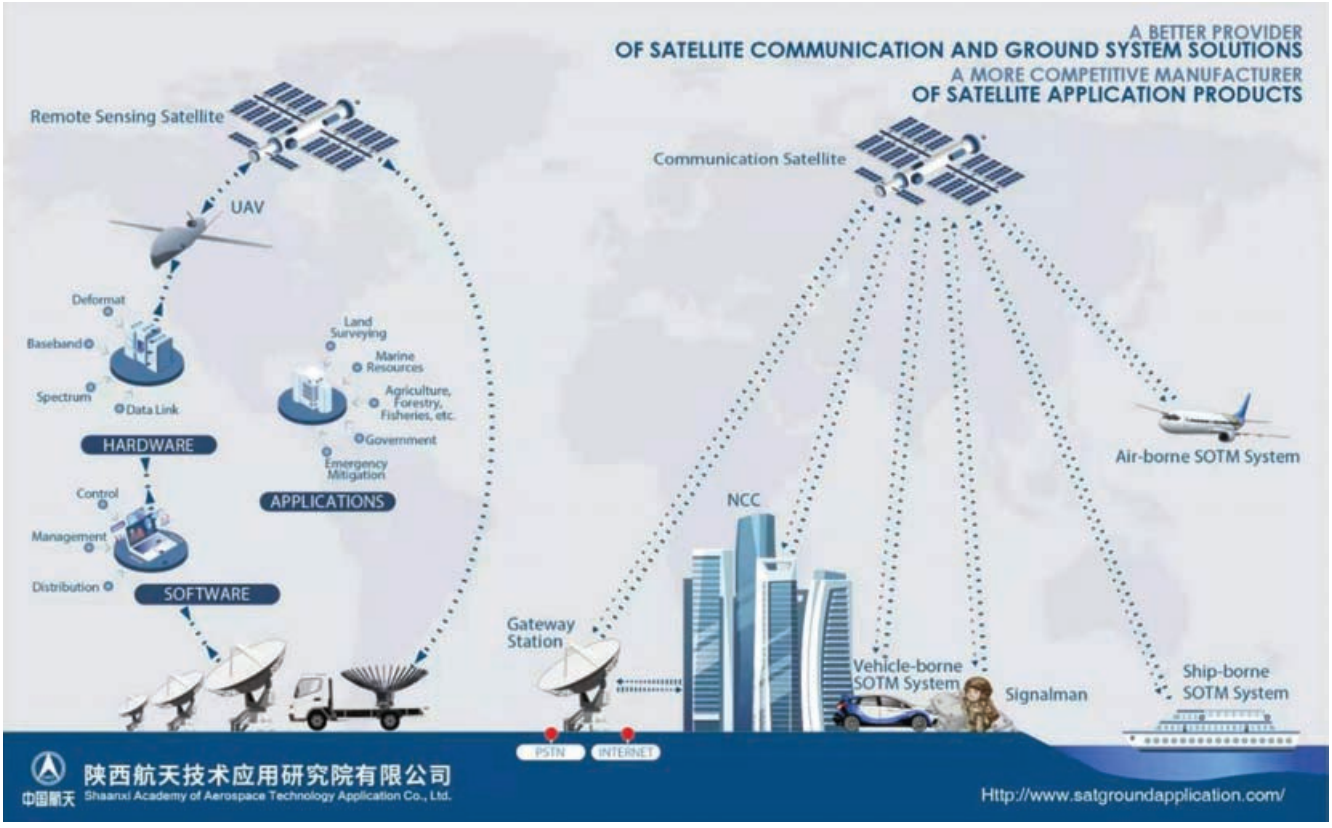

Photo courtesy of Rohde & Schwarz

T&M squares up to LEO satcom challenges

NewSpace constellations present new challenges for testing satellite communications systems. Innovative measurement solutions are being developed to successfully design, develop and test user terminals, ground stations and satellite payloads.

Matt Hammond, Business Development Manager Aerospace and Defence, Rohde & Schwarz

Today's satellite communication systems combine features from legacy cellular networks and emerging wireless technologies. New constellations are under development that attempt to provide ubiquitous broadband mobility via NewSpace Low Earth Orbit (LEO) satellite networks that include ground stations and user terminals.

LEO constellations promise vast improvements in latency and coverage. For example, Starlink latency performs roughly 15 – 20 times faster than GEO satellites. Such constellations offer a significant increase in aggregate network capacity, thus enabling satellites to support time-sensitive applications such as video streaming and data-heavy applications. However, the LEO environment introduces challenging test requirements compared to legacy GEO VSAT terminals.

LEO networks need to deploy user terminals that provide an agnostic interface between the satellite and the end-user communication device.

These CPE-like devices communicate via a commercial interface, such as Ethernet, to a commercial off-the-shelf device, such as a server, base station or Wi-Fi router. The user terminal essentially acts as a transparent relay to a preferred commercial user device. Networks and terminal vendors need to thoroughly test the embedded wireless communication systems and components to ensure uninterrupted operation with high quality of service.

Additionally, manufacturers need to reduce test time and keep user terminal costs at a practical level.

These challenges demand test and measurement solutions that cost-efficiently provide high measurement performance and repeatability.

RF verification versus modem verification

One particular issue in the LEO constellations is the high-rate Doppler effect that contributes to complex handovers. This requires greater complexity in the radio resource management (RRM) system. Some constellation scenarios involve several handovers per minute, and this creates new scheduling issues. Protocol stacks are complex too, with user terminals behaving like terrestrial mobile phones, thus applying greater burden on the RRM related to handovers and scheduling. Verification engineers must consider the

nuances of testing and validating RRM performance of LEO terminal radios.

Network emulation test systems

Modems running commercial firmware require dynamic algorithms that respond in real time when terminals measure network power, provide measurement reporting and respond to system scheduling. The strictly programmed commercial firmware fixes the radio's dynamic behaviour, thus preventing controlled RF parametric testing. Test engineers cannot parametrically characterize modems and RF systems under these conditions. In an ideal world, a test engineer sets the modem state machine to any condition and executes measurements in that controlled configuration. Legacy terrestrial mobility engineering teams benefit from "callboxes", which are configurable network emulator test systems controlling mobile phone state machines. They make RF parametric measurements on a mobile phone in a controlled state, such as fixed power or frequency.

So, how can NewSpace engineers realize the same features of a callbox, given the cost constraints? The answer lies in using either golden radios or software defined radios (SDR).

Golden radio vs. software defined radio

System and test engineering teams already use golden radios in wireless applications. To accommodate complex NewSpace RRM and even basic RF performance requirements, modified golden radios could include software instructions which interrupt the terminal under test, allowing test engineers to manipulate radio power, frequency and other RF and modem conditions.

In some cases, instead of modifying a golden radio, an SDR might better address the test solution. SDRs allow for a scaled-down set of stack features that only need to accommodate the test requirements. Here, only a minimum suite of protocol features needs implementing, depending on the test requirements.

Over-the-air (OTA) testing

Historically, the mobile phone industry relied on conducted measurements with a variety of industry certifications prior to commercialization. For satellite user terminals with beamforming and tracking antennas, over-the-air RF measurements take precedence over conducted measurements. The wireless industry is still debating how best to accomplish this for satellite user terminals and next generation 5G mobile phones. Many new near-field and quasi near-field chamber concepts are utilized.

Fast RF verification in production

The added complexity of modem testing also influences production testing. While initial manufacturing volumes might not exceed hundreds or even thousands of units, networks anticipate full production volumes with yields in the millions of units. Manufacturers require advanced strategies for reducing cost through efficient test methods.

RF calibration, or tuning and alignment for RF frontend modules, is common to both mobile phone and user terminal manufacturing. Terminals must compensate for non-linearities in power amplifiers during the manufacturing process. Swept power and frequency measurement techniques, coupled with advanced measurement algorithms, remove non-linearities and allow terminals to pass RF measurement specifications. In addition to RF calibration, all devices require basic RF and modem verification in manufacturing. Fast test methods utilizing pre-programmed sweep methods significantly lower overall test time by reducing iterative and repetitive setup production processes. By implementing such fast test modes in the system engineering design, chipset and modem designers can engineer these features early with technical ease and minimal cost.

Matt Hammond, Business Development Manager Aerospace and Defence, Rohde & Schwarz

Ground station considerations

Different NewSpace design approaches impact ground station functionality. Networks based on digital regenerative payloads implement much of the radio resource management on-board the satellite. For bent pipe systems, the RRM sophistication resides in the ground station, which direct the user terminals regarding IP scheduling and radio control.

Gateway and TT&C ground stations require similar testing to the user terminals. The needs for RF calibration and modem verification are similar, although methodologies could differ depending on cost and complexity. The large data throughput and combining of multiple return link signals adds significant complexity to the bandwidth and data handling for gateway terminals. Gateway modems and RF systems typically require more rigorous testing compared to user terminals.

Summary

LEO constellation terminals require test solutions that provide high measurement performance and repeatability for complex systems. Innovative measurement solutions enable users to successfully design, develop and test NewSpace user terminals, ground stations and satellite payloads. These test methods should be considered early in system engineering planning.

Alexander Mueller-Gastell, CEO of ND SATCOM ●●●

Q&A

Building on success

Following the announcement of ND SATCOM's new FlyAway terminal, the company plans to exhibit the product to show off its adaptability across bands and applications. Alexander Mueller-Gastell, CEO of ND SATCOM, walks us through the new terminal and the logic that went into its design, and how the company plans to build on its success.

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: How has ND SATCOM responded to the digitisation boom under the pandemic?

Alexander Mueller-Gastell: Given ND SATCOM's global presence, we already had strong use of digital technology before the pandemic. One area we did adapt was to create an online training platform for any clients who sought this option, with a secure video classroom interface and actual access to hardware/software.

Question: ND SATCOM recently introduced the multi-band FlyAway terminal MFT 1500 and will present it live at CABSAT. Could you tell us a bit about it?

Alexander Mueller-Gastell: The FlyAway terminal is a 'made in Germany' product that pushes the envelope of durability and performance in wide-ranging environmental conditions. Our expertise gained over 20 years in this industry has been incorporated in its design and construction. It is a rapidly deployable terminal that can be loaded into TULBs and used in many civil and military frequency bands.

We combine 'field usability' benefits, such as easy set-up and dismantling, with the robustness of a deployable ground station, which is unique in the current market. Furthermore, the components are specifically adapted to our SKYWAN 5G modem, and the requirements for climate resilience are reflected in the new software release, which includes ACM (adaptive coding and modulation).

Question: What were the challenges involved in the terminal's development?

Alexander Mueller-Gastell: Optimization led us to bundle our capabilities through integrated systems that include core ND SATCOM products as components - such as our SKYWAN 5G modem. Usability is always a priority, and we considered our solutions' user-friendliness and 'field usability' upfront in the design phase. In addition to focusing on and achieving outstanding performance parameters, this solution met military grade standards through our commitment to very high levels of robustness and resilience. In addressing flexibility and customization, we adopted a modular component approach to creating a terminal product family. Our multi-prong approach to solving challenges in providing superior solutions has firmly established our reputation among customers.

Question: When do you hope to have it available on the market, and what are your expectations for the product launch?

SKYWAN 5G modem. Photo courtesy of ND SATCOM ●●●

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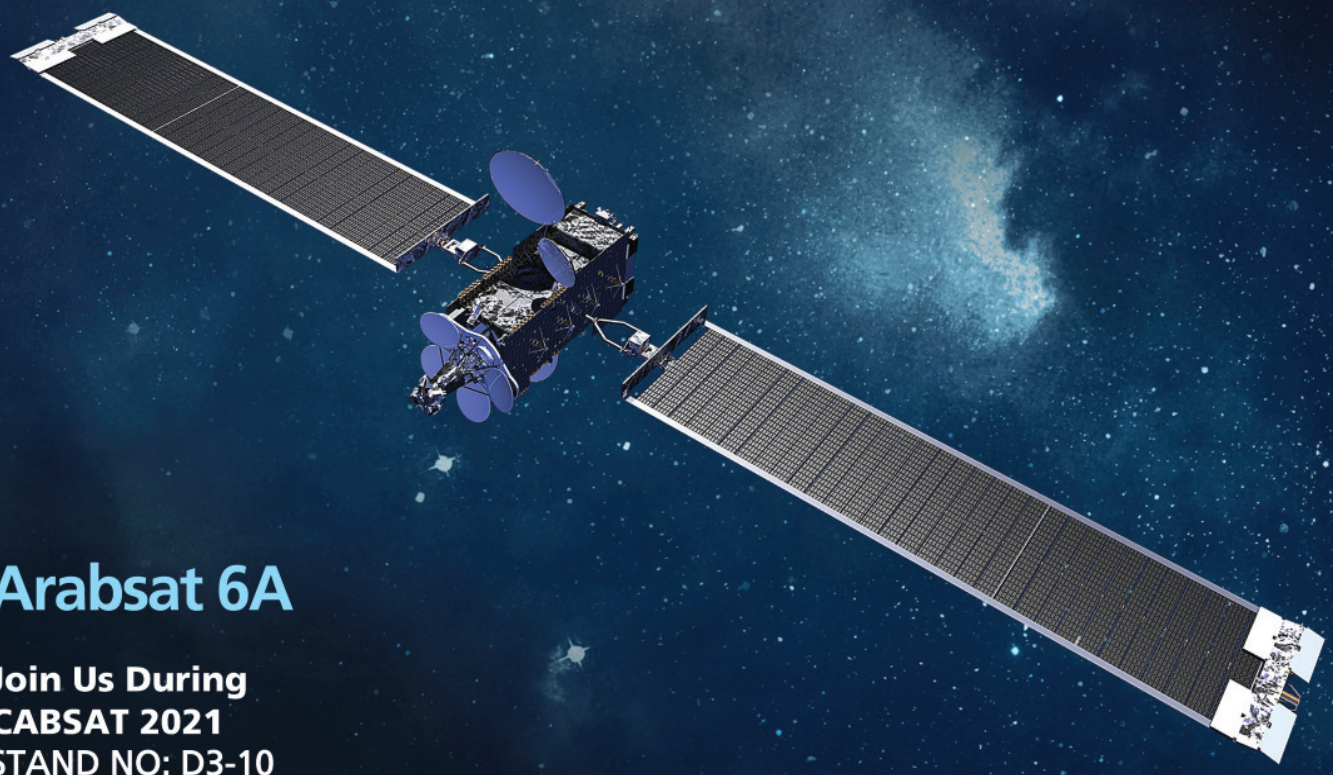

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Alexander Mueller-Gastell: The FlyAway terminal will be presented at CABSAT as a non-motorised version initially designed for Ku-band capability. This solution will be market-ready in 2022. The X and Ka-band-capable versions are in the pipeline, as is a motorised version.

Question: Reliability is often the golden ticket in communications. How does ND SATCOM approach that goal?

Alexander Mueller-Gastell: ND SATCOM has been a reliable partner for satellite communications with a proven track record for over 20 years. With our value proposition of installing reliability, we have been providing customers reliable solutions with high availability and outstanding performance, complimented by highly intuitive interfaces and a well thought out logistics concept. By marrying innovation, performance, and dependability throughout our portfolio, customers trust the substance and quality that our brand represents.

Question: The accessibility of hardware is a strong goal for developers too, is that a similar priority?

Alexander Mueller-Gastell: Hardware accessibility in terms of usability and streamlined processes for allowing customers to get up and running are indeed integral to our development as we continue to grow and innovate as a company. The FLYAWAY's ease of deployment and dismantling reflect this.

Question: What else is ND SATCOM working on these days?

Alexander Mueller-Gastell: This new FlyAway terminal is the cornerstone of a complete family of deployable ground stations. In the future, we will increase performance through modularity by using up to 2.4m antennas. The basic concept will always be the same. Future plans beyond a motorised version include an integrated ACU (antenna control unit) in SKYWAN.

In addition, ND SATCOM is developing together with a partner an AIRBORNE SATCOM solution for rotorcraft based on the SKYWAN modem platform in order to expand its position in the military SATCOM market. ■

ND SATCOM MFT 1500 Terminal. Photo courtesy ND SATCOM

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Connecting Africa

Bridging the digital divide, an extremely worthy goal, promises to improve the lives of billions across the entire world, with communities in Africa, Asia, Europe, and the Americas all set to benefit from affordable high-speed connectivity. Delivering on these connectivity promises is easier said than done but remains a high priority for satellite operators and services providers everywhere.

Amy Saunders, Editor, Satellite Evolution Group

An ever-present challenge facing those who live in remote and rural nations, the digital divide refers to the gap between those benefitting from the connectivity of the Digital Age, and those who don't.

Compact, highly populated areas such as the UK and much of Europe are largely – omitting small remote villages and sparsely populated, remote regions - served with adequate if not high-speed connectivity solutions, incorporating a mixture of fibre and wireless options.

It's an entirely different story for those living in low population density areas such as East Russia, for example, or much of rural America, where fibre is price-prohibitive and satellite coverage is often low speed and/or high cost. And again, the story is different for the island nations of Asia, or the hostile environments of the North and South Poles, where laying fibre is all but impossible. For such areas, wireless technologies are the only option. Africa, too, is a particularly challenging region, one facing both widely spread remote and rural communities with low population densities, and often lacking the power infrastructure which would enable wireless connectivity services to be delivered.

Closing the digital divide has been a top priority amongst government and businesses for more than a decade now. People without access to the Internet and communications technologies live at a distinct disadvantage, unable to utilise the connected options we in the west take for granted: Online learning and healthcare, education and up-skilling, shopping for groceries and consumer goods, banking, utilities, and of course, communicating with loved ones near and far. It's widely anticipated that bridging this gap, delivering much needed high-speed connectivity, will act to massively reduce the economic differences between developing and developed nations, levelling up the lives of those living in previously less connected regions.

A growing need

NSR has reported that more than 30 percent of the African population live in landlocked countries, many in remote rural

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areas, and that millions of Africans therefore experience significant challenges with access to reliable connectivity every day. Countries in Sub-Saharan Africa (SSA) are increasingly connected to the mobile Internet, however, in 2019, there were 520 million people that did not use mobile Internet and another 270 million who did not live within the footprint of a mobile network. The report highlights the immense upgrades still required to connect the unconnected of Africa.

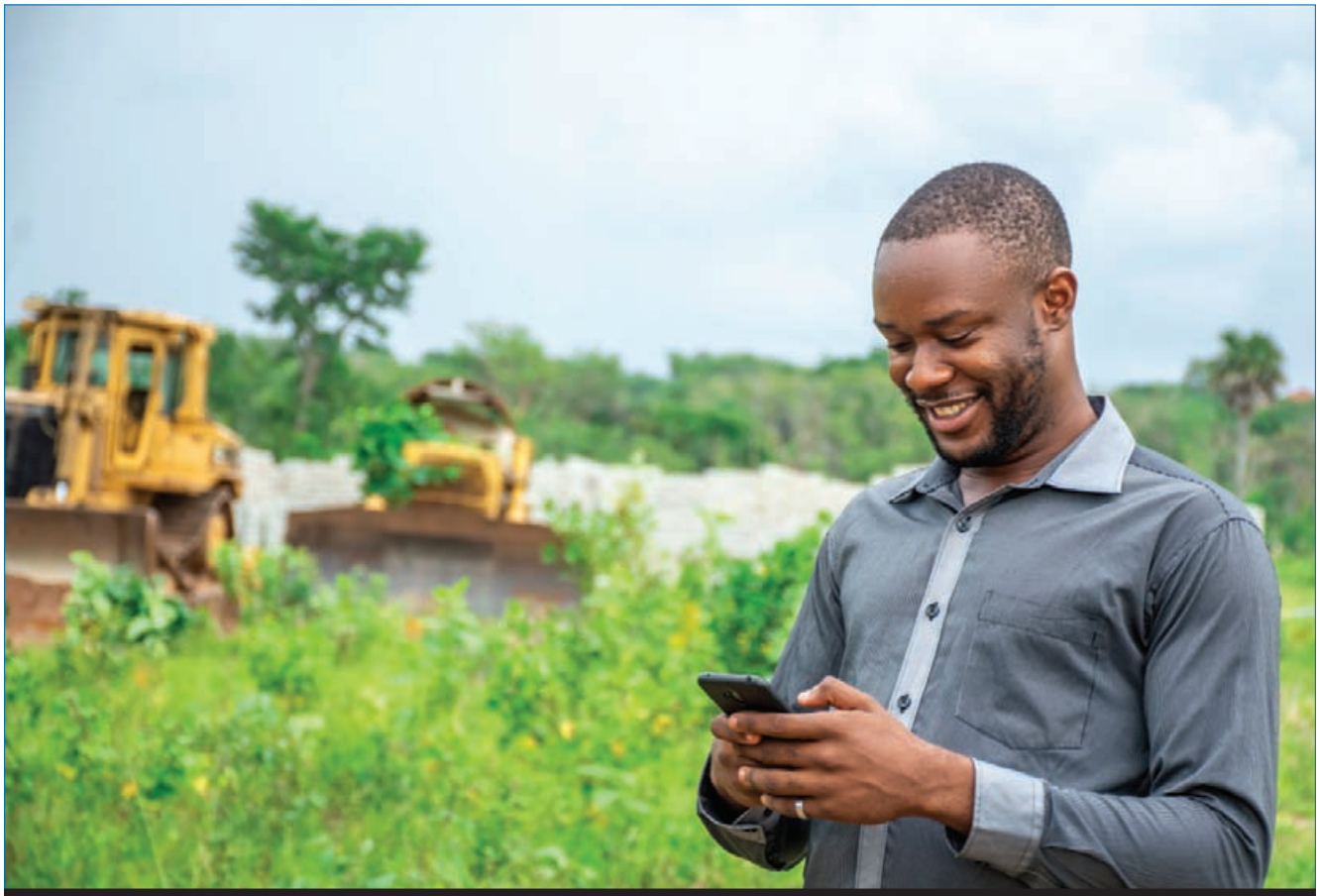
Another report from the Internet Society, 'Moving towards an interconnected Africa: the 80/20 Initiative,' talks of the urgent need to increase Internet access across the continent, especially in the wake of the Coronavirus pandemic. According to the United Nations Economic Commission for Africa, fewer than one in five households have Internet access. Reliable and affordable Internet access also fuels economic growth, with one recent study estimating that the Internet economy has the potential to contribute up to US$180 billion to Africa's gross domestic product (GDP) by 2025.

Levelling up over 2021

It's been an extremely busy year for African nations in terms of connectivity upgrades. Satellite, naturally, has a huge role to play given the disperse communities and remote and rural villages where connectivity can make the most difference. Over the year, projects have taken place across the length and breadth of the continent, although naturally, there is still much to do.

Eutelsat in particular has made its mark in the territory throughout the year; in May, the company announced the expansion of its use of Express Wi-Fi platform in partnership with Facebook to provide broadband services via satellite across several regions in SSA. With Express Wi-Fi, Eutelsat aims to connect thousands of people in rural and underserved communities spanning Democratic Republic of Congo (DRC), Nigeria, Côte d'Ivoire, Tanzania, Uganda, Zambia, Kenya, Madagascar, South Africa, Cameroon, Ghana, and Zimbabwe. The Facebook Connectivity-developed platform enables partners to build, grow and monetize their Wi-Fi businesses in a scalable way, while providing customers with fast, affordable, and reliable Internet access. Eutelsat and Facebook have previously conducted successful pilots in rural and underserved areas of the DRC enabling local businesses to offer affordable Internet access to customers on a pre-paid basis. To date, Eutelsat's use of the Express Wi-Fi platform has enabled access to affordable broadband for thousands of individuals across the DRC.

Later in October, Eutelsat and Globacom signed a multi-year, multi-Gbps wholesale capacity contract enabling Globacom to extend its coverage beyond the reach of its terrestrial infrastructure, leveraging the EUTELSAT KONNECT satellite. The service will be used to deliver high-speed broadband via satellite to businesses and communities in unconnected and underserved areas throughout Nigeria. In service since early 2021, EUTELSAT KONNECT is a new-generation high throughput satellite offering unprecedented



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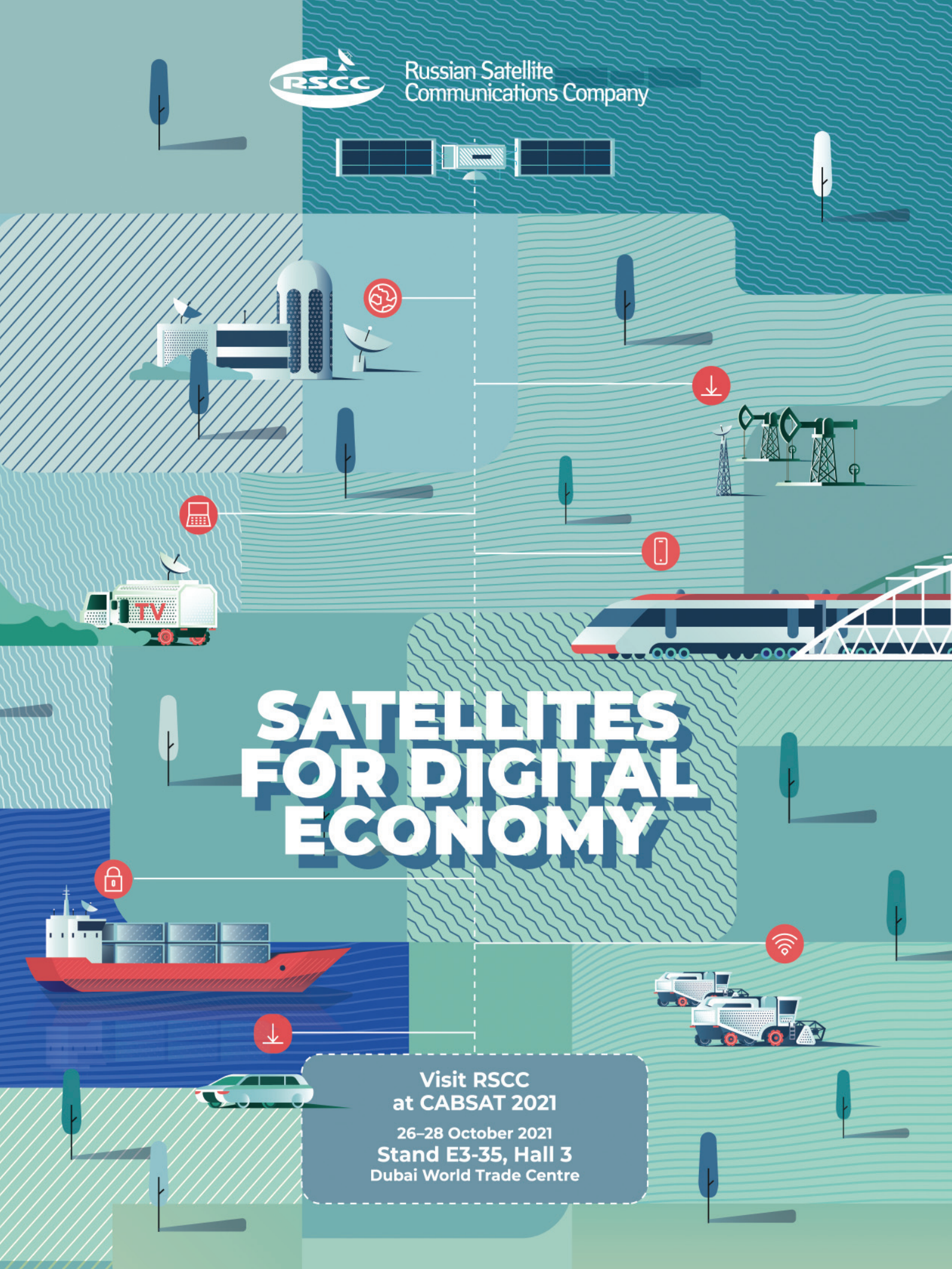
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operational flexibility. Delivering significant resources for broadband services with quasi-complete coverage of SSA, it addresses direct-to-user consumer and enterprise broadband services, with a comprehensive range of packages from bite-sized 'pay as you go' vouchers through to monthly and annual contracts.

The African waterways too, have received heavy focus this year. In June, Sternula entered a new partnership with the Ghana Maritime Authority (GMA) to enable satellite-based VDES to be used for enhancing navigational and safety-related purposes in Ghanaian waters. VDES is a new communication technology built on the capabilities of AIS and is expected to become mandatory under the Safety-of-Life-at-Sea (SOLAS) convention by the International Maritime Organization. The GMA will use Sternula's e-navigation connectivity service – a VHF Data Exchange System (VDES) solution – enabling reliable and accurate maritime navigational warnings to seafarers by the local authorities, while enhancing safety in Ghanaian waters. The world's first VDES satellite network will be commercially available to maritime service providers and authorities.

In the same month, Spacecom signed a strategic cooperation agreement with NuRAN Wireless Inc., including a US$3.2 million investment buying it a 9.3 percent of NuRAN's equity. NuRAN's satellite-based wireless communications solutions enable MNOs to efficiently deploy sites to generate network coverage in hard-to-reach and rural regions where infrastructure is neither economically feasible nor cost-efficient. The agreement grants Spacecom exclusive rights to provide satellite capacity and bandwidth for all future NuRAN African operations, including NuRAN's recently won large, long-term contracts to expand Orange's MNO satellite network coverage for its Cameroon and DRC operations. These deals, and all future ones, will utilize Spacecom's AMOS-17 advanced, digital satellite whose characteristics deliver significant advantages for Africa. The collaboration is integral to Spacecom's strategy to further its position as a leading communications service provider of satellite-based solutions in Africa.

Similarly, in July, SES and iSAT Africa signed a three-year partnership agreement to deliver 4G services to mobile phones across the eastern most peninsula of Africa. This new service will be available first via SES's O3b medium Earth orbit (MEO) constellation and will subsequently migrate to SES's next-generation MEO system, O3b mPOWER, in 2022. iSAT Africa will be able to quickly scale its network to meet anticipated extensive connectivity demands; the fibre-like connectivity will equip iSAT Africa to enable local mobile operators to deploy 4G services to close the digital divide.

A third announcement along the same lines came in

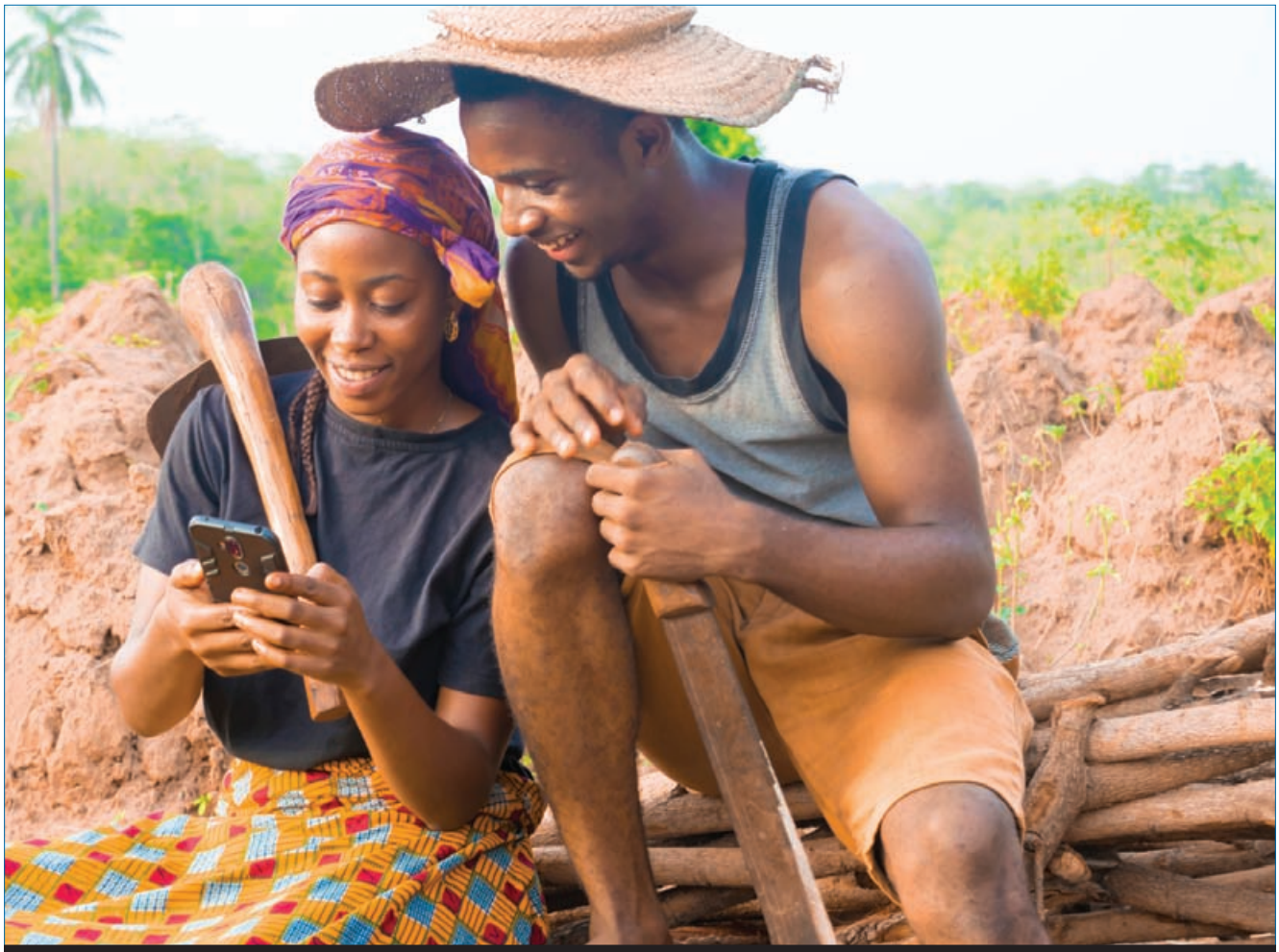

Photo courtesy Wazzkii/Shutterstock

October, when Avanti Communications launched Avanti EXTEND, a new managed satellite service for rural connectivity. Designed specifically for MNOs, Avanti EXTEND provides high-performance and cost-effective 2G, 3G and 4G solutions to remote and hard-to-reach areas across SSA. This enables customers to provide reliable cellular service to the 100 million people that would otherwise be impossible to reach using traditional terrestrial infrastructure. Avanti EXTEND's built-in and fully operational CAPEX solution integrates seamlessly into MNOs terrestrial networks to reduce network complexity and increase efficiency. This means customers do not need to manage satellite configurations, hub infrastructure or terrestrial networks to deploy a successful satellite cellular backhaul topology. The service also offers MNOs the opportunity to quickly and effectively undertake large deployments and scale operations to support long-term rural expansion at no additional CAPEX to customers.

Meanwhile, AAC Clyde Space founded AAC Space Africa in August to capitalize on the rapidly growing market for satellites and space services in Africa. AAC Space Africa will design, build, and deliver space missions to the continent from its Cape Town base. The new subsidiary will also be the group's centre of competence for advanced radio communication. The new company will be managed by Robert Van Zyl as Managing Director and Francois Visser as Technical Director, who bring more than 40 years of small satellite experience to the company, having pioneered the African CubeSat industry through several missions, including the first CubeSat launched by the continent. The team will initially focus on radio communication systems as well as sales and marketing.

Around the same time, YahClick announced a new partnership with Universal Satcom Group to provide reliable, high-speed broadband through the Al Yah 2 satellite. This new partnership will provide cost-effective, quick, and secure satellite broadband services to assist new enterprises throughout the Middle East and Africa. With the difficult conditions, unreliable connectivity, and lack of terrestrial infrastructure currently in the market, YahClick will provide its fast, and reliable satellite broadband services to support Universal as an established provider in the market. This will not only help support enterprises to grow and improve their business operations to become more efficient, but it will also provide the underserved and unserved communities across the nation with high-quality connectivity and reliable infrastructure.

A connected future

Projects across Africa have been rife throughout 2021, despite the ongoing challenges presented by the COVID-19 pandemic. Indeed, if anything, the Coronavirus has highlighted the need to bridge the digital divide now more than ever before.

We can expect new connectivity projects to continue at a comparable pace for the near future, and hope that the impact will be felt sooner rather than later.

Looking ahead, SES expects to launch the O3b mPOWER constellation, a revolutionary system of NGSO satellites operating in 8,000km orbit in the fourth quarter of 2021. Connectivity services will offer speeds ranging from 50Mbps, meeting the needs of ICT advancement to help boost infrastructure in global economies, but in particular, Africa. Based on SES' pre-existing fleet of O3b MEO satellites, O3b mPOWER will offer fibre-like low latency and high bandwidth connectivity to telco operators, service providers, enterprises, energy customers, aero service providers, cruise companies, airlines, humanitarian organisations as well as government and institutions across the globe. SES has already signed up its first African customer, Orange CAR, which will use the new connectivity to exponentially ramp up its consumer and business services in the Central African Republic (CAR), offering high broadband and seamless connectivity, while extending geographical reach.

Ross Hulbert, Business Development Manager, Spaceport Cornwall ●●●

Q&A

Partnering on launch and landing projects

In mid-2021, Sierra Space agreed to a memorandum of understanding (MoU) with Spaceport Cornwall in the interest of partnering on launch and landing projects including hosting the landing of their 'Dream Chaser' reusable lifting-body spaceplane capable of horizontal landings on airport runways. Ross Hulbert, Business Development Manager for Spaceport Cornwall, speaks about the relationship, and how he believes it will affect the UK space economy.

Laurence Russell, Assistant Editor, Satellite Evolution Group

Question: Earlier this year, Spaceport Cornwall signed an MoU with Sierra Space. Could you contextualize that news?

Ross Hulbert: We've been speaking to Sierra Space for a few years now. It has always been our intention to be a multi-user spaceport and has been part of our proposition since the first conversations with the UK Space Agency and Cornwall Council. Virgin Orbit represents our primary partner, but we've always been on the lookout for more.

We started a conversation with Sierra Space at the Space Symposium conference a few years ago about our ambition of hosting Dream Chaser. At that time Sierra Space had no relationships to speak of outside the US, so our early agreement constituted the establishment of Cornwall as their emergency divert site. UKSA funded a study for us in support of that, verifying the spaceport's suitability for Dream Chaser. We've come a long way since then.

That grew into an increasing interest from Sierra Space on the subject of our growth, and the developing understanding of what both of us could gain from a stronger partnership. Being used to Cape Canaveral and Kennedy Space Centre, Sierra Space were used to a certain world-class standard when it comes to their launch sites. Things like solid post-mission processing and

Dream Chaser in flight. Photo courtesy Sierra Space ●●●

analysis, proven logistics, and a global reputation. Those were some big shoes to fill. We knew that if we weren't able to meet their high expectations, we couldn't expect the relationship to flourish.

Though we've been working hard to suit the requirements of Virgin Orbit's LauncherOne, it's never been our priority to limit ourselves to a single launcher. Technical modularity has been a priority for Spaceport Cornwall since day one, which led to some healthy relationships with the University of Exeter who have a campus in Cornwall and other scientific interests in the short term. In the long term, this is just the first real step between us and Sierra Space, so expect to see more.

Question: As a potential second operational partner, joining Virgin Orbit, Sierra Space could allow Spaceport Cornwall to launch with a bang as missions commence in 2022. What is the potential of a multi-user spaceport in the UK?

Ross Hulbert: The difference between us and a conventional vertical launch site is we're an existing licenced passenger airport. Much of the expertise that's been developed in running a multiple airline airport has informed our work becoming a multiple launcher spaceport. We're not starting from scratch; we're growing a proven transit hub in a conducive direction in step with demand.

Being an airport, the runway already exists, the infrastructure has been running for years, the security is already experienced and effective. Though of course we're building new facilities, the airport provides much of what we needed.

Just like an airport, the more operators we have working with us, the more we can spread out our costs, and the more ROI we'll see for the same asset, which is especially useful here given the infrequency of launch in the first few years. When it comes to space, the reduction of cost is absolutely vital. Some of the business cases associated with this sector can be fragile, so the lower the cost, and the lower the risk, the more effectively we can prove these enterprises and realise a profitable new space economy.

Naturally, this is why Virgin Orbit are very supportive of our work with other operators. Exclusivity serves no one here. They want to work with the most successful, efficient site that they can, and we do that by working with as many partners as we can.

Question: With the UK eager to invest in the space economy, how can the nation's spaceports contribute to Britain's standing as a technological leader on the global stage?

Ross Hulbert: It's a great era of investment for space right now, and the UK is right to ensure it's involved in the trend. There's a certain prestige that comes with sovereign launch capability that gives us a particular edge there, which a real economic benefit associated with it.

While there's much to say of the supply chain, the R&D, and the talent that the space economy needs, launch is the magnet, the fulcrum that galvanises everything else. That's what's going to make tech companies want a foot in the door.

Cornwall represents a burgeoning hub of technology in the UK, powered by the universities. That's something we need to embrace. We have an opportunity to inspire the next generation of space and tech pioneers in the UK. There was a massive correlation in the states between the Apollo missions and an influx of students pursuing STEM degrees in the interest of realising space careers.

The UK missed out on that back then, to an extent, as although it was exciting it was viewed as a US program. We shouldn't underestimate the opportunity to make up for it now.

Question: Sierra Space's Dream Chaser is the world's only commercial spaceplane that can land on a runway. Are horizontal launch technologies the future?

Ross Hulbert: I wouldn't want to suggest vertical launch is going away, but I would say horizontal launch and landing technologies will certainly have a solid place in the future space economy. There are many times more runways in the world than there are spaceports after all.

However, it's not helpful to compare the two really as they are designed to serve different parts of the market. Larger vertical launch systems can carry more payload capacity, but horizontal launch systems aren't trying to compete with that. Horizontal Launch systems' USP is flexibility, rapid response, and fuel efficiency. It's easy to see how, once fully realised, these launch methods would complement one another, and widen the span of technological capability available in the space economy.

Question: Reusable launch technology has grown more popular. How many of these technologies will we see at Cornwall, and will they be a focus of future development?

Ross Hulbert: Reusability is a universal goal. Not only is it environ-

Virgin Orbit LauncherOne. Photo courtesy Virgin Orbit

mental and the right thing to do, it also just makes good business sense.

SpaceX has of course made remarkable strides in this field and are proving the process for others to emulate. It seems like everyone's in the process of catching up with them. I mentioned earlier how crucial bringing costs down are to realising the space economy, and the reusability of launch infrastructure is a pillar of that.

Cornwall's market philosophy is all about the green and blue economies, realising renewables, offshore floating, wind, and so on. It's a big part of why we were selected to host the G7 at this crucial juncture in the climate change timeline.

We've even been involved in supporting greener propulsion technologies through some work with Skyrora, which we'd be happy to continue supporting with them in the future.

All this is proof of how consistently this community has doubled down on the seriousness of sustainable progress, so we're very serious about encouraging launch sustainability.

Question: Some commentators argue that investment in UK launch capability is counter-intuitive, given our happy history of being served by European spaceports. Do you have a response to that line of thought?

Ross Hulbert: Every launch campaign has experienced some level of delay. Those difficulties can happen for any number of reasons, perhaps because foreign spaceports understandably prioritize launches from their own domestic companies, and whether or not that's the case, the uncertainty is a potential barrier to growth.

If the UK is serious about its ambition to get 10 percent of the global space economy by 2030, launch is a vital part of the equation that we need to account for.

Question: With the collaboration of Sierra Space, what do you foresee the spaceport achieving with their help over the next decade?

Ross Hulbert: Over the decade we're going to see business cases mature, not least our own. With regards to Sierra Space, by then I'd love to see us as a frequent planned return mission spaceport, with their staff here in Cornwall full-time. Needless to say, we'd love to see much the same from Virgin with a permanently deployed Cosmic Girl in our hanger.

I'd like to see the Cornwall space cluster here thriving around launch-enabled services, potentially satellite manufacturing here in Cornwall, besides Virgin Orbit hopefully building their rockets here.

We'd also like to see the career pathways that we're developing now at local colleges and universities delivering the graduates that our industry needs.

In ten years' time, it'll be a great vantage to look back over all the momentum the UK has put in since the 2010s, to measure what could well be a meteoric evolution.

CGI of Spaceport Civil Aviation Centre. Graphic courtesy Stride Treglown

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Travel industries are making moves to make connectivity mainstream. Photo courtesy Adobe Stock Images

The future of flat panel antennas

Flat panel antennas have been the talk of the industry for the best part of a decade now, but we're still waiting for representative examples to be brought into service. That time is now upon us, however, there remain several challenges to be wary of.

Mark Steel, Director, Satcoms Innovation Group; Managing Director, Micro-Ant

It has been years since flat panel antennas (FPAs) were first discussed within our industry. Since the first mention of the technology there has been a gentle hum of speculation; some have deemed FPAs as revolutionary while others have consistently queried their technological feasibility. In recent years, it has become clear that consumer interest and confidence in FPAs have grown; Northern Sky Research predicts the market will hit US$11 billion by 2028. We are even seeing the latest entrants to the satcom industry, including Amazon's Kuiper, share plans to adopt the technology in their lower Earth orbit ground networks. Small and lightweight, it is clear why they are an attractive option at the ground segment.

Increasing connectivity for the consumer

We all know that consumers are spending more time than ever on their devices. More and more people are incorporating the Internet of Things (IoT) into their lives, meaning that connectivity and the ability to get online is deemed highly important for many. Whereas we're currently used to being offline in certain situations, such as travel and in remote areas, can we expect this to change soon? Travel industries are making moves to make connectivity mainstream. Many travel businesses are turning to FPAs due to their lower weight and profile offerings; space and weight limitations can often inhibit technologies onboard and therefore FPAs are an attractive option. As we see this technology develop, paired with the introduction of LEO mega constellations, we're sure to see new applications increase, with some predicting that it could go as far as enabling the connected car. The right FPA technology has the power to increase the opportunities to deliver connectivity to consumers in a wider range of settings than ever.

FPAs and LEO – the obvious pairing?

LEO mega constellations promise to deliver low latency connectivity to previously unconnected places. FPA and LEO technologies are often discussed together as, for many, they go hand in hand due to LEO's need for compact ground terminals and its wide geographical range being perfect for the COTM industry. We know LEO will introduce new challenges within managing the ground segment; due to the lower altitude of LEO orbits, the ground segment will have to manage the tracking and switching of satellites. The LEO network, both in-orbit and at ground level, is going to be incredibly complex, and its reliability will depend on the quality of the network's interconnectivity.

The LEO ground segment will have to manage the balance of offering technologically advanced features, such as tracking and switching, with the need for delivering low-cost

antenna solutions. The LEO ground segment is set to be vast and LEO satellite operators will need to manage cost efficiencies at the teleport to maintain a financially viable business strategy. With cost saving being a priority, do we as an industry run the risk of reducing the quality of equipment?

The rumbling concern

Concerns regarding the technical complexity of FPAs have echoed around numerous industry discussions. They must be small and durable whilst preventing RFI, finding and securing links with satellites and maximising throughput. With cost and size efficiencies being central to the ground segment, especially as the teleport network grows with the introduction of mega constellations, there is going to be increasing pressures placed on manufacturers to deliver low cost FPA products.

Since their rollout, concerns have been voiced due to the lack of standards in place to qualify the performance of FPA equipment within networks. With high customer expectations, a lack of cohesion regarding FPAs within the industry could result in a poor user experience, and this could have negative ramifications for the entire industry. Anecdotally, very few FPAs meet the high-performance expectations of satellite operators and yet customers aren't aware of the problems this could cause.

Learning from past problems

This is not a new challenge; in the history of satcom, it has not been long since we had these discussions regarding parabolic antennas. As satcom use increased, so did the number of ground terminals - unfortunately with instances of RF interference and signal degradation to match.

Over the years, the three most common causes of RFI were seen as:

1. Poor-quality equipment;
2. Poorly trained users; and
3. A lack of monitoring systems.

The issue of poor-quality equipment was addressed through GVF's SOMAP group. The group was established to find a way to standardise requirements for antenna performance. This involved close cooperation between several global operators, with the results being positive for the entire industry. Manufacturers know that SOMAP performance requirements will satisfy most operators, with the remaining operators only needing to have to perform minimal additional testing. Operators can greatly reduce time taken to test and approve antennas and even share that workload between them to some extent. If another operator has already tested to SOMAP requirements, they can be confident it meets those conditions.

With both manufacturers and satellite operators working to the same objectives, a standardised approach has overhauled the quality of parabolic antennas used within satcom. This, paired with tools to improve set up and monitoring, has resulted in earlier detection and fewer instances of RF interference.

An industry-wide advance

So, can we expect to see the same approach to FPAs? We

Mark Steel, Director, Satcoms Innovation Group; Managing Director, Micro-Ant

hope so. SIG has called on an industry-wide approach to both the manufacturing and use of FPAs, similar to the guidance issued by SOMAP for parabolic antennas. This will enable manufacturers to deliver the products to the performance criteria set by their customers and satellite operators, building trust and confidence in their products throughout the industry,

Together, with SOMAP, SIG is looking to accomplish a few criteria to drive this topic forward:

- Engage with manufacturers to better understand their challenges, as well as communicating the requirements from the satellite operators.
- Spearhead discussions between operators to determine commonality when it comes to data required.
- Investigate new ways to test these antennas efficiently while ensuring an accurate picture of performance .

With this information, we are hoping that it will be possible to create guidance and standards such as that which was created for parabolic antennas by the SOMAP group.

With a wider understanding of what satellite operators and users need from FPAs, manufacturers can hone their technologies to deliver the features needed by significant users within the sector. Not only will this prevent technical issues caused by sub-standard equipment or mismatched specifications, but it will remove the need for multiple entry tests by multiple users and therefore enabling easier incorporation of the technology into infrastructures.

Overhauling connectivity for the future

FPA technology is set to deliver a plethora of benefits to users; but we must clearly separate the challenges, and also not use the acronym FPA so broadly because there are mechanically steered antenna (MSAs) and electronically steered antennas (ESAs), and define what flat really is?

We must address some of the archaic requirements on scan angles. As more satellites are deployed there are a number of benefits, but we should remember that this will be hugely beneficial for both the satcom industry and consumers. By guaranteeing the standards of the technology, confidence will grow, and new opportunities will develop.

As an industry, we know the importance placed on reliability of service; delivering a unified strategy for FPAs will enable industry-wide adoption and allow provision of the best services possible. Cohesion within the industry's use of FPA technology will benefit all corners of the ecosystem; satellite operators will have access to high-performance antennas, users will benefit from high-quality connections, and FPA manufacturers will have reassurance that their products are working to their full capabilities, resulting in customer satisfaction. These talks are an exciting step forward in the bigger picture of satcom; customers clearly see the appeal of FPAs, so it's now time to deliver standards to enable the satcom network to successfully incorporate the technology.

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Container ship owners have realized that reliable connectivity translates into operational cost savings. Photo courtesy Telenor Satellite

Communications technology – keeping vessels on the move

Connecting vessels on the move has long been a challenge for the communications sector, although many more options are available today than they were even 20 years ago thanks to huge leaps forward in satellite technologies. Picking the right solution, however, remains a balance of cost, convenience, coverage, and reliability.

Jan Hetland, Director of Data Services, Telenor Satellite

Digitalization was a little slower to be fully embraced by the maritime sector than other industries, but recently we have seen a paradigm shift in the attitude to connectivity. Over the past 10 to 15 years, maritime has made the move from a traditional voice-centric approach to today's emphasis on data. In fact, just as we have seen in terrestrial connectivity, voice communications are now commodity taken for granted, while access to data is what the consumer demands and is what the user is actually buying.

Just like on land, the cost of a Mbps over a satellite connection is a fraction of what it was 10-15 years ago. Users get more value for money, and in turn this has contributed to an update of new technology within the conservative shipping sector. Of course, along with the reduction in cost, there have also been huge improvements in the performance of satellite terminal equipment which historically struggled to meet all the requirements of the maritime mobility sector. The result is that mobility no longer places limitations on the connectivity desired by the sector.

Of course, maritime comprises many segments, each with its own unique requirements and specific challenges. Certainly, the fishing sector is especially demanding of ship and crew performance: The weather is harsh, and the seas are rough, particularly in the hostile polar region. Furthermore, the stipulation on commercial fishing operators to adhere to strict regulations and mandatory reporting means that reliable communications are vital.

At the other end of the scale, you have large cruise ships operating in more temperate climes and the onus is on the operator to provide always-on connectivity. The sheer volume of users (up to 6,000 guests supported by numerous crew) results in very heavy demands on satellite communications which are used by crew for business-critical applications and simultaneously by guests for leisure and recreation purposes. While for river cruise vessels, a sub-sector within the larger cruise sector, there is the added difficulty of providing reliable connectivity, particularly in city environments which feature tall buildings and bridges.

Jan Hetland, Director of Data Services at Telenor Satellite

The merchant vessels also come with unique requirements. While the crew size is small, these vessels travel the globe and require seamless connectivity wherever they are. Ship owners have realized that reliable connectivity translates into operational cost savings, allowing functions which used to be carried out on board the ship to be brought onshore. And increasingly, IoT technology requires many more things to be connected throughout the vessel, from the bridge to the cargo hold, providing critical information from navigation systems to hazardous goods monitoring.

Offshore support vessels are yet another example. Their operating environment is similar to fishing as they regularly operate in challenging conditions, but they frequently also carry specialized crew who are completely reliant on satellite connectivity in order to get their work done. Often, the vessels aren't even allowed to leave port without a well-functioning satellite connection.

The advent of spot beam satellites

The primary reason for the reduced cost of satellite connectivity has much to do with recent advances in satellite technology. For the last 5+ years, virtually all new GEO satellites serving the maritime mobility market use relatively small, focused spot beams, which accomplishes two things. First, small spot beams allow for frequency reuse which multiplies the number of Gbps a satellite can carry. And second, small, focused beams generally translate to higher satellite performance which increases the reliability of the link and allows for smaller and lighter antennas to be used on the ship. Effectively, we are seeing a cascading effect from newer spot beam GEO satellites such as Thor 7, which ultimately leads to lower cost of communication and higher bandwidth speeds.

Although there are still many satellite operators offering perfectly good services using wide-beam technology, the days of operators actively choosing that solution are numbered. While the wide beam satellite generally means less frequent beam switching, the satellite signal is usually weaker, and you are therefore prone to experience service disruptions for a variety of other reasons.

A few years back it was not uncommon for satellite beam switching to take several minutes to complete, leading to interruptions in service. Today, beam switching typically takes a few seconds and disruption to services is minimal, provided the satellite operator has chosen a service platform designed specifically for mobility applications.

Importance of choosing the right platform

Today, there are a handful of baseband service platforms suitable for mobility in use by satellite operators – each have their strengths and weaknesses and the skill lies in choosing the best option for your client base. In fact, there are a few more options today than existed when we launched THOR 7 a few years ago, but whichever you choose, when mobility comes into play, you must ensure they handle the unique characteristics of a moving vessel.

We touched on the subject of beam switching, but there are other things to look out for as well. Ship superstructures sometime obscure an antenna's view of the satellite, and a well-designed platform should recover quickly from such interruptions. Over-the-air upgrades is another key feature, allowing software fixes and enhancements to be uploaded to a large population of terminals in one go. Catering to mobile users also means the allocation of bandwidth within a spot beam can change dramatically throughout a day, week, or month. So, your chosen platform must be able to cope with congestion situations, and preferably have built-in mechanisms for doing traffic offloading to nearby spot beams when facing severe traffic peaks.

Once you understand the needs of your customers, it becomes much simpler to choose the appropriate service platform. For example, a typical passenger vessel requires a lot of bandwidth, say from 50-100Mb, all received through a single antenna or modem. For these operators, the demands on a platform will be great and it is vital that the platform

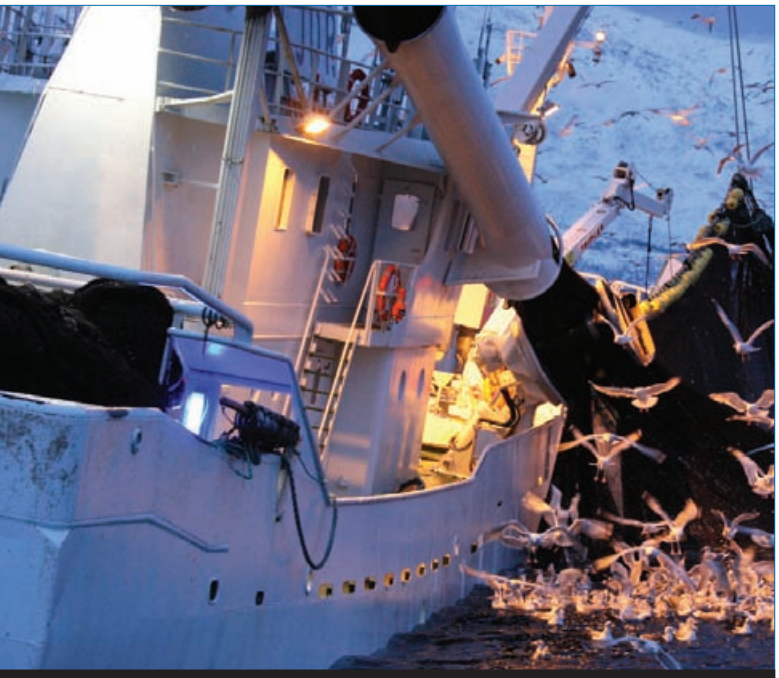
With passenger vessels the onus is on the operator to provide always-on connectivity. Photo courtesy Telenor Satellite

chosen can support the high bandwidth needed to meet both operational and social demands of crew and passengers. At the same time, it is vital to know the limits of your service platform. Special use cases such as cruise and ferries will almost certainly require ancillary equipment, such as traffic shapers and/or sophisticated bandwidth management tools to provide a well-functioning service under all circumstances.

On the other hand, cargo or fishing vessels operate with a relatively small crew and so make far fewer demands on the service offered so it is quite reasonable to choose a more limited platform. Cost will also play a role here as there is generally not a particularly large budget for communications services on these vessels, unlike with cruise liners where the cost of Internet will be passed on to passengers. Of course, there are exceptions as, for example, with survey ships where the crew remains small but there is the requirement to be able to upload large quantities of data.

Provided the service is correctly contended for the client's use, the choice of platform shouldn't concern the end user, especially if the connectivity contract is directly with the satellite operator. However, where intermediaries such as resellers are involved in the process, this introduces another layer into the platform choice. In fact, the choice of a suitable platform is frequently achieved as the result of a delicate balance between the capability of the platform and the familiarity of engineers with the different platforms available. There is a tendency for people to want to stick with a system they know and understand, rather than to undertake the training needed to adapt to something new, even where there is the opportunity for ultimately better results.

Today, we see multiple platforms operating smoothly side by side at teleports, with service platforms offering endless options in terms of Maximum Information Rate and Committed Information Rate, switching effortlessly between customers to provide each with the optimum performance. Provided the satellite provider has a competent and experienced team working at the teleport, smooth transitions can be taken for granted.



The fishing sector is especially demanding of a ship's, and crew's, performance. Photo courtesy Telenor Satellite

Selecting the appropriate antenna

Generally speaking, spot beam satellites allow smaller antennas to be used than conventional wide-beam satellites because smaller spot beams provide a stronger satellite signal. And vessel owners will typically look for the smallest antenna they can get away with while still supporting their particular use-case. There are a number of good reasons for doing so.

Often, a maritime satellite antenna is installed at the top of a mast to ensure un-interrupted view of the satellite. With larger antennas potentially weighing several hundred kilos you need a very solid mast to handle ship movement and vibration, particularly in rough ocean environments. This adds significantly to the cost of installing an antenna and can only be done when the ship is in port or dry-docked. Contrast this with a 60cm antenna weighing around 30kg, which can be hand-carried on board and installed by crew without the need for a large crane. This obviously translates to tremendous savings in installation cost.

When antennas are mounted on deck, the ship superstructure or other equipment on deck (cranes, masts etc.) often create blockage zones. If you want to have uninterrupted communications you therefore need two antennas installed – typically on either side of the vessel, alternatively fore and aft on the vessel. The larger the antennas being used, the more deck space they occupy, and the harder it is to find suitable deck space.

And there isn't just the installation cost to consider. The procurement cost of an antenna is almost exponentially correlated with antenna diameter. Where a large 2.4m maritime antenna will cost hundreds of thousands of US dollars, a small 60cm antenna typically costs in the range of US$12,000-17,000.

It is easy to forget just how difficult conditions at sea can be, so reliable connectivity is arguably even more important than that on land. Systems need to be monitored effectively and safety of crew and cargo is always an issue. Environmental factors also come into play as the ship's movement can result in an obstructed look angle at times so positioning of the antenna is also quite a skill to ensure that the satellite is always visible.

Solutions now available

From the early days when connectivity was fragmented and difficult to maintain, the satellite communications industry has resolved many of the issues that caused problems for maritime in the past. The cost of communicating via satellite is a fraction of what it was 10 years ago, and spot beam satellites have enabled the installation of smaller and more versatile antennas, while different platforms have been developed to resolve the individual needs of the different maritime sectors.

It is now the case that any vessel of any size, and working anywhere in the world, should be able to access reliable communications. This newfound stability in satellite communications is paving the way for a shift in attitude towards digitalization throughout the maritime industry.

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Richard Jacklin, Global Sales Director, ViaLite Communications

Q&A

From strength to strength

ViaLite is a leading developer of ground station components solving the technical problems of remote teleports and connectivity links. Following recent successes in Europe supplying to Austria and Switzerland, Richard Jacklin, Global Sales Director - ViaLite Communications, explains what the company's been doing right, and how they plan to go from strength to strength.

Question: Where do you see the current state of ground station technology, and where does ViaLite fit into it?

Richard Jacklin: If we take a high-level review of satellite payload and satellite ground architectures, we can see the industry following some major themes, including; LEO deployment now on a mass scale, continuation to move into higher regions of the radio frequency spectrum, and drive towards cloud-based and virtualized ground stations.

ViaLite of course has been following these trends and dramatically increased its R&D capacities at its HQ in Swindon-UK, and subsequently increased the delivery of innovative new product lines. ViaLite is well known for its RF over Fibre (RFoF) links used in satcom ground station teleports, but also many other markets including broadcast, GNSS distribution, signal intelligence and cellular.

From the ViaLite perspective, we have prioritized small modular solutions for the LEO market, we have continued to develop Ka-band solutions for a diverse dish to network operations centre (NOC) connection for higher frequency bands, and finally, ViaLite will continue to produce new solutions for both analogue and high-speed digital connectivity over fibre. Companies that ignore the changes in landscape for ground station solutions do so at their peril. Wasn't there a famous book about a cheese moving?

Question: Isotropic Networks recently invested in ViaLite RF over fibre HTS satcom links for their Alaska location with ruggedized design to allow them to operate from extremes of -20°C up to 60°C. Why were you the right choice for them?

Richard Jacklin: ViaLite has always developed products designed to work

ODE-MINI outdoor enclosure. Photo courtesy ViaLite

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in extreme environments. Over the years we have consistently installed and proved our products in hot, cold and high humidity climates. One recent example was our broadcast RF over Fibre links used in the winter Olympics in South Korea where the modules were working in conditions as low as -30°C!

If you are interested in electronics circuit behaviour, cold temperatures are actually good for semiconductors and amplifiers; they tend to deliver higher gains and the thermal noise contribution is lower. You just need to look after your capacitors and power supplies which need the most attention at those lower temperatures. For some of our enclosures, we have heater options in order to handle the very low temperatures, particularly on the power-up cycle.

Question: As remote locations become increasingly invested in and the climate changes, do you anticipate ground station hardware capable of standing up to temperature extremes will see increased demand?

Richard Jacklin: Yes, the capability to handle temperature extremes will increase in importance for the customer design and request for quote (RFQ) process. Another recent product innovation from ViaLite included a very low-profile fan tray that was designed to increase airflow across the RF over Fibre modules in a rack-based chassis, improving higher temperature performance and increasing the projected lifespan of the products.

On the topic of climate change, ViaLite has always endeavoured to produce the lowest power products, reducing power needs and contributing to customers environmental governance commitments.

Finally, one other thought is the distribution of LEO constellations is going to demand ground stations in more remote locations like polar areas as well as equatorial; they will be everywhere!

Question: Do you intend to devote special attention to the European region to build on the momentum of your expansions there, or do you see compelling demand elsewhere?

Richard Jacklin: The European customer base has always been a high priority for ViaLite; you just have to look at some of the major players in France and Luxembourg to see that. Pre and post Brexit we have been working hard to make sure that customers have not been negatively impacted by changes in shipping paperwork and tax handling. We have also continued to work with superb local partners in Europe to provide ongoing support to customers, where the partners have a high degree of technical knowledge around the ViaLite range and can support their specific RFoF applications.

Recently we made a partner expansion into Austria and Switzerland to help capitalise on some of the growth opportunities in those countries. Europe is a wide and diverse customer base and another trend we have seen is the rapid development of high-quality teleport operations now in the Eastern European region.

ViaLite Black OEM Outdoor Module. Photo courtesy ViaLite

Question: What are ViaLite's design priorities for coming products moving forward?

Richard Jacklin: The development roadmap for the next year includes higher frequency (>6GHz) products, following the theme described in the earlier question. High-frequency products with wider bandwidths mean you can service complete multi-GHz bands in one single link, without having to break it down into sub-bands.

The other design priority is in the digital communications market to service the 'digitisation' of the teleport, but also to address the increased security and cyber requirements for those customers handling sensitive data. Watch out for our announcements coming soon.

Question: What emergent demands do you anticipate from the ground station market in the next ten years?

Richard Jacklin: Before stepping into the satcom market about five years ago, I spent over 20 years working in the cellular device and infrastructure world. It's pretty clear to me that the emergent demands on the cellular industry are now squarely also in the satcom ground infrastructure world.

The cellular industry has gone through multiple incremental generations addressing the need to massively increase data capacity and speed, to open the market to not just smart devices but also mass-scale Internet of things devices, the need to integrate with non-cellular communications technologies and make all cellular and non-cellular interfaces standardised, and the need to virtualize core network and radio access network putting all the capability in software rather than white-box hardware solutions.

All these needs or trends you can see in the satcom world now as emergent and it's clear that the satcom industry will be able to piggyback on to many of these cellular developments. Demands of course will also be driven by the many new entrants into satcom from the LEO operators, new ground station as a service (GSaaS) suppliers, and cloud providers such as AWS and Azure. So, the next ten years is going to be a huge period of change for the ground station market which will keep us busy!

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