Special Feature
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Satellite Evolution

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Connecting cars – the technology revolutionizing the road

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/Ecology

Plus: Q&A Gilat | Ground Segment | Value Leakage

Editor - Amy Saunders ●●●

Returning to normal

We're now well into April, a quarter of the way through the year already and life is
starting to look a little more normal. Shops are reopening (hurrah for haircuts), pubs and nightlife are restarting, and life in the UK is starting to feel a little freer.

While things are largely improving, the latest stumbling block in the COVID-19 pandemic sees us suddenly with an immense shortage of vaccination doses for young people. The UK's Joint Committee on Vaccination and Immunisation (JCVI) has now recommended that people under 30 be offered other vaccines instead of the Astrazeneca (AZ) vaccine due to a small number of people developing blood clots shortly after vaccination. The large-scale vaccination roll-out in the UK means that we're seeing rare side effects more often and gaining valuable statistics; for every 10 million vaccinated, around 40 develop blood clots, around 10 of which will prove fatal. Of course, this needs to be compared with deaths from COVID-19 – for every 10 million 40-year-olds infected, 16 are expected to die, and this number falls with decreasing age. With the latest recommendation, and the AZ vaccine making up around 75 percent of vaccination doses in the UK, our vaccination roll-out will slow down significantly.

Meanwhile, space sector action is blasting off again at full speed, with some great news coming out on exciting projects and quieter companies alike. SpaceX launched 180 more satellites for its Starlink constellation in March alone, bringing it closer to its circa 1,500 satellites in orbit by year end. Virgin Galactic unveiled the first SpaceShip III, VSS Imagine, which will join its growing fleet of space tourism vehicles. The new addition will begin testing later in the summer from Spaceport America in New Mexico. A couple of companies we don't hear enough about have reported news too; Russian Satellite Communications Company's Express-103 satellite has entered operation, while SKY Perfect JSAT has selected Airbus to build its next Superbird-9 satellite, a fully digital in-orbit reconfigurable communications satellite.

A jam-packed issue this month, full of exciting features from well-known industry leaders. We've interviewed Gilat Satellite Networks to learn more about their 'Elastic Era' vision for satellite communications, and the need for flexible software defined technologies at all levels. We've also spoken with Open Cosmos; CEO Rafel Jordá outlines his expectations for the NewSpace economy and the future of satellite. Comtech EF Data weighs in on one of the biggest problems in satcoms networks today – value leakage – and how to solve it cost-effectively. Meanwhile, we've heard from industry stalwart Es'hailSat on the future of satellite; 5G, the cloud, software defined technologies and ground terminal equipment. Brian Billman from Isotropic Systems opines on the need for ground terminal technology to advance to meet the new wave of LEO satellite constellations coming into play. We've researched the latest developments in the connected car era and spoken with Saankhya Labs about their global expansion and new IoT project.
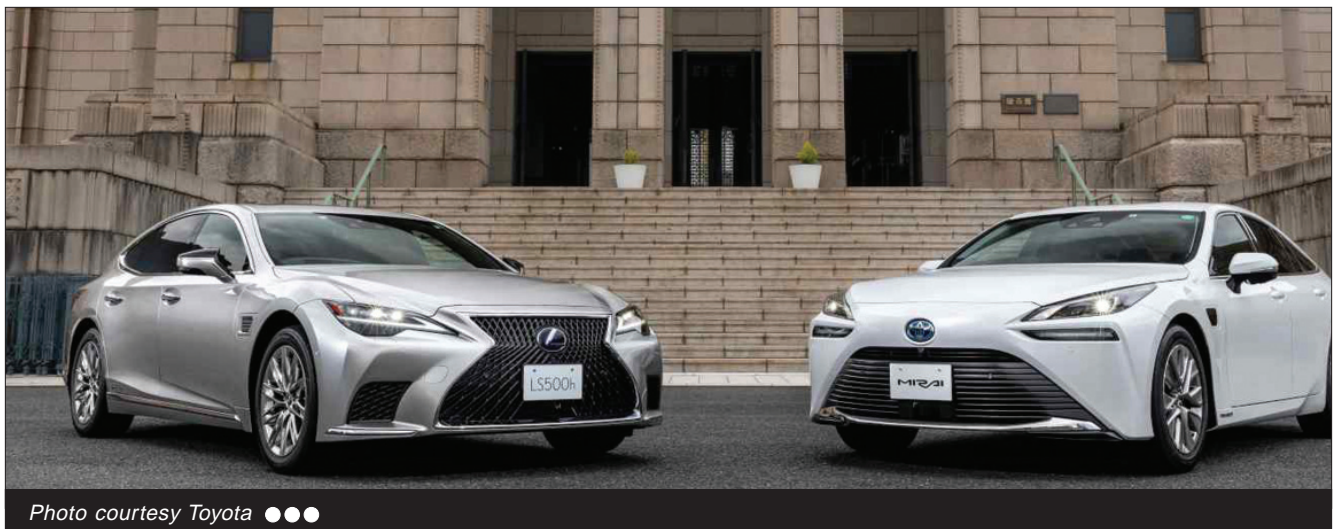
Photo courtesy Toyota ●●●

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OneWeb advances its 'five to 50' ambition with launch #6

OneWeb, the Low Earth Orbit (LEO) global satellite communications company, launched a further 36 satellites into Low Earth Orbit on 26th April as part of its sixth launch. The launch was conducted by Arianespace from the Vostochny Cosmodrome.

Lift-off took place on 25th April at 23:14 BST, 26th April at 07:14 Local Time, Vostochny and the mission to insert the satellites into initial orbit - prior to raising to operational orbit lasted approximately four hours.

The launch brings OneWeb's total in-orbit constellation to 182 satellites and is the third launch in OneWeb's 'Five to 50' programme, to deliver its connectivity solution to reach regions north of 50 degrees latitude by June 2021.

OneWeb's 'Five to 50' programme aims to connect broadband data users in the northern hemisphere, with services covering the United Kingdom, Alaska, Northern Europe, Greenland, Iceland, the Artic Seas and Canada. Service will be ready to start by the end of year, with global service available in 2022.

OneWeb also continues to grow rapidly as it sees increasing demand across its customer base. The company has recently announced distribution signings across multiple industries with The AST Group, PDI, among others, and more signings to be announced in the coming weeks as OneWeb expands its global capabilities.

OneWeb also agreed its latest MoU with the Government of Kazakhstan this month as it continues to demonstrate the company's commercial viability and the confidence customers have in its services and offering.

In March 2021, OneWeb conducted its first network demonstrations to the US Government and will be rolling out additional demonstration kits and Service Demo-centres in locations such as: Westcott 5G Centre, UK, Talkeetna, Alaska, in the Washington DC area and more.

ESA satellite-based monitoring to reduce risk and impact of geohazardous natural disasters

A consortium of Inmarsat, the world leader in global, mobile satellite communications with SINTEF, one of Europe's largest independent research organisations, and fellow Norwegian company Geonor has been awarded a three-year contract with the European Space Agency (ESA) to develop a natural disaster early warning system.

Using Inmarsat's award winning global L-band satellite network the consortium will develop a new government grade Internet-of-Things (IoT) solution that can provide early warnings in the event of a natural disaster, even in the most remote locations. This new satcom IoT technology has two important advantages over existing solutions: global coverage and security, thus making it extremely suitable for government applications.

SINTEF already has significant expertise in IoT and geohazards developed over several years through research projects such as KlimaDigital and Klima 2050.

"The objective is to demonstrate the use of a secure satcom IoT solution that will support civil government users to help reduce risks from geohazards, such as landslides, rock falls, avalanches, debris flow and floods," said senior SINTEF researcher Ivan Depina. "Inmarsat's unique global coverage allows us to install monitoring equipment anywhere around the globe, which is of crucial importance for monitoring remote and inaccessible areas threatened by geohazards."

The efficiency of IoT technology allows for monitoring over long periods of time, extending to several years, and yet requires low power use as well as low maintenance requirements.

The Inmarsat communications link is also supplied with world-leading cyber security, which is a key factor in the development of monitoring solutions for geohazards. Security-hardened IoT solutions will be developed for this project, which will benefit from Inmarsat's secure space and ground network.

"We are delighted to be working with SINTEF and Geonor on this ESA-supported project," said Nick Shave, Inmarsat's Vice President of Strategic Programmes, Global Government. "Providing critical safety of life services that are secure and reliable for our government customers is central to Inmarsat's mission. Norway can experience thousands of landslides every year and we are keen to see how this ESA pilot can make a positive impact to public safety."

The government IoT solution is capable of monitoring a range of geohazards, such as landslides and flooding. The Norwegian pilot will be monitoring landslides in the Trøndelag region of central Norway. The area is highly susceptible to various types of geohazards events due to the topographic, geological, hydrological and meteorological conditions characteristic for this region.

The solution is supported by ESA as a part of the "Space Systems for Safety and Security (4S)" programme, which is a new component in ESA's advanced research in telecommunication systems (ARTES). The programme aims to transform R&D investments to successful commercial products and services. The project is also supported by the

OneWeb spacecraft launch preparation ● ● ●

Department for Energy and Water (NVE) and the UK Space Agency and Norwegian Space Agency.

HISPASAT gives free remote education by satellite to 15 schools and rural communities in Honduras

The Minister of Education of Honduras, Arnaldo Bueso, the Spanish Ambassador in Honduras, Guillermo Kirkpatrick, and HISPASAT's Chief Commercial Officer, Ignacio Sanchis, inaugurated the connectivity and remote education service donated by the Spanish satellite telecommunications operator of the Red Eléctrica Group to 15 schools and rural communities in the country with a visit to a school in the department of Comayagua. This donation, the result of public-private cooperation, comes from an agreement with the Secretary of Education of Honduras in the framework of humanitarian aid that Spain has earmarked for the Central American country to alleviate the devastation caused by hurricanes Eta and Iota at the end of 2020.

Specifically, HISPASAT has provided all the equipment required to roll out 15 satellite hotspots located in different departments in the country, as well as a remote education solution that allows educational contents to be downloaded and accessed on local servers so that students can use them effectively. This solution provides a WiFi network in each school and also includes a community WiFi hotspot that provides Internet access to the residents of these rural communities. HISPASAT is also care of the installation and maintenance costs for this service, which will last for nine months.

The devastation brought on by last year's hurricanes led to the evacuation of half a million people and left 330,000 people without communications and half the country's students without an Internet connection. In disasters like these, satellite technology is a key tool to speed up re-establishing communications. The use of satellites is also essential for training on tools and digital skills in countries like Honduras, in which rural schools frequently lack Internet access through land-based or mobile networks.

Commitment to education in Honduras

The Minister of Education, Arnaldo Bueso, explained that the Government of Honduras is promoting major initiatives as part of its commitment to quality education. "We are united as a society and we are grateful for the help from all the participants involved: The central government, business people, technical teams, partners, civil society, fathers and mothers, teachers, churches, local governments and many others who, undoubtedly, are committed to the future of thousands of students", he stated.

Furthermore, he showed his appreciation to the Spanish Agency for International Development Cooperation and to HISPASAT for supporting these initiatives and how students can now have the right to access to quality

Photo courtesy HISPASAT ●●●

public-private partnerships to support initiatives that make digital education accessible for everyone without leaving anyone behind."

"HISPASAT is fully committed to the role that satellites play in addressing situations like the one in Honduras. But we don't want this connectivity solution to be used only for re-establishing communications in these 15 schools, we also want it to contribute to effectively bridging the digital divide in education, which is truly an essential service", added the company's Chief Commercial Officer, Ignacio Sanchis.

HISPASAT works in collaboration with the Spanish Agency for International Development Cooperation (AECID) on a variety of initiatives to provide satellite connectivity to schools and rural communities in Latin America and to promote quality education in remote, disadvantaged areas.

Resilient precision antennas for satellite navigation

Photo courtesy HELIX ● ● ●

Harwell-based Helix Technologies finishes funding led by Midven UK Innovation & Science Seed Fund

Helix Technologies, developer of resilient, precision antennas for GNSS (Global Navigation Satellite Systems), is pleased to announce it has completed a significant investment round led by the UK Innovation and Science Seed Fund (UKI2S), managed by Midven, supported by Helix's existing shareholders and incoming private investors. The funding round is geared at rapid growth as Helix commences manufacture of its precision GNSS antennas.

Following successful participation in Wayra's Intelligent Mobility programme and venture capital investor Seraphim's Space Camp in 2020, Helix has generated strong industry and investor networks, and anticipates accelerated growth in 2021 and beyond.

This funding round will enable Helix to strengthen its engineering team, build its IP portfolio and launch its first commercial antenna products in mid-2021. It will also provide the foundation from which Helix can raise further investment to start scale-up to mass production.
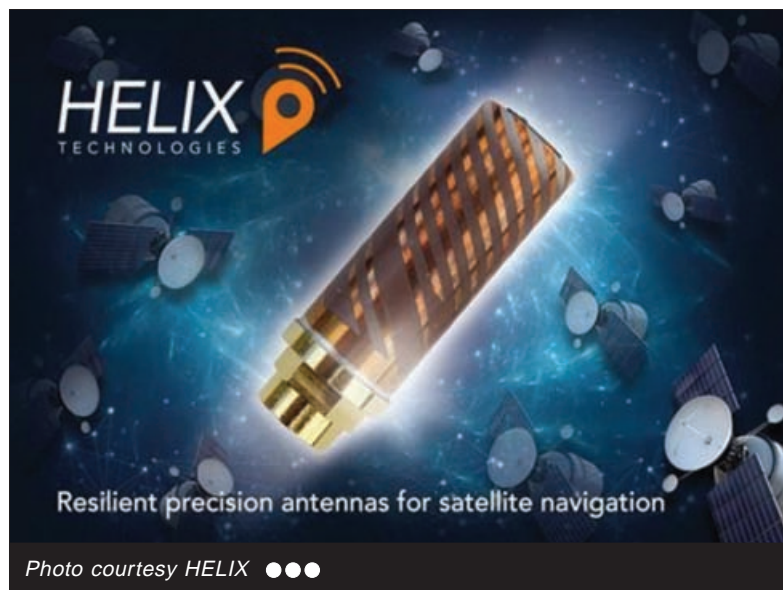
"We're delighted to have the Midven team and the UKI2S fund onboard as an investor in Helix. We are now able to confidently demonstrate our technology to lead customers in defence, aerospace and automotive sectors, and anticipate moving forward into production of our super-accurate GNSS antennas", commented James Lewis, CEO of Helix.

Andy Muir, Director at Midven, said, "We believe this is an important strategic investment for the UK which will unlock safe, autonomous mobility. Helix's location at our partner Harwell Campus, home to the Harwell Space Cluster, is perfect to aid their growth".

The new dimension in redundancy control: ND SATCOM's RCU 6000

Yet another dimension of ND SATCOM's satellite communication technology has been revealed: the new redundancy controller unit RCU 6000. Offering a highly intuitive user interface to manage all functionalities – from various base band encoders to multiple HPAs with all switch elements – the RCU 6000 represents ND SATCOM's ongoing commitment to superior mission-critical performance and reliability.

The new RCU 6000 2U unit has plenty of physical interfaces to not only control a 1:1 WGS system but also – and easily – 6:1 redundant uplink chains or more. The reliability of the RCU 6000 with fanless operation and redundant AC supply is the foundation for failsafe ground systems.

"With the RCU 6000, ND SATCOM strengthens its innovative product portfolio. The RCU 6000 is German-engineered, German-made, and ready for rapid customizations", said Bernd Lehr, Head of Sales at ND SATCOM. "In the broadcast ground station business, the new RCU 6000 helps to control more uplink components while concurrently performing more complex control tasks to minimise uplink outages. Customers can reduce station costs with less rack space and less dissipated heat, and benefit from economical cabling. This combination of exceptional quality, flexibility and cost savings are what our customers seek in failsafe operations."

The powerful new RCU 6000 features improved usability via "live view" WebUI and touchscreen. "The modern GUIs assist all engineers to quickly install complex uplinks. Selection of a specific uplink chain design is as easy as a parameter or switch command change, and are visualised in real-time," stated Michael Weixler, ND SATCOM's Head of Product Management. "Our unique GUI allows customers to deploy 'out of the box' and its clean design hides all the processing complexity. With RCU 6000 you can manage your ground station from your smartphone."

Other highlights include more processing speed and the embedded Ethernet switch that avoids communication bottlenecks over legacy serial lines. All M&C protocols support new LAN based equipment. With additional customised processing tasks, the RCU 6000 is ready to connect any device up to 1Gbps for rapid Monitoring and Control. Additional interoperability means the RCU 6000 can even optionally control customers' ND SATCOM SKYRAY antenna.

Eurotech collaborates with Infineon Technologies on security solution for IoT device identities

Eurotech, a company that designs, develops, and deploys hardware and software solutions for the Edge and Internet of Things (IoT), is working with Infineon, Microsoft and GlobalSign to simplify large scale, secure roll outs of

connected devices. This collaboration delivers assurance by extending the secured device identity chain from the edge to the cloud. Building on industry standards, the solution starts the chain-of-trust at Infineon's OPTIGA™ TPM (Trusted Platform Module) which is installed in all Eurotech IoT Edge gateways. As platform manufacturer, Eurotech extends this 'trust' to a secure Initial Device Identifier, an IEEE 802.1AR certificate-based identity that is cryptographically bound and uniquely assigned to the device. This identity attests the integrity of the platform supply chain and provides the necessary baseline for zero touch onboarding.

As part of this collaboration, Eurotech has worked with GlobalSign, one of the leading security certificate authorities, and Microsoft, with its IoT Identity Service security subsystem of the Azure IoT Edge, to further extend the chain-of-trust to cloud connectivity. This is achieved through the enrollment of additional local certificates confirming device ownership to a customer and using these identities for automatic provisioning of Azure IoT Hub operational identities by the Azure Device Provisioning service.

The solution drastically reduces the complexity of embedding strong certificate identities in cloud connected device architectures. It delivers a blueprint for the management of standard-based digital identities over the life-cycle of the device from manufacturing, provisioning, maintenance, and finally decommissioning.

Marco Carrer, CTO at Eurotech comments, "We are very proud of partnering with industry leaders Infineon, GlobalSign and Microsoft to lower the barriers of adoption of best practices for hardware-anchored digital device identities. This partnership reflects Eurotech's commitment to cybersecurity and supporting its customers to reduce device complexity and management."

"IoT is changing the way businesses think and operate, allowing them to optimize existing processes and opening the door for new business models and revenue streams," said Sam George, corporate vice president, Azure IoT at Microsoft Corp. "Streamlining the process of creating a chain of trust reduces the risk of supply chain tampering and device attacks that stem from compromised device identities. By helping to mitigate these risks, we're enabling organizations to build more durable and resilient IoT solutions—to innovate on a foundation of trust."

"Security remains the key enabler for cloud service adoption. The necessary level of protection can only be achieved by combining software security mechanisms with robust hardware-based security capabilities based on globally accepted industrial and IT security standards. A chain of trust from the node to the cloud using hardware based security anchors allows to securely identify each IoT and Edge device, to protect sensitive data as well as the integrity of the Cloud", says Juergen Rebel, Vice President & General Manager Embedded Security at Infineon Technologies.

"Secure, zero-touch onboarding of IoT devices to the cloud is an important solution that realizes immediate value through its security and efficiency said Lancen LaChance, VP of IoT with GlobalSign. It's a solid blueprint that benefits the broader IoT industry by providing a proven, best practice solution to a common IoT device identity management challenge. Our collaboration with notable experts Infineon, Eurotech and Microsoft has enabled the entire IoT industry to take one secure leap forward."
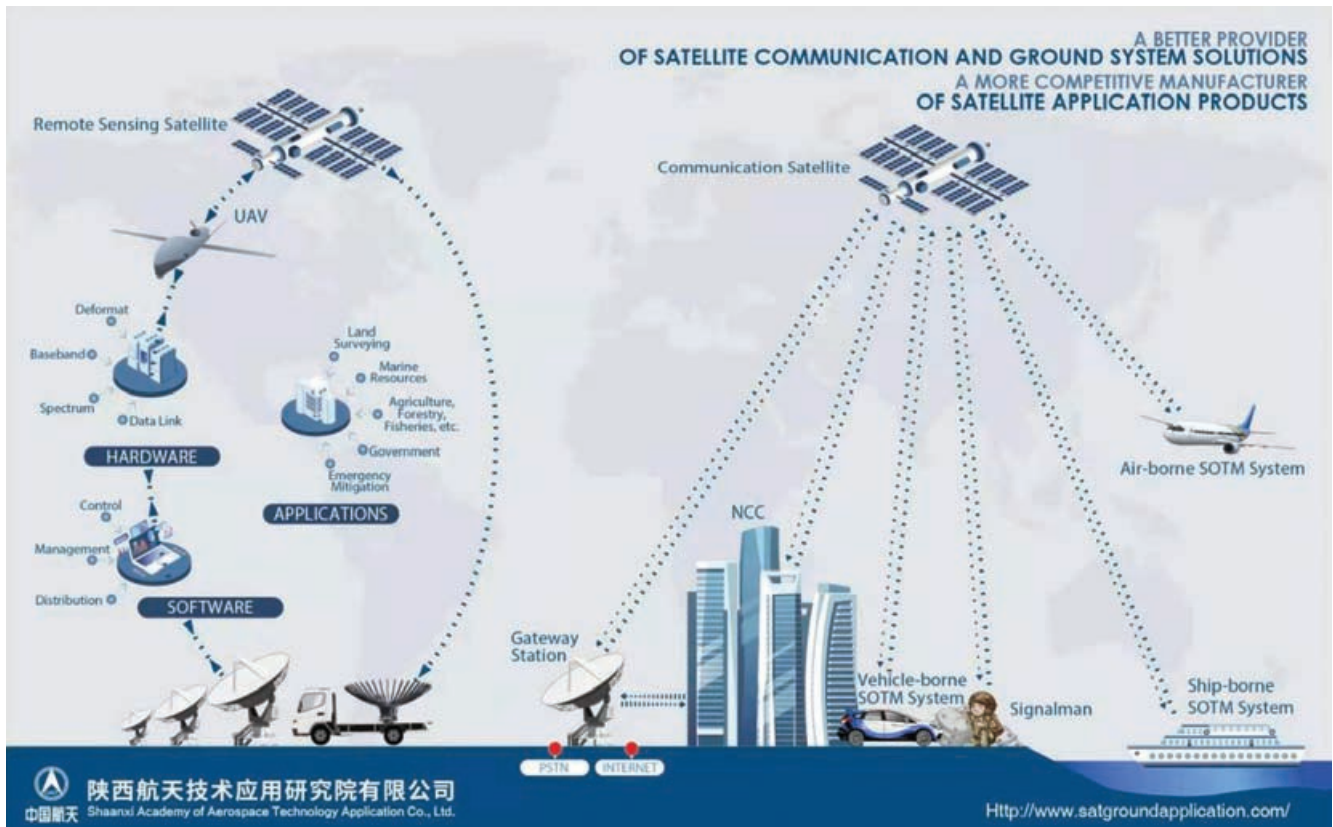
Value leakage is your biggest problem

Value leakage is a growing problem in the satellite sector as technologies come on in leaps and bounds, but smaller sites continue on with legacy equipment. Upgrading equipment is often seen as a hefty expense to be put off for as long as possible while the status quo works the same as it always has, however, upgrades needn't always be as pricey and complex as imagined.

David Burr, Vice President, Business Development for Comtech EF Data

What exactly is value leakage, you're probably asking. It's the latest buzzword for leaving money on the table. The value is there but you're not able to fully capture it for some reason.

Budgets are tight these days, and a step that many businesses are taking is to reduce CapEx spend on things like network refresh projects. While this may seem logical, many older networks are leaking value and as a result, companies are leaving money on the table because modem technology has come a long way in the last few years. Today's satellite modems are much more efficient than previous generations featuring:

- More efficient coding such as DVB-S2X, which squeezes more bits into the same bandwidth;
- Higher order modulation as high as 256 APSK that can take full advantage of higher power, more sensitive HTS and Ka-band satellites; and
- Higher processing power, which supports better WAN optimization of networking protocols to avoid transmitting unnecessary bits.

Here is the typical scenario that we see: The network is a few years old and uses an aging strictly TDMA VSAT system that is still working but has limited MODCOD support and maybe an outdated coding scheme like Turbo. In the time since the network was originally deployed the satellite operator has replaced the satellite with a more powerful one,
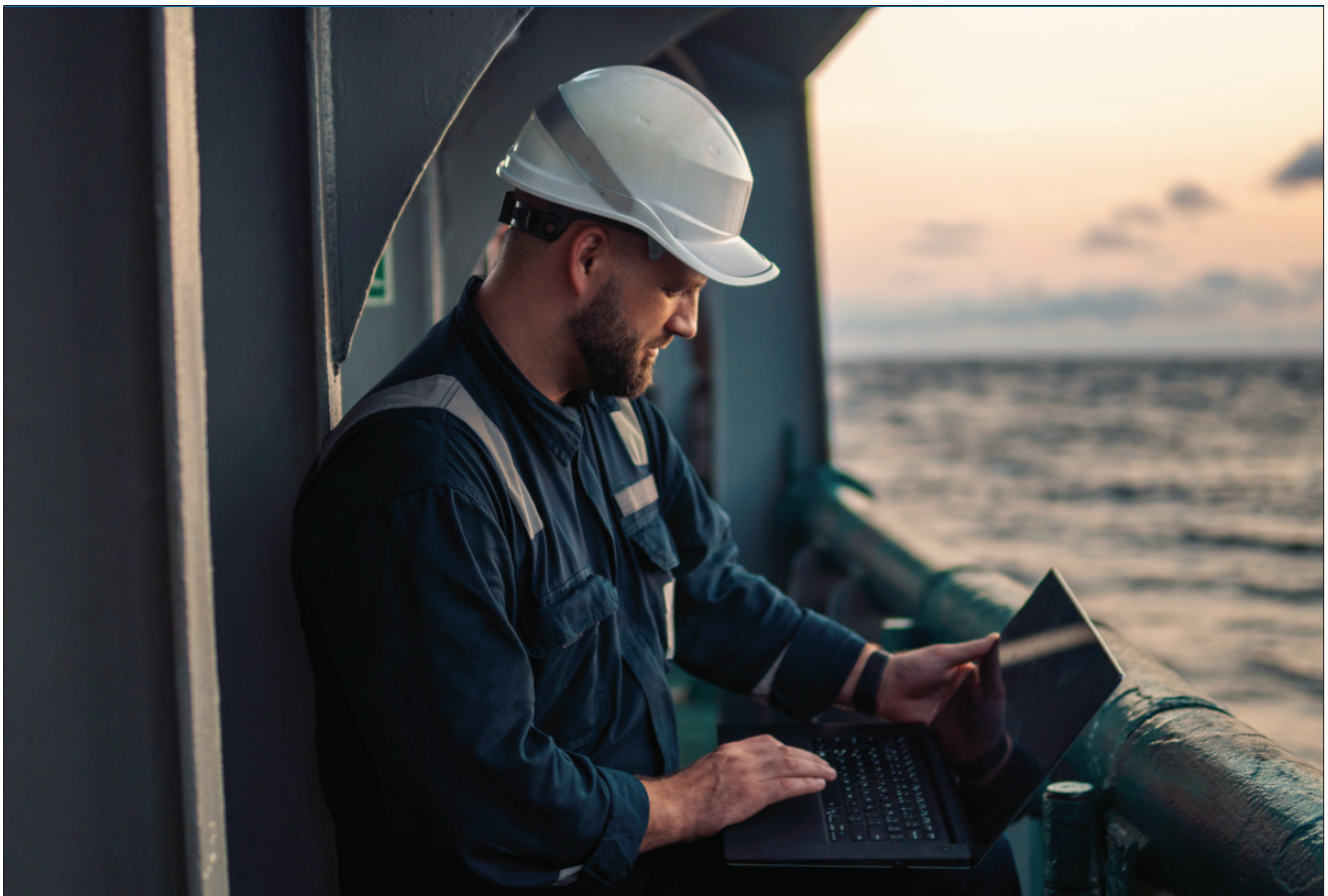
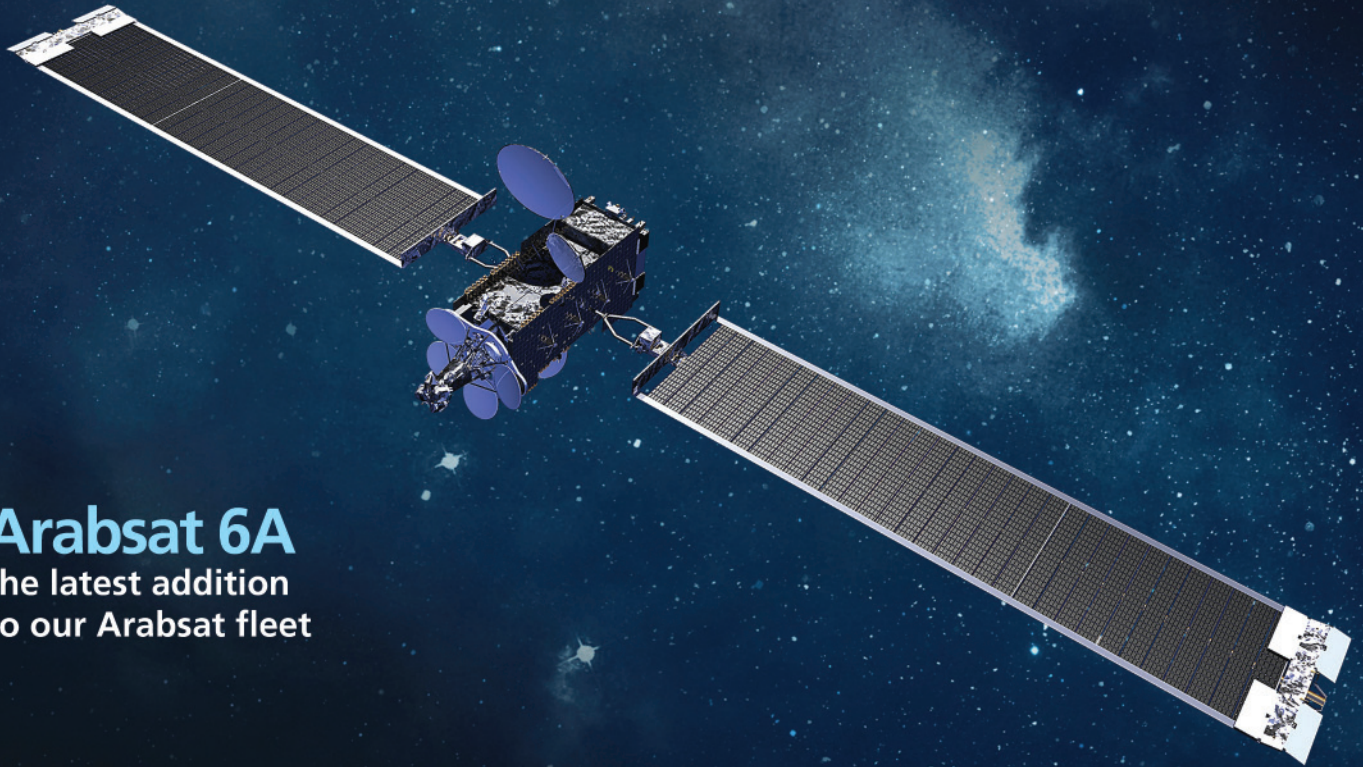*Crew connectivity is on the rise. Photo courtesy Istockphoto* ●●●

David Burr, Vice President, Business Development for Comtech EF Data ● ● ●

possibly an HTS satellite. The new satellite is providing a much better C/N than the previous satellite, but the legacy TDMA VSAT can't take advantage of the better C/N because of the limited MODCOD support. The customer doesn't really notice because everything is still working as it always did. There are fewer rain outages, which seems like a good thing until the user realizes that's because so much margin is being wasted under clear skies. Value is leaking and you are not realizing the profits that you should.

Getting value leakage under control

Even though there is value to be recovered, cash flow is still tight, so it's not easy to fund a technology refresh. So, how do you realize the longer-term value of efficiency while balancing short term cash flow constraints? Start with the highest capacity sites. While it may not be strictly an 80/20 situation, most networks have a few high-capacity sites that use much more bandwidth than the rest. High-capacity sites are also usually less bursty and benefit less from TDMA oversubscription. You can move these larger sites off the

TDMA platform and onto dedicated SCPC links with better efficiency. This allows you to either reduce the MHz – and the associated costs – or add more (billable) Mbps, both of which improve profitability and cash flow. You can then use the additional cash flow to fund the next level of sites.

Brazilian use case

One of Comtech EF Data's customers is a key service provider to the energy sector in Brazil and had to develop a plan for upgrading their network to support the increased crew Internet requirements based on the updated Brazilian regulation NR 37. They considered the two choices; adding more bandwidth to their existing TDMA platform; or transitioning to Comtech EF Data's more efficient SCPC technology.

The service provider conducted side-by-side tests over the air to compare the spectral efficiency – a measure of how much data is carried in a fixed amount of satellite bandwidth – of their existing TDMA platform and Comtech EF Data's high-performance SCPC modems. Their testing demonstrated that they were able to more than quadruple the link efficiency from 1.75 bits/Hz to 7.7 bits/Hz without having to change out any of the stabilized antennas or amplifiers offshore while at the same time significantly improving the link availability. Over a 1.5m stabilized antenna, an impressive throughput of 25Mbps duplex was achieved over Ku-band with a link availability of 99.7 percent a year even considering the regions notoriously challenging tropical storms.

In the Brazilian case, Comtech's SCPC approach was able to provide 4.4 times the throughput per MHz compared to TDMA. SCPC will provide the more efficient solution for sites and/or networks where the traffic oversubscription is less than 4.4x. The network operator can easily examine the performance of the existing network and identify sites with lower oversubscription rates, which are the best candidates for moving to SCPC. In the case of the Brazil network, all of the sites met this criterion, and the entire network was migrated to SCPC.

The H-Plus Heights Remote Gateway – The best of both worlds

The Brazil case showed the benefits of upgrading TDMA VSATs to Comtech EF Data's high-performance SCPC

Network mode ● ● ●

Point-to-Point SCPC mode ● ● ●
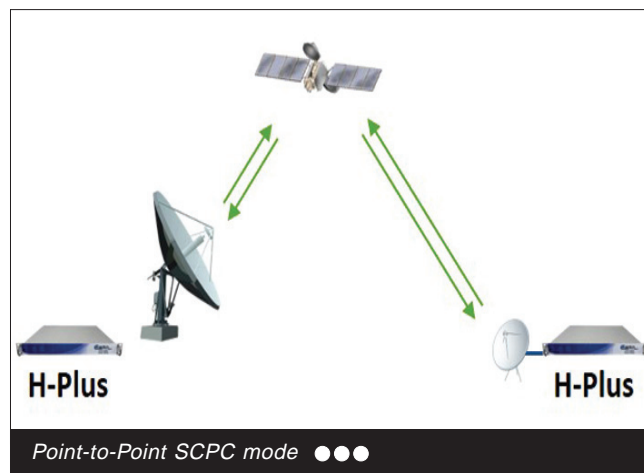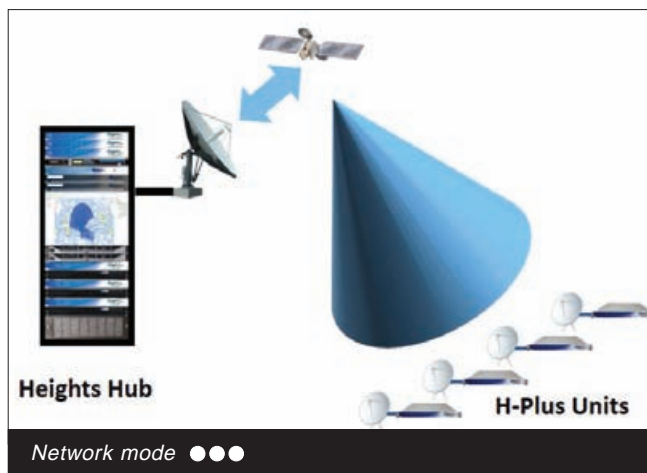
C- & KU-BAND CAPACITY FOR THE EASTERN HEMISPHERE

Yamal-601 (49°E) Yamal-402 (55°E) Yamal-401 (90°E) Yamal-300K (183°E)

The wide coverage areas of Yamal satellites enable communication services delivery to different parts of the world for the purposes of Oil & Gas, Government, Aviation, Maritime, Education and Emergency segments. Yamal Satellite Capacity is successfully used for communication links and data transmission, TV distribution, occasional use, trunking, backhaul, inflight and maritime connectivity.

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technologies. Comtech's dual mode H-Plus Remote Gateway offers service providers tremendous flexibility. In point-to-point mode, the H-Plus offers the same functionality as the CDM-625A modem including high performance coding and Doubletalk® Carrier-in-Carrier® technologies and is even interoperable with the CDM-625A. In addition, in Heights mode, the H-Plus can function as a remote modem as part of a point-to-multipoint Heights VSAT network, bringing the advantages of a shared bandwidth on demand networking using Comtech's industry-leading Heights Dynamic Network Access (H-DNA) waveform.

Using the H-Plus Remote Gateway, service providers are able to fully optimize the network by configuring sites to either high-efficiency point-to-point links using DoubeTalk Carrier-in-Carrier for high traffic sites or configuring the site as part of a managed Heights network allowing capacity to be efficiency shared by multiple sites with bursty traffic. As the network evolves, sites can be reconfigured from Heights to point-to-point mode and vice-versa, ensuring that expensive satellite resources are fully optimized.

The H-Plus provides service providers with the best of both worlds, providing the most efficient use of satellite resources while minimizing the number of modem types that need to be supported.

Many service providers look at SCPC as being 'old school,' but the superior efficiency still has a role to play, especially with today's COVID reality. Budgets may be tight, but cutting CapEx isn't necessarily the best strategy to optimize cash flow. The strategic deployment of more efficient technologies such as Comtech EF Data's advanced satellite modems with high performance, low latency VersaFEC®-2 encoding and Doubletalk Carrier-in-Carrier technology can reduce bandwidth costs and improve network profitability. A phased approach which prioritizes the largest sites can form the core of a strategy which minimizes value leakage and provides substantial financial benefits for service providers who are often forced to choose between the efficiency of SCPC and flexibility of a managed network. In this environment the H-Plus dual mode support enables service providers to offer the best of both worlds, reducing OpEx in the near term while building the foundation to transition to a fully managed network.

Value leakage. Photo courtesy Istockphoto ●●●

Es'hailSat Teleport Office. Photo courtesy of Es'hailSat ●●●

The future of satellite

There has never been a better time to discuss the exciting future for satellite communications. Recent developments and advancements in technology on multiple fronts has helped to allow closer integration with terrestrial connectivity requirements such as 5G and cloud deployment across the globe.

Zoubair Kachri, Vice President – Technical, Es'hailSat

There has never been a better time to discuss the exciting future for satellite communications. Recent developments and advancements in technology on multiple fronts has helped enable closer integration with terrestrial connectivity requirement such as 5G and cloud deployment across the globe.

The increasingly integrated networks allow purposed-fit delivery based on requirements for different applications through a combination of satellite and terrestrial deliveries.

Software defined satellite

One of the latest trends within the satellite industry is the emergence and adoption of software defined satellites for both geostationary and non-geostationary orbits. Software defined satellites have the capability to dynamically change coverage, power, and frequency allocation dynamically in-orbit. For end users, software defined satellites offer the possibility to customize coverage requirement for connectivity not only at the stationary ground location but also on moving platforms such as aircrafts, vessels, and vehicles.

With software defined satellites, the flexibility on-board can be used as an additional mitigation technique to overcome unwanted interference signals and thus enhance the reliability of a communication link.

From the satellite operator's perspective, these types of satellites help operators to optimize, protect and allow entry into new markets as demand changes over the satellite long operational lifetime. The optimization can be done through effective allocation of usable bandwidth to high demand area as well as adapting capacity and coverage in accordance with the latest spectrum license and coordination agreement with other operators. As for protection, software defined satellites can be used as an effective in-orbit backup within a fleet of satellites either through changes in coverage or a one-to-one swap with a failed satellite.

Given that in-country VSAT markets are regulated by their respective national regulator, a local gateway is generally required as part of the pre-requisite to serve the market. It is notably hard for existing high throughput satellites to have gateway beams designed for each and every country within its coverage, however, with a software defined satellite the operator can set up gateway beams for countries in accordance with market demand on-the-fly without the need to over-design the satellite capability prior to launch. This

would usually require three years minimum of advance planning and have a fixed setup for the next 15 to 20 years. It is worthwhile to note that despite the software defined satellite concept gaining traction across the satellite industry, there is still room for further development in technology to achieve full flexibility, particularly in areas such as regenerative payload, interface standardization, and higher power module onboard.

Cloud and network integration

On the network level, cloud integration with satellite operators is becoming more prominent.

As reported by NSR, cloud services delivery in communication via satellite is seen to have the greatest revenue potential of up to US$1.8 billion by 2029 starting from US$200 million in 2019. Cooperation between cloud providers and satellite service providers in recent years has been increasing where integration of cloud servers at the operator's teleport is done to serve remote satellite users. This improves the end user customer experience and allows penetration of cloud services to areas not connected by terrestrial networks.

With further expansion in edge computing, it will be no surprise that one day the current deployment model could be further expanded to on-site remote community where the edge computing servers will be hosted and connected to the cloud via satellite backhaul. On the other hand, the implementation of SD-WAN technology will further increase the cross-integration between multiple access technology i.e.,

satellite, cellular and fixed line. Together with application of cloud computing power to analyze the traffic, we believe SD-WAN will help to optimize the delivery of data in accordance with data type and application and provide unification to end user experience. The blend of connectivity will help to expand satellite use cases in 5G scenarios where satellite can be used to complement the terrestrial connectivity in meeting availability and coverage requirement.

Ground terminal improvement

Lastly, the development of flat panel terminals and their associated beam forming technology will also help to expand the use of satellite connectivity, particularly in mobility segment. The small form factor and efficient performance will be a key enabler to serve aviation, maritime and land mobility connectivity requirements. One example is maritime where the smaller form factors open the market for smaller vessels, where in the past it was limited by the space available on board.

As of today, the effort and development of these terminals are still on-going by established flat panel providers as well as new manufacturers. Ultimately it is expected that the performance and cost efficiency of flat panel antennas will be improved and thus help to increase penetration into more diverse markets.

With continuous development in space, ground and network, satellite communication will continue to be part of the important link in supporting connectivity requirement across the globe, be it in air, at sea or on land.

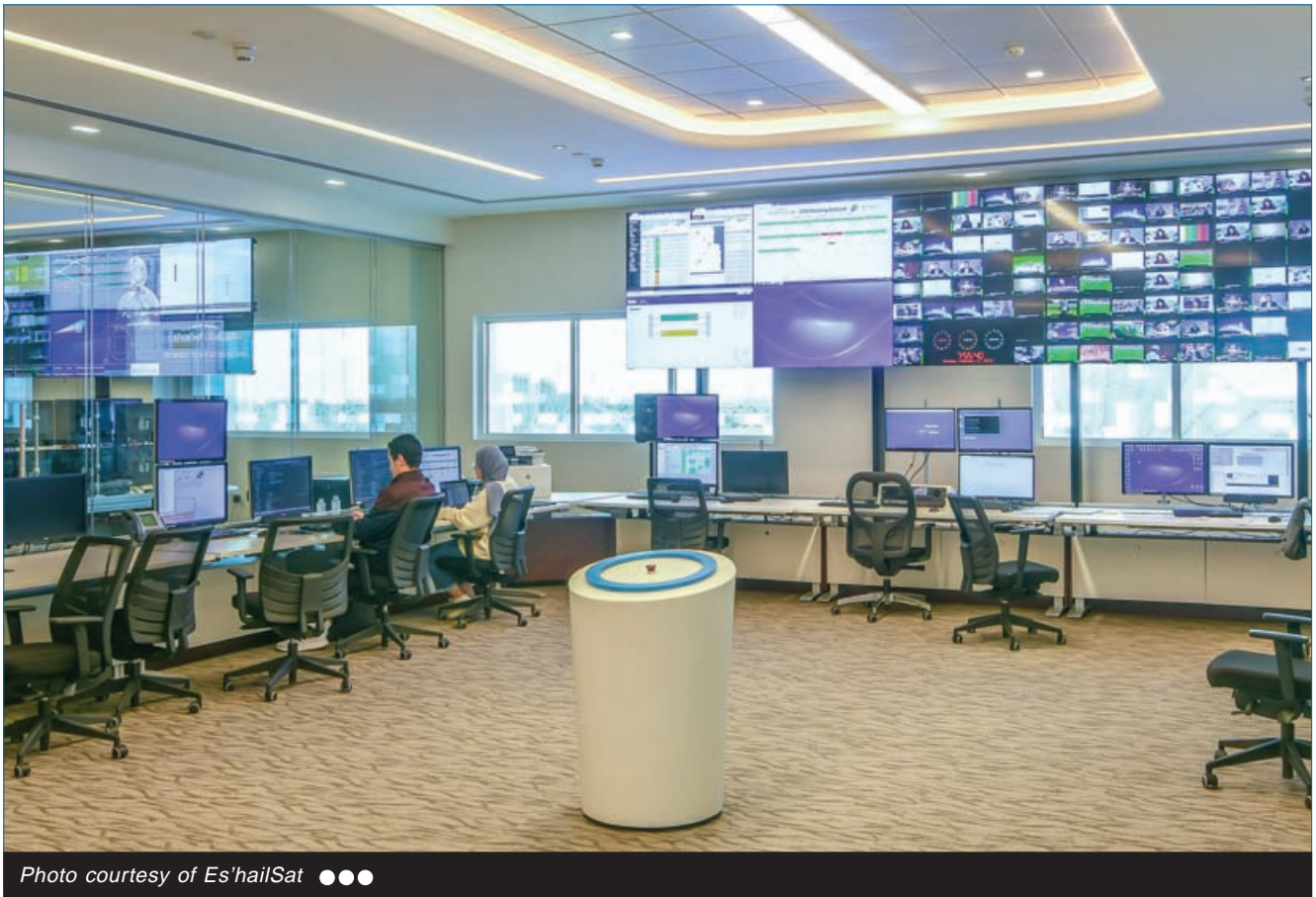
Photo courtesy of Es'hailSat ● ● ●

Kia reveals new UVO connect phase II connected car features. Photo courtesy Kia ●●●

Connecting cars – the technology revolutionizing the road, and how it's skirting the potholes

In the revolution of digitization endemic to industry 4.0, connecting our cars seems like one of the more obvious steps forward. However, with the high demand of automotive technologies, there is no room for error. Innovative car safety, vehicle automation, and true connectivity technology must be rigorously reliable before being fully integrated into a three-tonne machine capable of reaching tremendous speeds.

Laurence Russell, News & Social Editor, Satellite Evolution Group

It's predicted that by 2030, all new vehicles produced will contain connectivity technologies. Already, many pioneering products and services are trailblazing the market. Hyundai's Blue Link suite offers 50 connected-car functions supported by over-the-air (OTA) updates. Features include wake-up commands for management of climate control, fans, radio, media, and navigation as well as remote solutions like remote lock, find-my-car, tyre pressure data, crash routines and stolen vehicle tracking and immobilisation. Another service, Kia's UVO Connect suite, integrates with smartwatches, and allows nine voice command categories for control of calling, media, navigation, and weather notifications.

The integration of touchscreens, sensors, modems, or IoT integrated remote capabilities like virtual assistants, satellite geolocation, dashcam activation, and security measures to deter theft in the modern smart car are steadily turning vehicles into vessels of consumer electronics and applications in line with the culture we associate with our phones.

Connective technologies

Roshan Batheri, Director of the Automotive and Manufacturing Industry Hub of Capgemini explains: "Car manufacturers have prioritized connectivity features as part of their respective brand strategies and positioning of the products… Certain concierge services included in these features are high in demand among consumers."

The onset of 5G is said to be especially lucrative for industrial applications, though vehicle IoT stands to benefit too. With reliable communication from car-to-car as well as the road infrastructure their use could revolutionise automotive safety, optimize traffic throughput, and better accommodate emergency vehicles.

Honda's SAFE SWARM technology, first developed in 2017, uses cellular vehicle-to-everything (C-V2X)

communication to coordinate vehicles and road use. The technology requires onboard artificial intelligence capability inside a car in order to properly operate, which could be made far more realistic with the advent of 5G.

"Honda's research collaboration with Verizon is an important step in our multi-year effort to develop connected vehicle safety technology to realize our vision for a collision-free society," said Ehsan Moradi Pari, Research Group Lead at Honda's Advanced Technology Research Division. "While the research is preliminary and not intended as a product feature at this time, 5G-enabled vehicle communication and MEC have the potential to advance safety for everyone sharing the road."

"The need of the hour is a 'platform' architecture with advanced analytical capabilities," concludes Batheri. "Contextualized to the need of customers from a business use-case perspective. OEMs need to have a clear approach towards the architecture and offer relevant use cases to generate initial interest."

Automating cars

The logical extension of car connectivity lies in the full automation of the driving experience, delegating the job to sophisticated systems primed to drive faultlessly. The potential to reduce car accidents and eliminate the problem of drink driving is an attractive one, but it requires road infrastructure which is automation friendly. Richard Robinson, CEO of Atkins predicted that around 80 percent of the infrastructure being built today will last until 2050, meaning it needs to be

rigorously futureproofed for the advances in car technology we're seeing today.

While the proper infrastructure is important, the potential for automated roads can save public money, too. A theoretical argument proposed by pro-automation commentators explains that a world with only self-driving cars wouldn't need any of the traffic infrastructure required to coordinate human drivers, suggesting a potential UK£300 million could be saved in CAPEX and OPEX investiture by national and local government per year. Zero visibility, unlit, small lane roads, without traffic lights or complex intersections are far cheaper to run than the traditional highways we use today.

While the full automation of automobiles is unlikely in our lifetime, even marginal uptakes of automated personal travel could result in massive savings in government expense. Potential automated-only travel zones, perhaps as a traffic mitigation method in cities, could field-test these technologies.

A series of Centre for Connected and Autonomous Vehicles (CCAV) innovation trials are being undertaken around the UK, though true commercial viability is still being searched for, as investment is found, technology becomes affordable, and the public slowly accepts the notion of being transported by automated services.

The cybersecurity risks

These new technologies possessing control of ever more analogue systems of the vehicle has put some consumers ill at ease, admitting that they're afraid of their vehicle being hacked, allowing them to be tracked, remotely locked (in or

The Toyota Lexus LS, left, and Mirai FCV are equipped with level 2 autonomous driving. Photo courtesy Toyota ●●●

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out of their vehicle), or having an automated car's destination redirected against the owner's will.

Cybersecurity experts highlight other vulnerabilities like trojan effects such as fake updates sent to the car or dubious products which circumvent security by being plugged into the car's OBD II port. The sensors and cameras too, can be tricked with the right projection of light. "Our biggest worry is the hacking of a fleet," said Ronen Smoly, Chief of Argus Cyber Security, a division of the auto supplier Continental. "Most serious hackers come from well-funded groups working for long periods of time."

Indeed, in 2019 an automotive cybersecurity company called Karamba Security made their vehicle electronic control unit accessible online as a secret test to see how many actors would attempt to hack into it. In under three days, 25,000 breach attempts were logged on the platform, with one being successful. The project being a test meant the hacker didn't gain control of anything, but the demonstration affirmed fears of vehicle hackers all the same.

Scores of similar breaches have been reported across the world's major automotive brands, though given the emergent nature of connected car technology, many of these hacks were benign. "To take control of a vehicle's direction and speed: This is what everyone in the industry is worried about," said Ami Dotan, Karamba's Chief Executive. "And everyone is aware this could happen."

Given the difficulty of securing air travel in the wake of 9/11, exposing vulnerabilities in our cars could stand to be an even greater challenge. Luckily, OEMs are aware of these dangers and are actively layering in security measures at every step of the manufacturing chain. Electronic control units are being designed to alert of all unexpected communications between systems, locking them down by default, and vehicle control is kept in its own separate domain. This all lies beneath explicit cybersecurity suites featuring firewalls, fail-safes, and user overrides. "Human life is involved, so cybersecurity is our top priority," said Kevin Tierney, General Motors' Vice President for Global Cybersecurity.

At the time of writing, these efforts are still being performed absent of any active international standards or regulations, though the United Nations are continuing to legislate on the issue, establishing vehicle cybersecurity risk assessments and readiness reports for manufacturers which will come into force in Japan and South Korea in 2022, and Europe by 2024. The United States unfortunately abstained from agreeing to the standard.
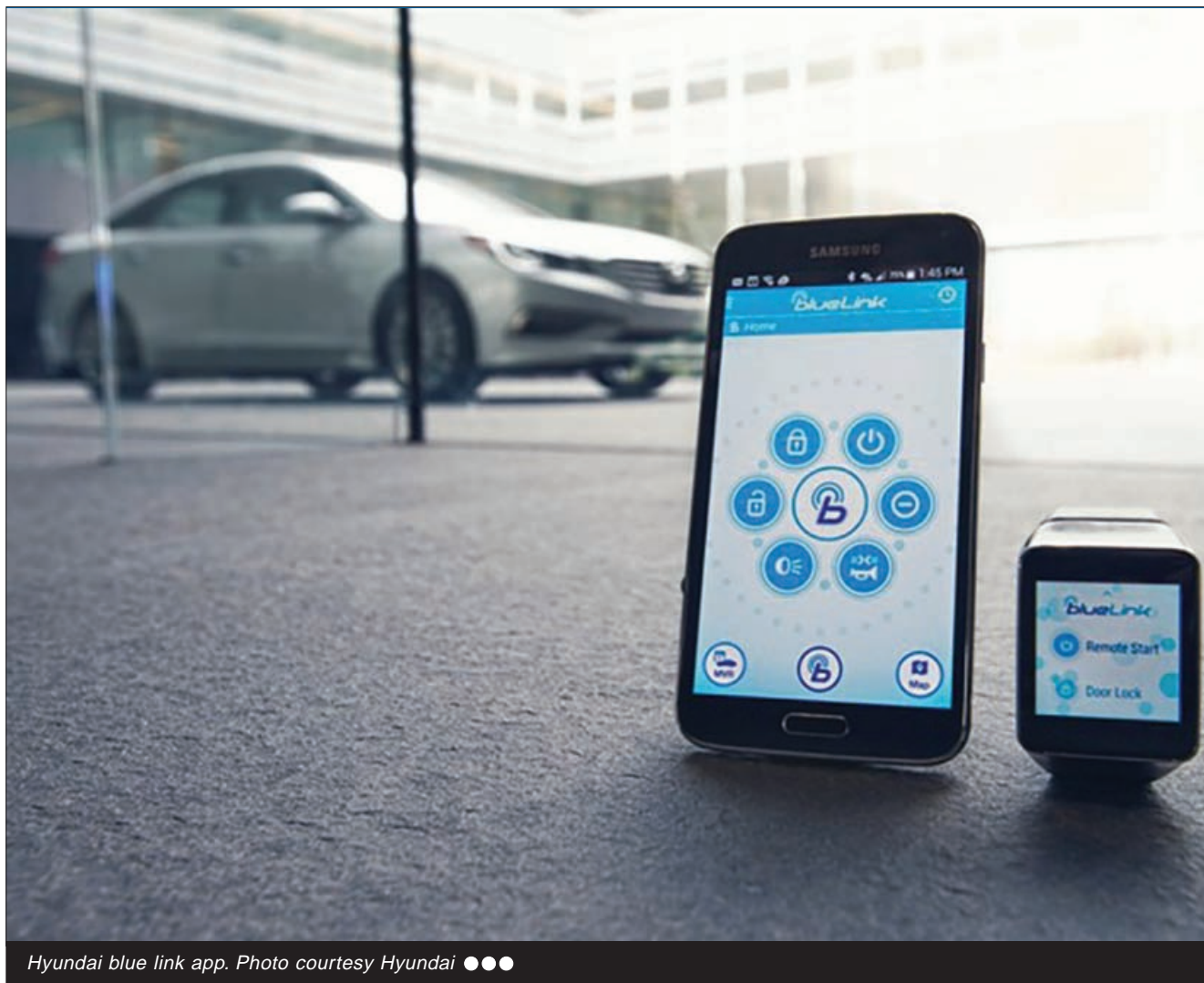
Hyundai blue link app. Photo courtesy Hyundai ●●●

Doreet Oren, Director - Product Marketing, Gilat Satellite Networks ●●●

The elastic era

Founded in 1987, Israel's Gilat Satellite Networks develops VSAT satellite ground station terminals and related equipment. In recent years, the company has managed some impressive feats, and is now focusing on the new challenges of flexible satellite networks. Doreet Oren, Director - Product Marketing, at Gilat Satellite Networks, explains.

Amy Saunders, Editor, Satellite Evolution Group

Question: What advantages will next generation satellite communications deliver?

Doreet Oren: The satellite communication industry is going through an enormous transformation. Next generation satellite technology is evolving to multi-orbit constellations that include non-geostationary orbit (NGSO) constellations, very high throughput satellites (VHTS), as well as the traditional geosynchronous Earth orbit (GEO) satellites. This next phase will enable ubiquitous connectivity for fixed and mobility sites, 5G and IoT, and will require innovation to provide the needed higher throughput, higher flexibility and network orchestration between ground and space. At Gilat we refer to this next generation as the 'Elastic Era' of satellite communication, based on the demand for agile, flexible, and scalable solutions.

The Elastic Era, the next generation of satellite communication, will more accurately and efficiently focus resources on actual demand with minimal costs. This transformation will address the major satellite industry challenges of needing higher network capacity, at a lower cost, with ensured availability, lower latency, and higher throughput per user. The network elasticity will address both day-one operation as well as on-going changes in network requirements.

In this new era, fully elastic networks will be configured and maintained on-the-fly to best match customer bandwidth demand, maximize space segment efficiency and rapidly adapt the network to support changes in service requirements through the whole lifecycle of the network. The Elastic Era challenge must be met by both satellite operators and ground segment providers.

The challenge requires the flexibility and adaptability of software-defined satellites. The new dimension in satellite connectivity supports hundreds to thousands of beams that can be created on-demand, with dynamic beam shapes

Figure 1. Photo courtesy of Gilat Satellite Networks ●●●

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enabling a flexible ground footprint. Using dynamic inter-beam connectivity, satellite beams no longer need to connect a service from only a preassigned gateway.

Furthermore, the throughput of software defined satellites can be modified per demand and maintained under fade conditions due to dynamic power and frequency allocation. The elastic satellites provide a better answer for changes in user demand and network conditions, as well as better meeting the challenges of mobile applications.

For the next generation network to operate most efficiently, harmonious integration between the elastic software-defined satellites and the elastic ground segment must take place. In addition, central orchestration of the ground and space segment with smart resource management is key to meeting the demands of the Elastic Era.

The Elastic Era will increase reach to better enable bridging the digital divide, will support bandwidth intensive applications such as used on cruise ships, wide-body passenger airplanes, 5G cellular backhaul, and IoT aggregation, as well as enable low latency real-time applications that will unleash new market opportunities, where satellite communication was previously unfeasible or commercially challenging. On top of this, new standards integrating the satellite domain with terrestrial communication will deliver added flexibility and improve utilization of all network assets to boost the connected world.

Question: What are the implications of the Elastic Era on the ground-segment?
Doreet Oren: The implications of the next phase of satellite communication requires a ground-segment that is scalable and agile, providing an order of magnitude increase in performance, density and flexibility as well as providing support for multiple orbit solutions.

Gilat's elastic architecture supports the dynamic needs of the network throughout its ongoing operation. This includes accommodation of day-one operation over a large geographic coverage area, as well as scaling up with increased bandwidth, an increase in users and expanded geographic coverage as well as support during the network maturity phase and accommodating ongoing changing demands.

In the elastic architecture, ground-segment scalability is no longer tied to the beam structure and peak usage. This gives a great advantage for network scaling independent of the beam peak throughput, beam footprint and beam coverage. As a result, ground infrastructure is better optimized, reducing costs and footprint while hardware is added only as network utilization increases, enabling maximum CAPEX utilization on day-one operation. *See Figure 1.*

The virtualized architecture supports a cloud infrastructure and thereby significantly improves software agility and compute density.

The programmable Software-Defined Network (SDN) also allows for on-the-fly changes to beam carrier configuration to address dynamic network optimization. Carriers can be modified to increase or reduce capacity to better accommodate service needs, or to mitigate signal fade conditions. For example, as a larger passenger airplane goes through a beam, capacity can be temporarily increased to accommodate the need of intensified usage.

Or, when fade mitigation is required the SDN provides capacity steering to ensure uninterrupted service. The elastic architecture enables seamless

ELASTIC ARCHITECTURE MATCHES SERVICE NEEDS
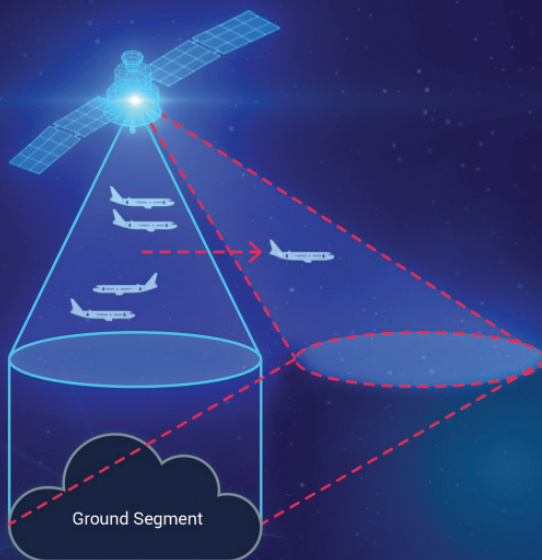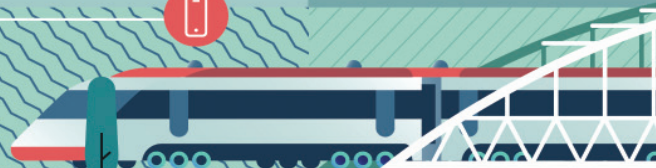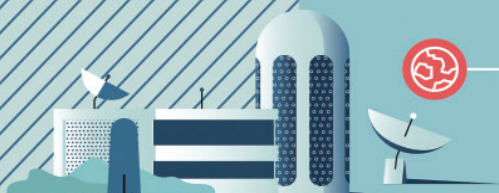
Seamless reconfiguration of resources

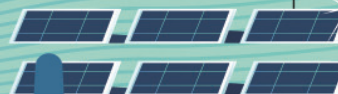Ground Segment

Figure 2. Photo courtesy of Gilat Satellite Networks ●●●

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reconfiguration of resources. *See Figure 2.*

Gilat's elastic architecture also allows dynamic capacity steering of resources between beams to answer real-time changes in terminals throughput demand over specific geographic locations. No longer will it be required to allocate the maximum needed carrier size and compute power ahead of time. The inefficient 'design to peak usage' is no longer essential, due to the architecture's elastic nature.

Question: What are the main challenges for the ground-segment, specifically as the industry transitions to NGSO constellations over GEO satellites?
Doreet Oren: The Elastic Era has massive implications on the ground-segment in order to support NGSO constellations. Unlike GEO networks, the ground-segment now needs to communicate with 'moving' satellites.

Gilat's elastic architecture is designed to address the multi-orbit operation of any satellite constellation, LEO or MEO, including seamless handovers between GEO and NGSO, implementing 'make before break' for an uninterrupted user experience. This ensures that service is continuous and

that the change of coverage between satellites in different orbits is totally transparent to the end-user. *See Figure 3.* On the physical layer, the Doppler effect and the dynamic fade of the physical link are significant in NGSO, as the satellites are constantly moving relative to each other. This effect can be mitigated with Gilat's Air-Interface modifications that include timing synchronization, frequency corrections and power management.

Yaron Katriel, VHTS & NGSO Senior Product Manager: "There are exponentially more complex design considerations for the ground-segment when operating with 'moving' satellites. These design considerations are carefully mapped to the network Operational Concepts, known as CONOPS, and require smart engineering and modifications to many aspects of the ground-segment. These include processes such as satellite acquisition, initial pointing and VSAT logon, as well as continuous communication while performing seamless satellite handover.

Question: What level of integration is required between the satellite and ground-segment resources?

Doreet Oren: The Elastic Era of satellite connectivity requires a much tighter integration between the satellite and ground-segment than was previously needed. In traditional networks the satellite and the ground system were managed separately and relatively decoupled. However, the next generation network requires a new entity, a Resource Manager (RM), to orchestrate between the space and the ground- segment. The elastic network is constantly changing to dynamically meet both user demand and network conditions.

This requires the RM to carefully analyze the real-time situation as well as to anticipate upcoming trends that must result in smart decisions on resource allocations in space and on the ground. The RM then must orchestrate the execution of the required changes simultaneously to both segments, in a coordinated streamlined fashion. As an example, creating a new beam in space and generating a new carrier on the ground must be coordinated from one central place, to ensure reliable and fast network operation.

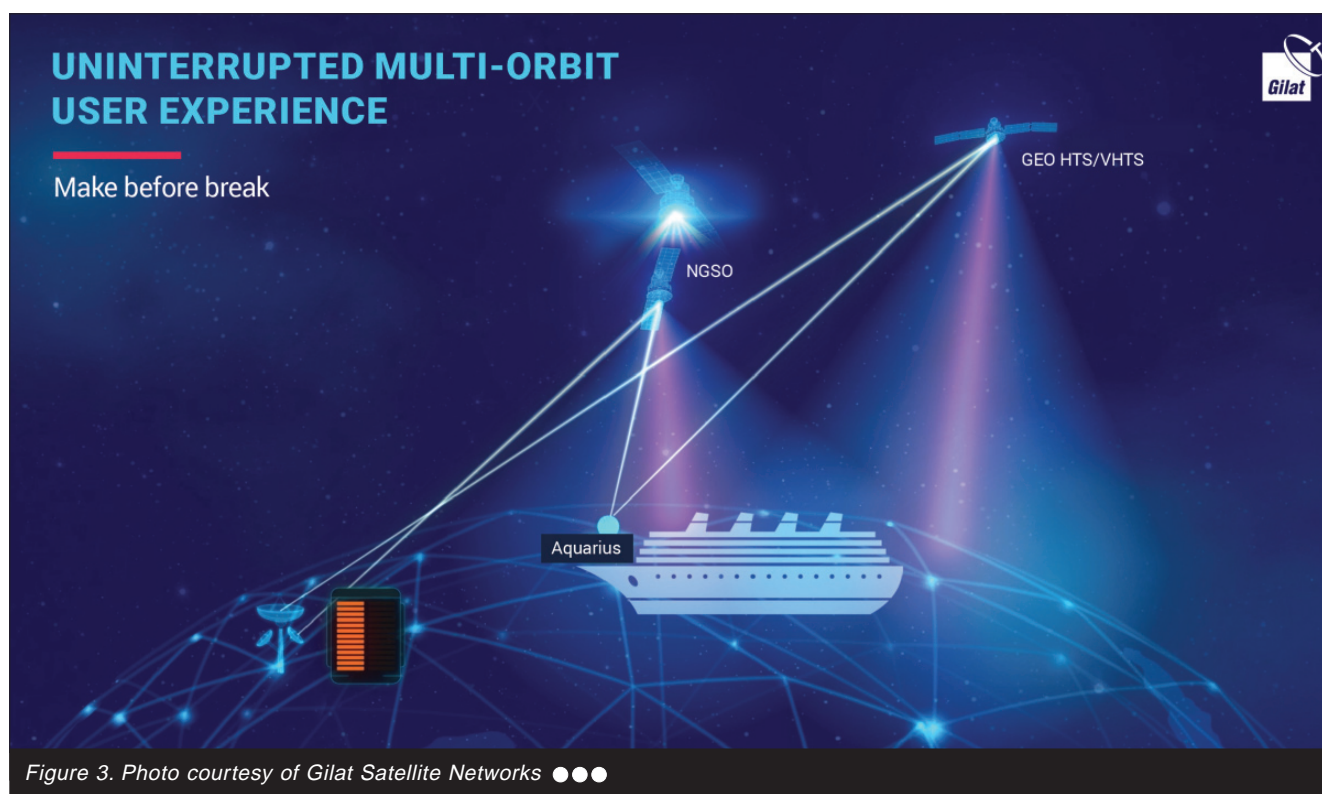For the Resource Manager to make the best ongoing decisions on current needs, it requires from the ground-

UNINTERRUPTED MULTI-ORBIT USER EXPERIENCE

Make before break

Figure 3. Photo courtesy of Gilat Satellite Networks ● ● ●

segment real-time input on the network's status such as: Per beam user demand, links' utilization, fade conditions and user locations. Furthermore, the RM receives detailed information on the status of the resources from both the ground and space segment.

Gilat's SDN platform is designed to provide the required high agility by enabling fast steering of platform resources in addition to providing high quality big-data collection that is used as input to the RM's smart decision making. This is done with a robust open interface that supports streaming of large volumes of information to the RM.

Gilat's next generation ground-system is designed to be able to monitor and collect detailed accurate information in real-time and at a high resolution, on all elements of the network. The ground-system must also have the intelligence to receive input from the RM in order to smoothly and seamlessly execute configuration changes without service interruption. It is the agility of the elastic architecture that steers network resources from place to place.

Question: What are the key domains that require focus and attention to best meet future requirements?
Doreet Oren: In order to meet the future requirements of the Elastic Era, there are two additional elements that have not yet been addressed in this interview, namely network performance and multiple solution scenarios.

Network performance
The Elastic Era of connectivity requires a tremendous increase in speed. The industry conversation has changed from requiring megabits per second to gigabits per second. The Internet is no longer mainly the provider of content, but the platform for considerable data sharing requiring high bandwidth. The need for uploading data to the cloud, such as social media videos, is setting the requirements for faster VSATs in both directions.

Next generation VSATs must be designed to serve, with maximum efficiency, data intensive applications. The VSATs must exhibit ultra-high processing capacity achieving unprecedented high throughputs for both downloads and uploads including

> **"Gilat's SDN platform is designed to provide the required high agility by enabling fast steering of platform resources in addition to providing high quality big-data collection that is used as input to the RM's smart decision making. This is done with a robust open interface that supports streaming of large volumes of information to the RM."**

●●●

high packets per second processing to meet the high-performance demands. The combination of high throughput and the low latency from NGSO constellations creates an opportunity for delay-sensitive applications.

As an answer to this need, Gilat has already launched the Aquarius family of next generation VSATs to address the elastic nature of tomorrow's data and media intensive applications. The Aquarius family of VSATs builds-on Gilat's long-time expertise and patented technologies and enables over 2 Gigabits of concurrent speeds and higher packets per second to serve bandwidth hungry applications such as required for 5G connectivity. The Aquarius VSAT family also answers the need for multi-access edge computing infrastructure, enabling deployment and orchestration of third-party virtualized network functions on the VSAT modem itself, simplifying remote site management and operations for next generation edge services, such as video caching and IoT gateways.

Another performance concern of a next generation satellite network is the return access scheme, that must rapidly adjust to the changes in the network. The VSATs must have the flexibility to best address the 'moving' satellites as well as high throughput backhauling and mobility applications. It is essential for the elastic network to have the flexibility such as incorporating different VSAT types on the same beam and various applications on the same network. To meet this challenge, a wide range of return carrier symbol rates are needed to address the variety of applications and their dynamic needs. At Gilat we refer to the next generation access scheme as having elastic dimensions for dynamic channels.

Multiple solution scenarios
The next generation ground-segment must be built to support multiple solution

scenarios. The platform must provide service to multiple vertical markets that can operate in multiple frequency bands, across multiple beams and satellites, as well as across multiple orbit constellations.

Gilat's elastic architecture serves multiple applications with varying needs and is equipped with a set of VSATs that are fine-tuned to best address the diverse dynamic needs.

We expect that GEO, MEO and LEO constellations will continue to live in harmony as complementary technologies, each with its own advantages. As such, Gilat's elastic architecture is designed to provide seamless handover between orbits.

This is important to enable multi-orbit, per application and per geographic area with varied service options, and to deliver orbit redundancy. A seamless multi-orbit operation ensures that users can continue to enjoy uninterrupted service being completely oblivious to the orbit switch.

Opportunities
To conclude, the Elastic Era of satellite communication is introducing the opportunity for creating a gradual but profound change in our digital lives, which will influence all aspects of our existence, from health to education to banking and to social connectivity.

The significantly larger amounts of bandwidth, reduced service price, and promise of improved latency enable new markets including 5G, video conferencing, tele-medicine, compute intensive IoT, banking/trading and other cloud-based applications. This is in addition to new dimensions of more traditional markets such as maritime, commercial/business aviation, education, government, and rich media services. In order to harness the power of next generation satellite communications, elasticity is the name of the game.
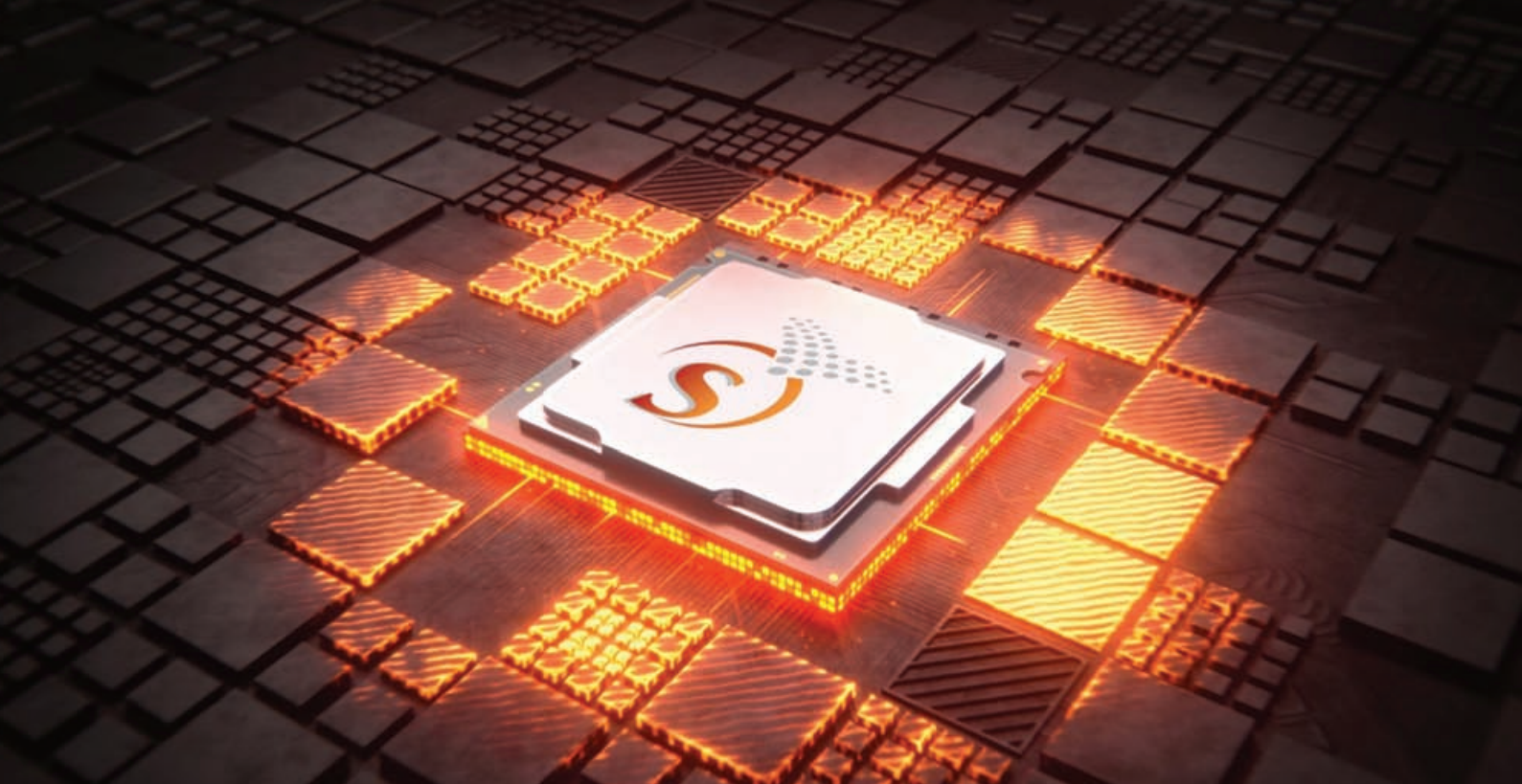
Image courtesy Saankhya Labs ●●●

Redefining the Satcom landscape with SDR based solutions

Established in 2007, Saankhya Labs is India's premier wireless communication systems and semiconductor solutions company. With many wins under its belt including the industry's first software defined radio (SDR) chipsets, Saankhya Labs offers a whole suite of transformative solutions and has huge global expansion plans.

Dr Amy Saunders, Editor, Satellite Evolution Group

Saankhya Labs has been taking India by storm since its inception back in 2007 and has now fixed its eyes firmly ahead on global expansion in Satcom.

The company is redefining the satcom landscape with SDR based solutions, having already developed next generation solutions for 5G Open RAN, broadcast and satcom applications. Its solutions are based on its award-winning patented SDR chipsets supporting a wide variety of wideband and narrowband waveforms. The field-proven solutions differentiate themselves with programmability, size, weight, power efficiency, thanks to its SDR technology.

With extensive experience in asset tracking solutions on land and at sea, as well as secure, reliable voice communications via Satphone, Saankhya Labs is extending its reach further into an SDR supported satcom's future to address the growing need of low power, small footprint Sat-IoT applications.

Ensuring coastal security

Vessel tracking systems are big business - initially optimized for monitoring larger boats, the systems are now being rolled out to a wide range of vessels including fishing boats, marine fleets and ocean buoys. These systems provide numerous advantages for users, including improved security at sea, increased cost efficiency, emergency broadcast messaging applications, SOS signalling and ensuring regulatory compliance.

In 2008, India witnessed one of the most horrific terror attacks in which terrorists travelled by fishing boat to reach Mumbai. Over 166 Indian and foreign citizens were killed in the 26/11 terror attack. Since then, India has been beefing up its coastal security apparatus.

Addressing the requirement of a vessel tracking system for small and deep-sea fishing vessels, Saankhya Labs developed an innovative vessel tracking terminal in collaboration with ISRO. Saankhya Labs' award-winning system consists of a two-way MSS terminal called NAVDOOT, which contains a battery powered S-band modem, a GPS/IRNSS-NAVIC receiver, a Bluetooth module, and antenna on top of fishing vessels.

NAVDOOT communicates over satellite link and interoperates with an L-band Multichannel Burst Demodulator installed in the central hub location. NAVDOOT transmits its geolocation coordinates to the satellite at regular intervals, and operates as a satellite hotspot for Android phones, enabling two-way data connectivity between ship and shore.

The vessel tracking infrastructure over Indian satellite provides a common communication platform for Indian

maritime agencies to track and monitor suspicious activity along India's maritime border. Fishermen can report suspicious activity from deep-sea to shore and aid nearby shipping vessels during emergency.

So lauded is the Navdoot Vessel Tracking System that it won the Skoch Defence Award in the Gold category in 2020. Saankhya Labs will be operationalizing an end-to-end vessel tracking and monitoring network of approximately 3,000 fishing vessels for one of the coastal states in India.

Enhanced tracking on the rails

Real-time locomotive tracking has been proven to provide better regulation of railway traffic, reducing collisions, increasing punctuality and providing more accurate information on arrivals, departures and delays to passengers.

Naturally, Saankhya Labs has a solution for this as well. Its Real-Time Locomotive Tracking System comprises the two-way MSS fully ruggedized terminal NAVRAIL - configured to continuously transmit its geolocation coordinates to the satellite via S-band - mounted on top of locomotives, and an L-band Multichannel Burst Demodulator installed in the central control location.

Apart from real-time location tracking, NAVRAIL enables two-way communications between the locomotive and central control.

To date, more than 2,600 NAVRAIL terminals have been deployed as part of the Indian Railways' Real-Time Train

Two-way MSS terminal called NAVDOOT. Photo courtesy of Saankhya Labs ● ● ●

Information Systems (RTIS) project in collaboration with ISRO and Bharat Electronics Limited.

With Saankhya Labs acting as satcom technology partner for the project, providing the modems and hub-side equipment, the RTIS project is an ingenious end-to-end solution with countless benefits:
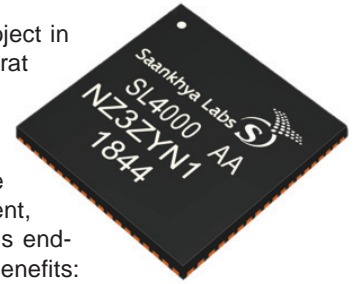
- Improved efficiency: Railway controllers can track, monitor, and regulate traffic in the entire network and enables two-way communication between controllers and loco pilots,
- Aids Emergency Response: During an emergency, knowing the exact location of the train enables speedy response by rescue teams.
- Commuter Friendly: Integrated with the New Train Enquiry System (NTES), Commuters receive accurate information regarding the arrival/departure of trains.

Secure communications via Satphone

Satphones have long been used for communicating in areas with no cellular coverage – remote and rural locations, battlefields, at sea, etc. – or when secure connections are required. Satphone enables voice, data and two-way messaging via satellite from any point on Earth within the Satellite coverage area.

There are a variety of models available in different form factors from several suppliers; however, Saankhya Labs' offering is truly unique. SAMRAT is a handheld, two-way Satellite Mobile Radio Terminal which supports voice, data, short messaging and geolocation services over S-band satellite. Designed to fit as an add-on device for a 5.5" Android Smartphone the industry's first S-band satellite phone terminal for Indian strategic &, defence users. SAMRAT operates via user-friend Android app and supports wired (USB) and Wireless (BT/Wi-Fi) / Hot Spot connectivity.

Looking ahead: SDR meets IoT

One of the biggest ongoing advances in wireless technologies is the Internet of Things (IoT), which describes a network of physical objects – the 'things' in IoT – embedded with software, sensors and other connectivity technologies enabling the exchange of data with other devices over the Internet.

While business, government and industrial applications have received less press coverage than the consumer-centric, the IoT is meeting extreme demands for better ways of tracking, monitoring and controlling pretty much anything, including offshore mining operations, agriculture, livestock and herds.

Given the wealth of relevant experience under its belt, it's no surprise that Saankhya Labs has set its sights on the IoT market. The company plans to launch a satellite gateway product supporting multiple IoT protocols – NB IoT, LoRa, Zigbee, Sigfox, etc. – on the front haul, with satellite connectivity as backhaul. Saankhya Labs' IoT solution is based around conceiving and architecting a new chipset, bringing cutting edge software defined radio chipset technology to Satcoms.

"NAVDOOT communicates over satellite link and interoperates with an L-band Multichannel Burst Demodulator installed in the central hub location. NAVDOOT transmits its geolocation coordinates to the satellite at regular intervals, and operates as a satellite hotspot for Android phones, enabling two-way data connectivity between ship and shore."

The new solution will enable re-use of existing sensors/nodes and remote monitoring of local networks, quicker time to market, lower cost of operation, generate valuable data for back-end analytics and commercial exploitation, and will target low power, small footprint, narrowband applications. The modem features an internal GPS module for tracking and monitoring assets. It may also feature a hybrid cellular/satcom gateway. Saankhya Labs anticipates that its IoT gateway solution will find application in shipping vessels, oil and gas, agriculture, mines, windmills and solar farms, among others – not just in India, but throughout the world.

Expanding global footprint

Saankhya Labs has been very successful in the Indian market with its Satcom solutions being field deployed across the length and breadth of the country and is now expanding its global footprint.

The company is in talks with leading satellite network operators in the US and Europe to offer next-gen satcom and sat-IoT solutions to the US market.

Given its unique Chips-to-Systems expertise, Saankhya Labs is well poised to redefine the global satcom landscape with its low-power SDR based Satcom and Sat-IoT solutions.

Find out more at www.saankhyalabs.com.

Image right: SAMRAT is a handheld, two-way Satellite Mobile Radio Terminal

IoT gateway solution will find application in shipping vessels. ABIR ROY BARMAN /Shutterstock.com

Rafel Jordá, Founder and CEO, Open Cosmos ●●●

Space economy at large

Open Cosmos is an innovative satellite developer and mission planner, delivering Earth observation, telecommunications, and space science services from design to operation. As an SME with a five-year history in the UK, we asked founder and CEO Rafel Jordá how he sees the UK market and the NewSpace economy at large.

Laurence Russell, News & Social Editor, Satellite Evolution Group

Question: In recent years, the space industry has seen a surge in new commercial applications, dubbed 'NewSpace.' How have businesses responded to that revolution?

Rafel Jordá: The space sector is undergoing a revolution today like what the computer industry experienced over the last few decades. Computers used to be very big and expensive, then came the PC and the smartphones and with them ever smaller form factors with exponentially higher compute power and functionalities. The same thing is happening now with satellites. Companies in the space sector, such as Open Cosmos, are investing in research and development precisely to lead this revolution with the aim of opening the space sector to all types of businesses, industries, and end users. With the advent of artificial intelligence (AI), the industry is now ripe for a new revolution, where satellites won't be programmed in advance to achieve a limited set of tasks, but rather become multi-purpose reconfigurable devices able much like smartphones to provide actionable insights from data in real time. Space is no longer a place reserved only for the few.

Question: How has the UK responded to the worldwide boom in space businesses?

Rafel Jordá: The UK has developed in recent years one of the most innovative and vibrant space ecosystems in the world, becoming a major driver of economic activity, technological innovation, and job creation. This is what led us to found the company there five years ago. Since then, we have been working closely with the country's main space organisations such as the UK Space Agency and the Satellite Applications Catapult, as well as a number of small & medium size businesses across the country. The Harwell Campus, which houses research infrastructure and equipment worth more than £1 billion, is a great example of this ecosystem driven by collaboration, talent, and innovation, and has become a seedbed of space startups looking to set shop in Europe. There is a reason why it is referred to as the 'Gateway to the UK Space Sector!'

Question: What can Open Cosmos offer the market?

Rafel Jordá: Open Cosmos aims at solving Earth's biggest challenges, from

Open Cosmos team ●●●

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Photo courtesy of Open Cosmos ●●●

space. We are located on the Harwell Campus where we design, manufacture, and operate satellite missions from start to finish. We offer a comprehensive set of services that addresses the entire value chain from early constellation feasibility study to building and operating satellite systems tailored to the needs of companies, institutions, and governments around the world. These satellites are primarily used for collecting Earth observation data critical for economic, environmental and security decision-making; to provide telecommunications services on a global scale; or to develop space science and technology.

To give some examples, one of our customers is a European company looking at deploying a constellation of satellites with IoT transceivers with the goal of offering ubiquitous affordable connectivity for commercial and governmental machine-to-machine communication. Another one is an Asia-based government looking at mapping & monitoring its landmass for urban planning, agricultural development, and border control.

Question: Some suggest that the UK is set to play a complementary role to larger space powers such as NASA, ESA, UAESA and JAXA in offering academic, design, and manufacturing support. What are your thoughts?
Rafel Jordá: As we mentioned above, the UK has in recent years developed one of the strongest space ecosystems in the world. There are ongoing collaborations between the UK, the US, the European Union and other space-faring countries and we think this trend will continue to accelerate in the years to come.

Question: You've celebrated the 'democratization' of space technologies, heralding the revolution as comparable to the dawn of personal computers and smartphones. What will it take for space technologies to become as widely reliable and affordable as those products?
Rafel Jordá: Space technology in general is already much more reliable than consumer products, as traditionally those systems were worth hundreds of millions and had to work in orbit for decades. The real question is now that the paradigm has changed with the cost of those systems being orders of magnitude cheaper, how will businesses take advantage of shorter product life cycles to innovate at a much faster pace and add new functionalities as market demands evolve.

Question: Regulation in space - with regards to green launch and debris mitigation - are hot topics in space science academia. With strong regulation being exemplified in France and the US under pressure to set standards, how should the UK approach regulation as it attempts larger ventures in space?
Rafel Jordá: In our opinion the UK is doing a tremendous job at setting-up regulations that put the right standards in place around debris mitigation and space safety as a whole while continuing to involve industry in shaping those policies to avoid unnecessary red tape. 'Responsible Space' is becoming a key differentiating factor between existing and new space players, and the need to apply those principles to design and operational practices will only get stronger as the number of objects in orbit continues to grow.

Photo courtesy of Open Cosmos ●●●

Isotropic Systems infographic one terminal - all satellites ● ● ●

Satellite poised to deliver on insatiable connectivity demand from the ground up

Demand for broadband Internet connectivity on land, air and sea has never been higher than these last 12 months, providing a much-needed boost of anticipation ahead of the next wave of LEO satellite constellations coming into play. However, these new on-orbit capabilities require next-gen ground infrastructure to reap the full benefits of the technology. Moreover, new age ground infrastructure could give satellite the elusive edge in high-valued mobility markets.

Brian Billman, Vice President of Product Development, Isotropic Systems

There's an insatiable desire to connect anywhere. Demand for connectivity on the go is driving new innovations in connected trains, planes, and cruise ships. Rising demand also continues to stir frustration – especially among discerning travellers, such as airline passengers whose high-flying expectations still outpace IFC capabilities.

There's no doubt we have arrived at the point where ubiquitous high-speed connectivity is expected everywhere. At the same time, our throughput and data needs have exploded to unprecedented levels – with everything moving

to video and streaming content. Even terrestrial networks are pushing the limits – to the point where we must explore new frontiers such as 5G just to keep up with the insatiable appetite for mobility.

And just when you think terrestrial may have a newfound mobility edge, satellite could actually be narrowing the gap with its own transformational advancement.

It could come down to interoperability and standards. With the explosion of new satellites across LEO, MEO and GEO orbits beginning later this year, it's more important than ever for users to be able to switch seamlessly between all of those satellites versus disparate, isolated networks.

With that in mind, the real mobility game changer may

Brian Billman, Vice President of Product Development, Isotropic Systems ●●●

not be found in space at all, but in satellite's versatile ground game.

Honing the mobility ground game

The success of satellite-delivered mobility hinges heavily on performance and capacity, which has been held back by launch costs and complexities. Historically, satellite has lagged behind terrestrial because it has always taken a long time to get a few satellites into space.

The result is sparse coverage of older, super expensive satellites that don't offer much capability and capacity. As a result, the satellite technology refresh rate has been slow at best for decades.

Enter Blue Origin and SpaceX and all of a sudden dozens of small satellites can be launched into orbit on a single launcher – thrusting the door wide open to inexpensive prototypes and in-space demonstrations of new satellite technologies like never before.

The costs are so low in many cases that even universities are hitching rides into space with their own satellites and tech demo payloads, which enable more experimentation and speeds up technology advancements – in space and on the ground.

Every constellation, no matter how advanced, has its strengths and weaknesses. And every service is defined by a unique mix of capacity, coverage, price, and latency. Users of isolated networks will be locked into the deficiencies of any given system and stuck with high conversion costs. Interoperability unlocks isolated networks and allows the level of coopetition currently behind cellular operations.

The interoperability of cellular towers and networks is a key component behind the success of mobile phone services. Cellular service providers, even the fiercest competitors among them, work together to ensure their customers experience seamless global connectivity every time their signal is handed off to another tower.

Satellite operators and service providers have yet to adopt this interoperable approach – understandably opting to protect their constellation and network investments. In the end, however, satellite mobility will thrive in a world where collaboration and interoperability are key components of the next generation of seamless services.

Isotropic Systems' patented multi-beam antenna. ●●●

Satellite is certainly poised to enable a new generation of mobility. New satellites and constellations are moving closer to earth, offering better throughput in LEO and MEO. Even in the case of GEO, HTS satellites offer far better bandwidth.

Satellite operators, service providers and manufacturers are now recruiting experts in software-defined networks to bring cloud benefits closer to the end user.

By implementing software-defined networks, we can separate the function and configuration from the hardware, allow the user to influence the configuration with on-demand requests, and create virtual channels to separate traffic and increase security.

The more we can leverage the flexibility we have in our hardware with interoperability and open standards, the more influential and powerful software functionality will become.

Empowering mobility with multi-beam

Cracking the satellite mobility code will require ground segment that can cost effectively and simultaneously meet the performance requirements across all orbits. It will take a revolutionary terminal that can affordably and effectively link with satellites in LEO, MEO, and GEO at the same time to ultimately provide a terrestrial-like mobility experience.

A multi-beam antenna capable of seeing and switching between hundreds of satellites in its field of view opens the door to a cellular-like experience. The satellite mobility user will never know the switch from one satellite to another has been completed, much like the handoff from one cell tower to the next.

In many ways satellite's ground game holds the industry's 5G-like potential and promise – the ability to tap and deliver all that new and legacy capacity with a single antenna to a broad range of markets starving for next-gen connectivity.

The fact that antiquated parabolic antennas, inefficient phased-arrays, and other outdated solutions are still being used to power disparate, patchwork networks simply underline the real need for new ideas and innovations in infrastructure – designed from the ground up.

The top characteristics that enable next-gen antennas to deliver a new age of mobility include the performance and flexibility to connect to any orbit; multiple beams to seamlessly switch between satellites and across any constellation; and low profile and all electronic scanning capabilities for mobility and non-geosynchronous orbits.

A new age of satellite-delivered connectivity

Antenna innovations must evolve ahead of the markets they serve – a big reason why Isotropic Systems has enlisted key technologies such as 3D-printing to help accelerate the development and delivery of its patented terminals.

Investors across the globe are leading major waves of funding in Isotropic Systems' multi-beam terminal, which is just as cutting edge as the next generation of constellations and equally game changing as reusable rockets.

The company is halfway through a year of pivotal commercial and government trials of its multi-beam antenna, which is on track to enable a whole new level of connectivity in aero, maritime, defense, and enterprise markets beginning next year. By leveraging breakthrough optics and circuitry, a single Isotropic Systems multi-beam antenna can connect with virtually every satellite in space – providing the missing link satellite has long needed to deliver a new age of mobility services.

Thousands of new satellites are bound for multiple orbits to offer unprecedented connectivity across a broad range of markets. But the whole next-gen ecosystem will fall flat without an equally transformational ground segment. Without new antennas, new constellations simply cannot realize their full potential in space and won't be able to satisfy a ravenous appetite for more connectivity here on earth.
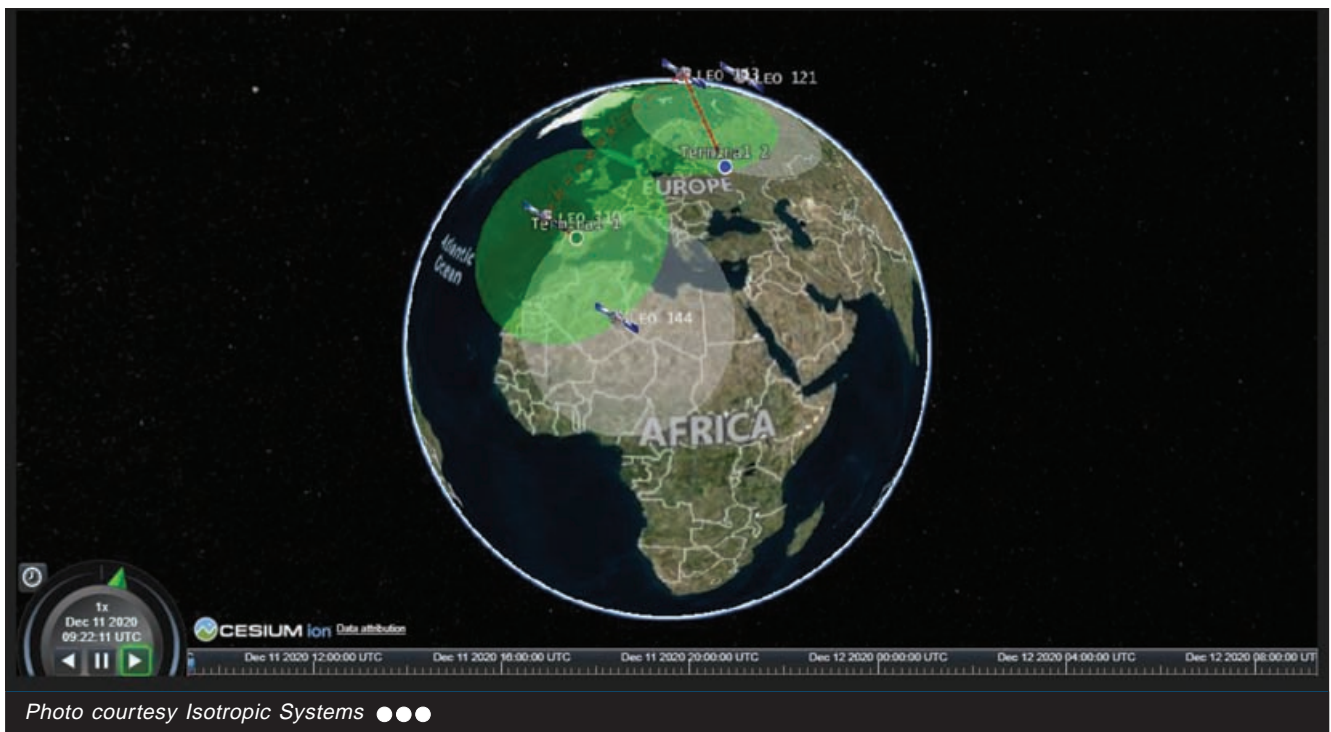

Photo courtesy Isotropic Systems ●●●

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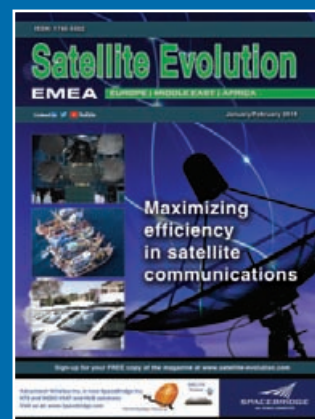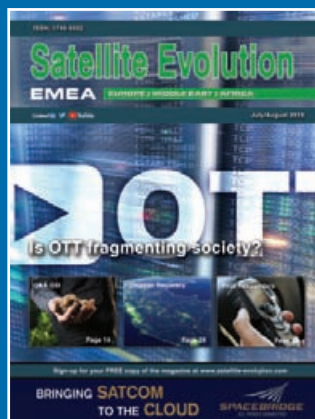
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