



SATELLITE EVOLUTION

November 2023

GLOBAL

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Crispin Littlehales, Executive Editor ●●●

In 1987, AT&T released its iconic “Reach out and touch someone” advertising campaign. It aimed at the heart of connectivity—hearing the familiar voice of a beloved family member; catching up on their news; knowing that they care. Although closing the digital divide involves all sorts of very important goals including online education, telemedicine, and the means to accelerate economic development, the ability to connect with another human being is just as vital—particularly when times get tough.

According to research organization demandsage, there are currently some 5.3 billion active internet users accounting for 65.4 percent of the global population. China has the highest number of users, with 1.05 billion, followed by India, with 729 million, and the United States, with 311 million. In 2025, the number of global internet users is expected to rise to 6.54 billion.

While those of us in urban areas not only take our cell phone and computer connectivity for granted but also crave higher download speeds to support virtual reality, artificial intelligence, machine learning, the Internet of Things, and the Metaverse, there are still billions of individuals who can't just grab a cell and get a clear connection to anyone outside their own isolated community. That said, progress is being made and satellite is playing an essential role.

With nearly 35 percent of the world still lacking connectivity, satellite broadband has a lot of ground yet to cover. There are many companies in our industry working hard to bridge the gap: Astranis, Avanti, Comtech, Gilat, Hughes, Kacific, Kratos, OneWeb, Starlink, ST Engineering iDirect, Telenor, and Viasat, to name a few. These companies are already providing consumer broadband, Wi-Fi hotspots, and cellular backhaul. They've had to comply with myriad regulations, get buy-ins from countless governments, form alliances with telcos, and figure out ways to keep the volume high and the prices low. When you talk to these companies about their work in this area, you can hear the passion and dedication that drives them. At their core, these companies understand what is at stake—the ability to reach out and touch someone.

In this month's issue of Satellite Evolution Global, we delve into the challenges and the triumphs involved in connecting the unconnected. Julian Crudge, Sales Director of Data Services Division for Telenor Satellite addresses the ways in which his company is working to aid growth and development in remote communities by making online services accessible. Libby Barr, COO for Avanti Communications, shares her insight about the ways that satellite can break down barriers preventing South Africa's most vulnerable from accessing education and healthcare. Dave Harvey, Principal System Test Engineer for AccelerComm explains how and why satellite industry players have joined forces to revolutionize global connectivity and additional flexible spectrum for everything from voice and data services to rural and enterprise broadband, mobile backhaul, and even direct-to-handset services. We also hear from Kevin Corbley, CEO of Corbley Communications about the launch of the Norwegian NorSat-TD microsatellite which marks the latest success in an extraordinary space program that has delivered some of the most significant advancements in maritime navigation and vessel safety since the advent of GPS.

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DS Air Publications

Boxer Retreat, Langhurstwood Road, Horsham, West Sussex, RH12 4QD, United Kingdom
T: +44 1403 473982 | Email: admin@dsairpublications.com | www.satellite-evolution.com

Executive Editor

Crispin Littlehales
crispin@dsairpublications.com

Business Development Manager

Belinda Bradford
belinda@dsairpublications.com

Managing Director

David Shortland
david@dsairpublications.com

News & Social Media Editor

Nicole Lewis
nicole.lewis@dsairpublications.com

Publisher

Jill Durfee
jill.durfee@dsairpublications.com

Circulation Manager

Elizabeth George
admin@dsairpublications.com

Publishing Director

Richard Hooper
richard@dsairpublications.com

Marketing Production Manager

Jamaica Hamilton
jamaica.hamilton@dsairpublications.com

Production

production@dsairpublications.com

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Azercosmos and Brazilian Space Agency sign MOU for space initiatives

AZERBAIJAN/BRAZIL: Azercosmos and the Brazilian Space Agency (AEB) have signed a Memorandum of Understanding (MoU) on space cooperation.

The MoU envisages Brazil-Azerbaijan collaboration in space science, technology, and application and will serve as an instrument to establish a framework for future cooperation in the domain of outer space.

Under this MOU, Azercosmos and AEB will explore ways to support socio-economic development in both countries through satellite imagery data in areas related to: agriculture, water resources, urban and regional planning, environmental assessment, land cover mapping, disaster monitoring, mapping of natural resources, maritime and terrestrial monitoring, geospatial systems, as well as communications on satellite ground stations.

The two organizations will also study the use of academic and training opportunities for personnel and broaden student participation at the development program from both countries in the fields of space science, technologies, and applications.

Samaddin Asadov, Chairman of Azercosmos, emphasized the importance of cooperation with Brazil in the space sector. "With this MoU and our closer partnership, we hope to achieve our vision of boosting Azerbaijan's space industry and supporting space-related activities," he added.

"Azerbaijan has huge potential in the space sector, which can be successfully used for the development of various areas, including scientific research, technological innovation, education, and the economy," head of the Brazilian Space Agency (AEB) Marco Antonio Chamon noted.

Spaceflux secures UK Government contracts to enhance sovereign space domain awareness capabilities

UNITED KINGDOM: A UK space technology company focused on providing Space Domain Awareness (SDA) services based on high-quality optical data from its proprietary global network of optical sensors has won lucrative contracts with UK Space Command and the UK Space Agency.

The contracts have been awarded to London headquartered Spaceflux to provide tracking data about satellites in geostationary orbit (GEO) and to build a new, national, ground-based SDA sensor in Cyprus.

The satellite tracking data will be acquired using Spaceflux's global optical sensor network with 10 unique locations across 5 continents. The data will be used by the UK Space Agency (UKSA) and Space Command to monitor various satellites in geostationary orbit and to protect UK space assets from collisions and adversarial actions.

Spaceflux was set up in 2022 with the aim of leveraging their ground-based telescopes, in combination with a unique AI-driven analytics platform, to tackle the problem of space congestion in view of rising satellite deployment. The company will use its expertise to build, maintain, and routinely operate the commissioned sensor, which will be tasked by UK Space Agency and UK Space Command analysts from the UK Space Operations Centre at RAF High Wycombe. The sensor, a part of Project Nyx Alpha, will monitor objects in GEO, approximately 36,000km above Earth's equator, with its primary mission being the provision of information on UK satellites, helping to prevent collisions and protect critical space assets. The system has also been designed to allow for the sharing of data with partner organisations and international allies, improving the UK's contribution to strategic space relationships, and increasing opportunities for collaboration in the space domain.

The contract award was announced on stage at the UK Space Conference in Belfast by Air Vice-Marshal Paul Godfrey, Commander of UK Space Command, who stated, "Space Domain Awareness underpins our ability to protect and defend UK and allied interests in space. The UK has critical assets in geostationary orbit, and Project Nyx Alpha will help us to monitor them more closely."

It is great to see that UK Space Command and the UK Space Agency are working with some of the most innovative UK space companies to develop our nation's space capabilities."

The location and elevation of the sensor site in Cyprus makes best use of geography available to the UK and allows a better view of the geostationary orbit than sites



Photo courtesy Spaceflux ●●●

on the UK mainland. These procurements will play a key role in helping UK Space Command protect and defend UK interests in space, including SKYNET, the UK's world-leading family of military communications satellites.

The CEO of the UK Space Agency, Dr Paul Bate, joined Air Vice-marshal Godfrey at the announcement, underlining the joint procurement from UK Space Command and the UK Space Agency. Dr Paul Bate said, "As our reliance on satellites for everyday activity grows and the UK becomes a hub of small satellite design, manufacturing, and launch, we are at the forefront of ensuring a safe and secure space environment.

"But with more than 8,000 operational satellites and more than 30,000 pieces of trackable debris, the ability to operate safely in space is growing increasingly challenging. Operating a sensor in Cyprus enhances our vital national capability to track objects in space to help avoid collisions and protect the satellites we depend on.

"This procurement marks a significant development in bringing together the capabilities of both the UK Space Agency and UK Space Command and achieving maximum value for UK taxpayers."

In addition to awarding these contracts, UK Space Command and the UKSA will launch the National Space Operations Centre (NSPOC) next year. Both projects will fulfil elements of the National Space Strategy, and the supporting Defence Space Strategy, both of which highlight SDA as a key civil and defence space capability priority.

On the important milestone for Spaceflux, Founder and CEO Dr Marco Rocchetto stated, "Space Domain Awareness is vital for the safety and security of in-orbit assets and is becoming increasingly foundational in space operations. Spaceflux has developed solutions, which guarantee timeliness, reliability, and accuracy of SDA systems.

"As a company based in London, we're thrilled and deeply proud to support the Space Agency and UK Space Command in enhancing this sovereign capability, protecting the safety of our national space assets, and promoting a secure and sustainable space environment. These contracts will not only allow us to further advance our technologies, but also contribute to the growth of the UK space ecosystem." ●

Eutelsat OneWeb first to receive approval from Indian space regulator for satellite broadband services

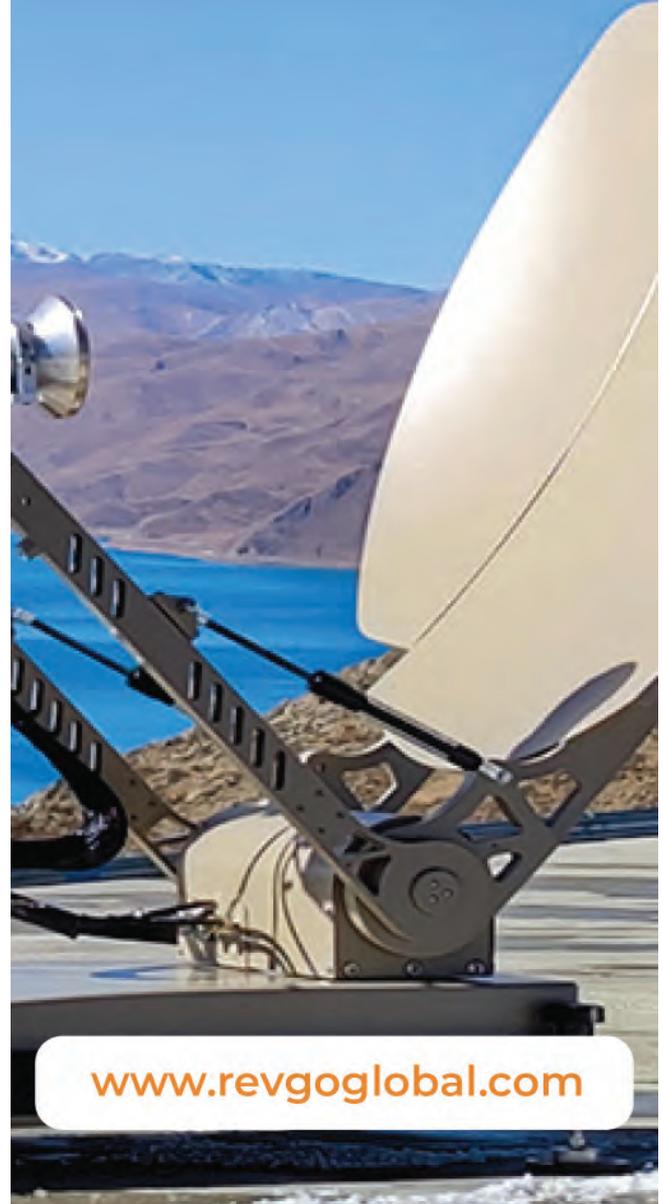
INDIA: OneWeb India has received the necessary authorisations from IN-SPACE to launch Eutelsat OneWeb's commercial satellite broadband services in India. OneWeb India is the first organisation to be granted this authorisation. Eutelsat OneWeb, the low earth orbit operator, is part of Eutelsat Group.

IN-SPACE is the agency of the Government of India, responsible for regulating space activities and granting authorisation for conducting the space activities in the



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country. This authorisation means Eutelsat OneWeb can launch commercial connectivity services as soon as spectrum allocation has been granted by the Government.

Bharti Group Chairman and Vice-President (Co-Chair) of the Board of Directors of Eutelsat Group, Sunil Bharti Mittal, said: "We are pleased to note the Indian space regulator's green light to launch Eutelsat OneWeb's commercial satellite broadband services in India. This will be a critical step forward to meet India's ambition of providing internet connectivity for all and will enable the Hon'ble Prime Minister's vision of Digital India. Eutelsat OneWeb is ready to deploy as soon as it receives the final spectrum authorization to launch commercial services."

Cyril Dujardin, Co-General Manager of Connectivity at Eutelsat Group, said: "Bridging the connectivity gap around the world requires collaboration across business but also with governments and regulators. We are pleased to have received these approvals from the space regulator that bring the country a significant step closer to providing high speed connectivity to even the most remote locations. Having completed our LEO constellation last year, we are perfectly placed to deliver this vital connectivity service to businesses across India."

This news adds to Eutelsat OneWeb's existing strong position in the Indian market, where OneWeb India already holds the necessary licences from the Department of Telecommunications to provide broadband services using satellite connectivity. The business has also obtained in principle approval to establish and operate two gateways in Gujarat and Tamil Nadu, which would secure the provision of vital high-speed, low-latency internet connectivity to customers across India, once services are rolled out.

Transformative partnership between Kratos Defense & Rocket Support Solutions

USA: Kratos Defense & Rocket Support Solutions has announced the formation of Atreus Technologies, LLC, a Small Business Association Mentor Protégé Program joint venture. A visionary collaboration between these two companies, Atreus Technologies was created to rapidly and cost effectively deliver leading edge technology and innovation tailored specifically for our valued customers in the defense and aerospace sectors.

Atreus, the son of Kratos, was the inspiration for the name chosen for this strategic partnership that embodies the formidable strength, unwavering determination and forward-thinking innovation that both Kratos and ReLogic Research are renowned for within their respective fields. Atreus Technologies' core objective is to harness the combined strengths of both companies to provide groundbreaking solutions addressing the evolving needs of our Nation's Warfighters. Kratos utilizes proven, leading-edge technology, not unproven, bleeding edge technology, to rapidly develop and field relevant products, software and systems in support of National Security priorities. At Kratos, affordability is a technology, and Kratos' leading technology approaches also reduce program and initiative cost, risk and schedule. This methodology will similarly be executed at Atreus.

Charles Farmer, Senior Vice President at Kratos, shared his enthusiasm, stating, "I am incredibly excited to embark



Photo courtesy Shutterstock ●●●

on this mentor protégé joint venture with ReLogic Research. This collaboration represents a significant milestone in our journey, promising a future filled with innovation, mutual growth, and shared success. I am eager to see the remarkable outcomes of this partnership."

"Our collaboration with Kratos in the creation of Atreus Technologies underscores our dedication to providing exceptional solutions," stated Chandler Wicks, CEO of ReLogic Research. "I am excited for this partnership to deliver uniquely packaged, high-quality, timely, and customer focused solutions."

Atreus Technologies is committed to providing excellent support, pursuing innovative opportunities, including research and development projects, providing cutting edge technology and solutions, and contract offerings within the defense and aerospace sectors, all with the goal of enhancing our customers' capabilities and missions.

Viasat's broadband Arctic extension closer as spacecraft complete key tests

USA: Viasat has announced the second satellite in the upcoming Arctic Satellite Broadband Mission has completed thermal vacuum testing at Northrop Grumman's Dulles, VA, site: a significant milestone as the project looks to connect the Arctic region with high-speed broadband in the second half of 2024.

The mission, led by the Space Norway subsidiary

Heosat, will see two satellites deployed in a highly elliptical orbit (HEO) in the world's first HEO mission carrying a broadband commercial service payload. The two satellites – ASBM-1 and ASBM-2 – will host Viasat's GX-10a and GX-10b Ka-band payloads, extending Viasat's high-speed global network across the Arctic region.

The spacecraft are designed to integrate as part of Viasat's wider satellite fleet and extend the coverage of its Ka-band network beyond that available from geostationary satellites. The payloads will be Viasat's first in non-geostationary orbit and will become a key element of its co-operative hybrid network. Once launched, these new payloads will increase Viasat's fleet size to 20, with an additional eight under development.

The Arctic has rapidly growing connectivity needs to serve governments, shipping companies, commercial airlines, and scientists. In October 2023, the UK Government's Environmental Audit Committee called for a greater political focus on the region and further research into the potential for environmental and economic impacts of changing weather patterns. Alongside GX10a and b, the spacecraft will host payloads for the Norwegian Armed Forces and the US Space Force.

Mark Dickinson, Head of Space Systems, Viasat, said: "We have been talking with our customers, partners, and shareholders about how the combination with Inmarsat has given us a new scale and scope to deliver new solutions to meet our customers' requirements. This is an example of what that means in practice. The investment we've made in our network is creating the flexibility, coverage, and interoperability to meaningfully connect the world wherever and whenever our customers need it – even if they happen to be standing on the North Pole."

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In addition to an AIS receiver and VDES two-way communication device with Yagi antenna, NorSat-TD carries four experimental payloads ●●●

Norway maintains leadership role in space-based maritime situational awareness with small satellite program

Launch of the Norwegian NorSat-TD technology demonstration microsatellite earlier this year marked the latest success in an extraordinary space program that has delivered some of the most significant advancements in maritime navigation and vessel safety since the advent of GPS. The program was the first in Norway to receive Automatic Identification System (AIS) signals from ships at sea by a satellite in orbit, thereby dramatically enhancing marine situational awareness over a wide area.

Kevin Corbley, CEO of Corbley Communications, Inc.

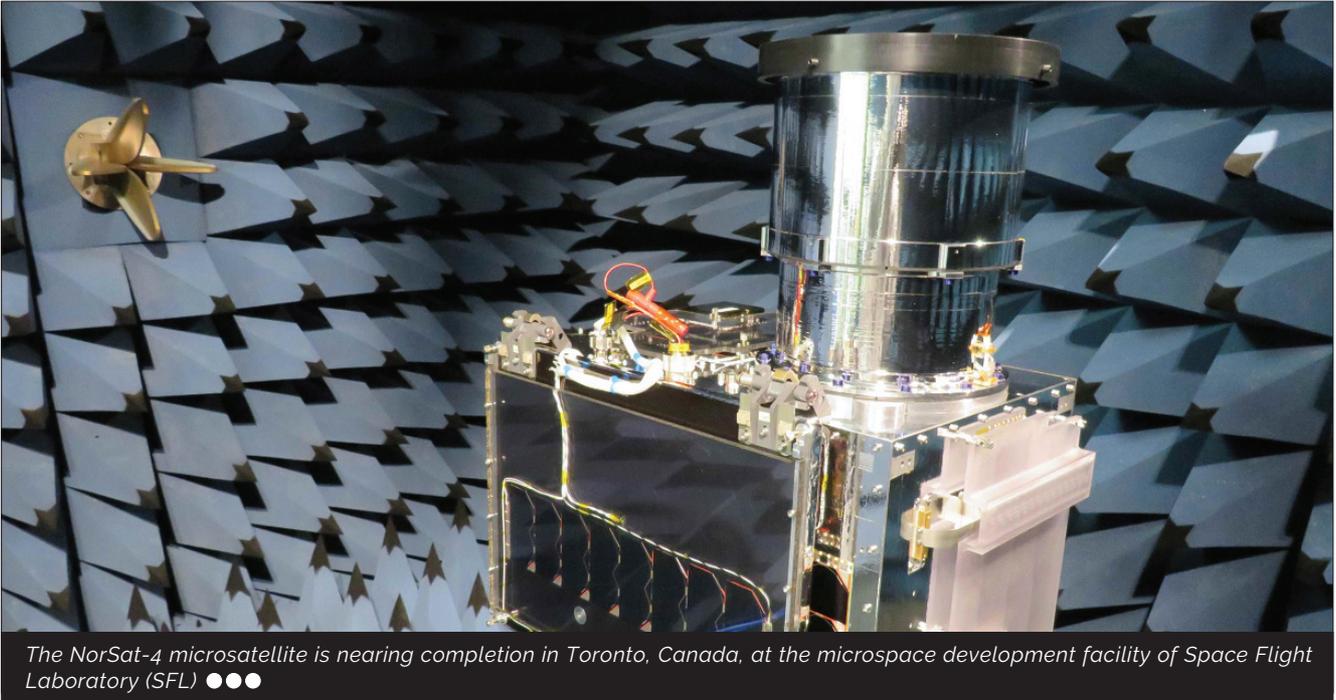
Norway's tradition of testing cutting-edge onboard technologies for space-based ship tracking and communications is scheduled for more advances in 2024. The seventh mission in the program, the NorSat-4 microsatellite equipped with a low-light imaging camera, is nearing completion in Toronto, Canada, at the micro space development facility of Space Flight Laboratory (SFL), which has built the entire series of satellites for Norway.

Each satellite has presented unique development challenges posed by accommodating one or more payloads on extremely small spacecraft platforms within

limited budgets. The satellite-based situational awareness activities have been unquestionable successes for Norway, especially given the budget constraints.

BEYOND LINE OF SIGHT

Large vessels at sea are mandated to operate AIS transponders that send and receive location identifier signals so ships can avoid collisions. Some ports also monitor AIS for traffic management. While these line-of-sight signals support safe navigation, the Norwegian Coastal Authority (NCA) saw an opportunity to expand utility of AIS for regional ship tracking, rescue activities, and illegal fishing enforcement by capturing the signals from space.



The NorSat-4 microsatellite is nearing completion in Toronto, Canada, at the microspace development facility of Space Flight Laboratory (SFL) ●●●

NCA teamed with the Norwegian Space Center (NOSA) and the Norwegian Defence Research Establishment (FFI) to determine if AIS signals could be captured by satellite. Under an extremely tight budget, NOSA contracted SFL to develop a satellite carrying an AIS receiver/transmitter designed by Kongsberg Seatex AS of Trondheim, Norway. SFL integrated the device and antenna into its mission-proven 20x20x20 cm Generic Nanosatellite Bus (GNB). Despite its 7-kg mass, the AISSat-1 nanosatellite included an onboard computer and three-axis attitude control.

NOSA launched AISSat-1 in 2010. Within 24 hours, the space-based AIS reception concept was proven, and the satellite was transferred to operational status. The nanosatellite captured the AIS signals from hundreds of ships in an expansive geographic area and transmitted them to an NCA base station on land. This enabled NCA to accurately track the locations of identifiable vessels far from shore in thousands of square kilometers of Arctic waters, ultimately creating a National Maritime Tracking Information System that could relay AIS info to vessels.

NOSA launched AISSat-2, a twin of the first, in 2014 which continued to operate for nine years until October 2023. AISSat-1 remained operational until 2022. NCA relies on AIS data for many applications, including guiding its frigates and aircraft to vessels in distress. Precise ship location is critical, particularly for helicopters, which sometimes arrive for a rescue with only minutes of fuel remaining to evacuate the vessel crew and return safely to shore.

AISSAT EVOLVES INTO NORSAT PROGRAM

Based on the success of AISSat-1 and -2, NOSA opted to expand the satellite program and rename it NorSat. While the primary application remained ship tracking, the satellites would also carry scientific instruments for a variety of projects. Following an international open bid

process, NOSA awarded the contract for the NorSat satellites to SFL.

"SFL beat out other suppliers based on technical merit, price, and schedule," confirms Tyler Jones, Norwegian Space Center (NOSA) Senior Advisor and NorSat-TD Project Manager. "SFL agreed to a contract for NorSat-1 with options for extra satellites...and that made the acquisition process for the other satellites a breeze."

"SFL is proud to have played a key role in expanding the applicability of a crucial maritime safety technology," notes SFL Director, Dr. Robert E. Zee.

Plans called for NorSat-1 to carry an upgraded AIS receiver with improved signal detection. In addition, the satellite would test two new payloads – a multi-needle Langmuir probe for space plasma measurements in low-Earth orbit, and a Compact Lightweight Absolute Radiometer (CLARA) to record solar output from the sun. The CLARA experiment will contribute to the long-term monitoring of the total solar irradiance (TSI) variability to support the analysis of potential trends in the Sun's variability. It complements other TSI monitors like the Virgo instrument on SOHO.

Continuous and precise TSI measurements are indispensable to monitoring short and long-term solar radiance variations. The existence of a potential long-term trend in solar irradiance and how much a trend could affect the Earth's climate is of great interest.

Three payloads required a larger platform, and SFL transitioned the program to its Next-generation Earth Monitoring and Observation (NEMO) small microsatellite bus. NEMO gave NorSat-1 the physical size (20x30x40 cm), attitude control, high-speed downlink, and power to carry and operate the three payloads. The total satellite mass at launch in 2017 was 15 kg.

"A major challenge in NorSat-1 development was ensuring electromagnetic compatibility of the upgraded

AIS receiver with the satellite systems and payloads," says Alex Beattie, a Senior Mission Manager at SFL.

The new AIS device was more susceptible to electromagnetic noise than previous receivers which meant SFL had to carefully situate the payloads on the platform and plan their operation in orbit to avoid interference. Another challenge was incorporating the deployable Langmuir probe onto the bus for extension after launch without damaging the fragile elements. NorSat-1 and its payloads still operate today.

NorSat-2 posed even bigger challenges with the addition of the world's first VHF Data Exchange System (VDES) payload for high-bandwidth two-way communications. This meant the AIS data could be transmitted directly down to ships at sea, especially to NCA rescue frigates, giving them real-time visibility to other vessels hundreds of kilometers away. More importantly, NCA and ships could communicate with each other beyond line of sight, sharing vital information such as sea ice maps and weather updates.

"VHF data exchange had never been attempted from a satellite," explains SFL's Zee. "Although NOSA provided the VDES device, there was no directional high-gain VHF antenna available for operation from a microsatellite in space."

To assist with antenna electromagnetics design, SFL initiated collaboration with the Electrical Engineering Department at the University of Toronto. An electromagnetics professor and his research group engineered the RF aspects of a VHF Yagi antenna based on initial specifications from SFL. To achieve the effective performance, the antenna had to extend more than twice

the length of the NEMO bus. SFL leveraged its internal mechanical engineering expertise to create a foldable Yagi, compact for launch and then deployable in orbit. Both the deployable antenna and first-of-its-kind VDES were operational shortly after the 2017 launch of the 15-kg NorSat-2 microsatellite.

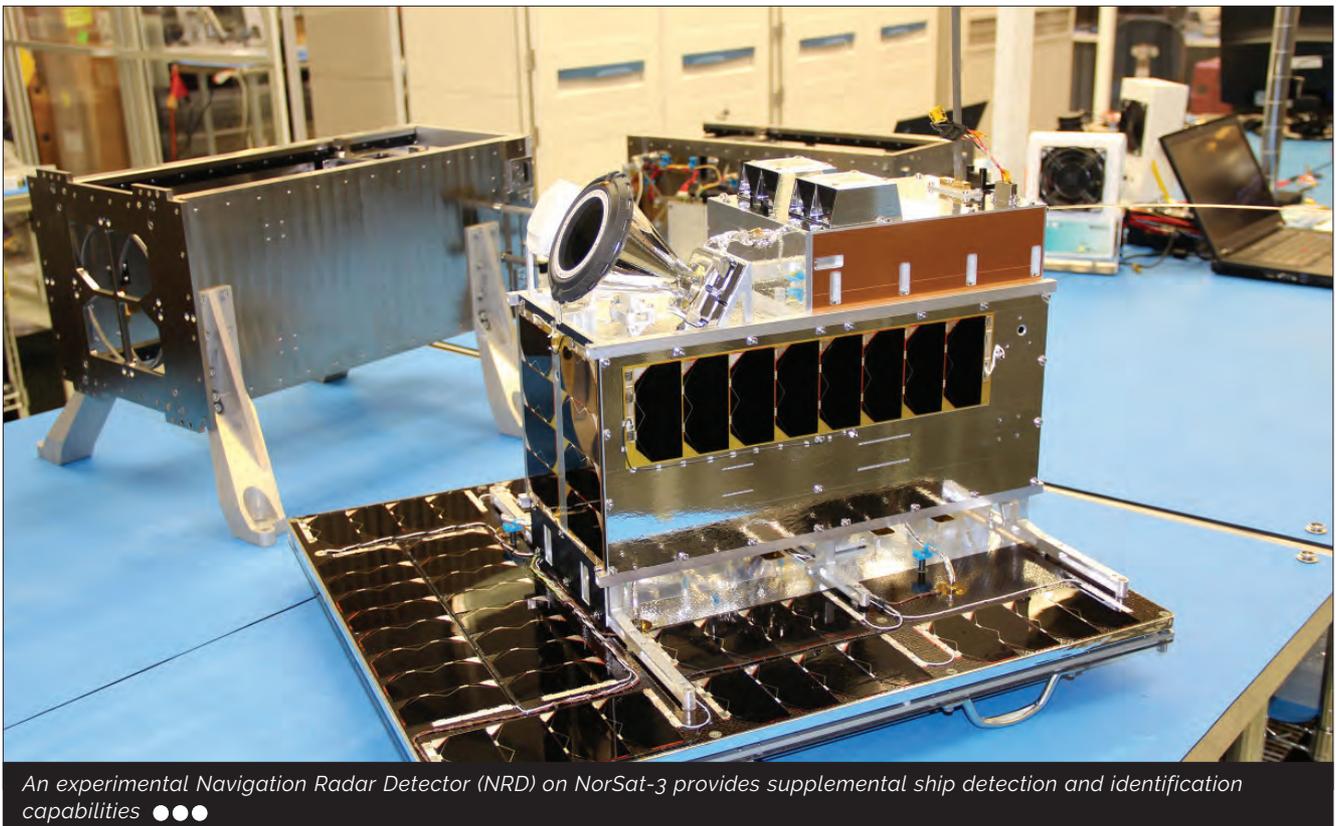
DETECTING "DARK" SHIPS

With concerns over ship piracy, sanction breaking, and illegal fishing growing worldwide, NOSA collaborated with NCA to include an FFI-developed experimental Navigation Radar Detector (NRD) on NorSat-3, along with the AIS receiver. Ships operating with nefarious intentions often turn off their AIS transponders or spoof the signal with incorrect location data, making the vessel appear to be somewhere else.

The NRD was added to provide supplemental ship detection and identification for more accurate marine situational awareness desired by NCA, Norwegian Armed Forces, and other maritime authorities. As the name implies, the new device detects signals emitted from navigation radar systems during regular operation aboard ships. Even if the AIS is turned off or manipulated, the detector can still pinpoint a "dark" vessel and its location.

"The NRD posed two major challenges – development of a first-of-its-kind rigid antenna array and a new attitude control mode," notes SFL Mission Manager, Brad Cotten.

While FFI was responsible for the RF aspects of the NRD antenna, SFL designed the antenna structure with carbon fiber since it was lightweight and unsusceptible to thermal deformation. After manufacture and calibration, the antenna underwent extensive thermal and vibration



An experimental Navigation Radar Detector (NRD) on NorSat-3 provides supplemental ship detection and identification capabilities ●●●

testing. SFL engineers then had to reconfigure the payload layout on the NEMO bus to accommodate the rigid NRD antenna and avoid radio frequency interference.

"The antenna is very sensitive," adds NOSA's Jones. "They had to build a very, very quiet satellite."

In terms of attitude control, SFL had pioneered the precise pointing of low-mass satellites for Earth observation, atmospheric monitoring, and space astronomy. The NRD, however, required development of innovative attitude control algorithms to maximize scanning of large maritime regions with a very narrow field of view on each orbit. The unique new mode enables the detector to pan across the horizon while maintaining the orientation of the antenna relative to the vertical direction.

NOSA launched NorSat-3 in 2021. The onboard ship detection capabilities have contributed to Norway's efforts to expand its fight against illegal fishing in multiple international programs, including one called Blue Justice. Through the initiative, Norway is sharing NorSat data with developing countries to help them track illicit fishing in their territorial waters.

"Norway's maritime territory is seven times its land area, and we don't have enough frigates and helicopters to patrol everything," admits Jones. "We wanted to be able to verify what's out there, and we've been able to do that. NRD is a very powerful tool."

Concurrent with NorSat-3, the NorSat-TD (Technology Demonstration) microsatellite was under development at SFL and undergoing an intriguing evolution. The original design called for a duplicate of NorSat-2 carrying an AIS receiver and VDES two-way communication device with Yagi antenna. Both instruments, however, had been upgraded since the earlier mission and would require greater onboard power to operate.

SFL recommended transitioning the mission to its larger microsatellite bus, the 30x30x40 cm DEFIANT platform. This spacecraft offered more power and greater size at 35 kg. NOSA decided to take advantage of the extra capacity and added four experimental instruments from European partners to the manifest. These included satellite-to-ground optical communications, a payload to enhance GPS precision for space situational awareness, a retroreflector to aid in spacecraft tracking by laser, and iodine-fueled propulsion system.

"Volumetrically, the platform was big enough to fit all the payloads but getting them to point in the right direction was a challenge," explains Jakob Lifshits, SFL Mission Manager.

The operation of NorSat-TD in orbit required careful planning because all instruments couldn't function at the same time due to conflicting power demands, thermal thresholds, and frequency interference. In addition, NorSat-TD would have to maneuver in orbit to orient the various instruments in a required direction for optimal performance. The solution involved a combination of strategic device placement on the bus and writing custom software to achieve balanced payload operation.

NorSat-TD's ship tracking capabilities were performing as planned shortly after launch with evaluation and characterization of the experimental payloads ongoing.

As noted, NorSat-4 is under development at SFL in

Toronto. Like NorSat-TD, this mission requires the DEFIANT microsatellite bus to carry a new, relatively large instrument. In addition to a fifth-generation AIS receiver, NorSat-4 includes a unique low-light sensor designed to capture optical imagery in the Arctic.

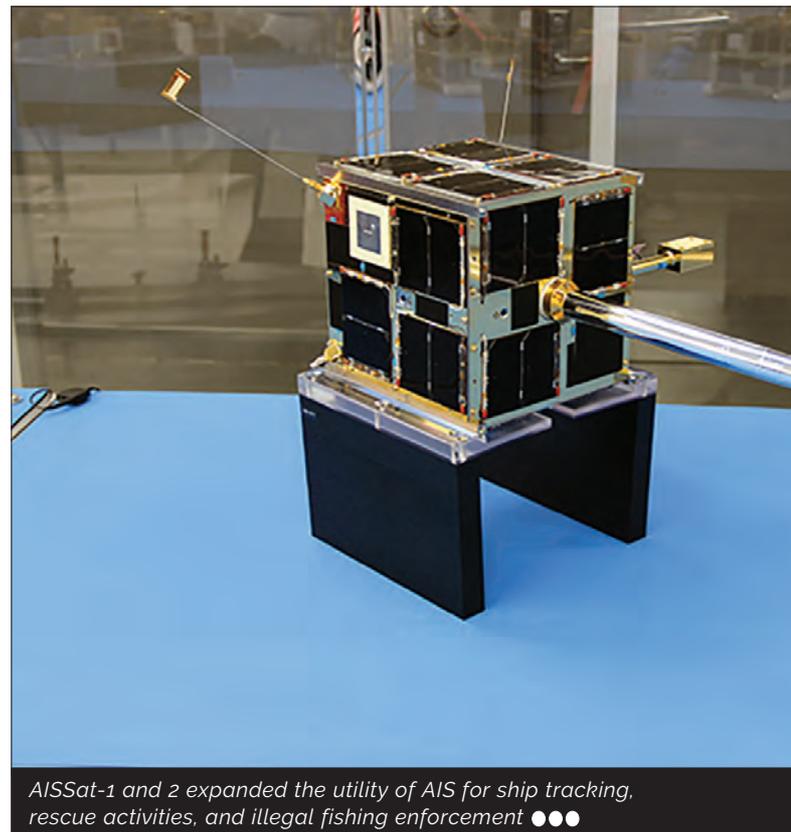
The imager will further expand Norway's ability to detect dark or AIS-spoofing vessels. Its imagery will have the spatial resolution to differentiate ships of various types. For example, the sensor can distinguish a fishing trawler that may be manipulating its AIS signal to appear digitally as a cargo ship.

"The imaging system, however, is a demanding payload from a satellite development perspective," explains SFL Mission Manager, Brad Cotten, "The imager requires active thermal control to maintain low-light image quality and needs extremely precise attitude control for exact image geolocation."

Another first-of-its-kind development challenge for NorSat-4 has been the design and manufacture of a very compact mechanical iris shutter for the sensor aperture. This SFL-developed shutter will open and close as needed in orbit to protect the sensor from direct sun exposure. The microsatellite is on track for launch in 2024.

SUCCESSES SHAPING NORSAT FOLLOW-ON PROGRAM

NOSA and FFI are planning additional maritime situational awareness missions, according to Jones. The next satellite will likely build on the advancements in dark ship detection capabilities made possible by the addition of NRD technology first introduced on NorSat-3. The next operational satellite developed by Norway after NorSat-4 will launch in the 2026-27 timeframe. ●



AISSat-1 and 2 expanded the utility of AIS for ship tracking, rescue activities, and illegal fishing enforcement ●●●

Bridging the gap: How connectivity accessibility can deliver digital empowerment

In this era of unprecedented technological advancements, the digital divide between those who have access to this bright new world and those for whom it is still lacking, is impeding overall global progress. Telenor Satellite, the leading European provider of satellite broadcast and VSAT data communications is working to aid growth and development in remote communities by making online services accessible.

Julian Crudge, Sales Director of Data Services Division, Telenor Satellite

The digital divide can be seen between citizens within nations, largely due to economic differences, but it is far more marked between different nation states. In this case the issue is more multi-faceted, encompassing



Julian Crudge, Sales Director of Data Services Division, Telenor Satellite ●●●

aspects such as accessibility and usability of connectivity, as well as economics - the three key challenges facing those communities that are behind the technology curve.

Accessibility can best be explained by how readily available technological infrastructure and resources are for those who wish to be digitally connected, whether through devices, internet or other essential tools.

Usability refers to the skills and knowledge required to use digital technologies effectively. Even where access is available, there can still be a lack of general digital literacy and experience which can hamper individuals and

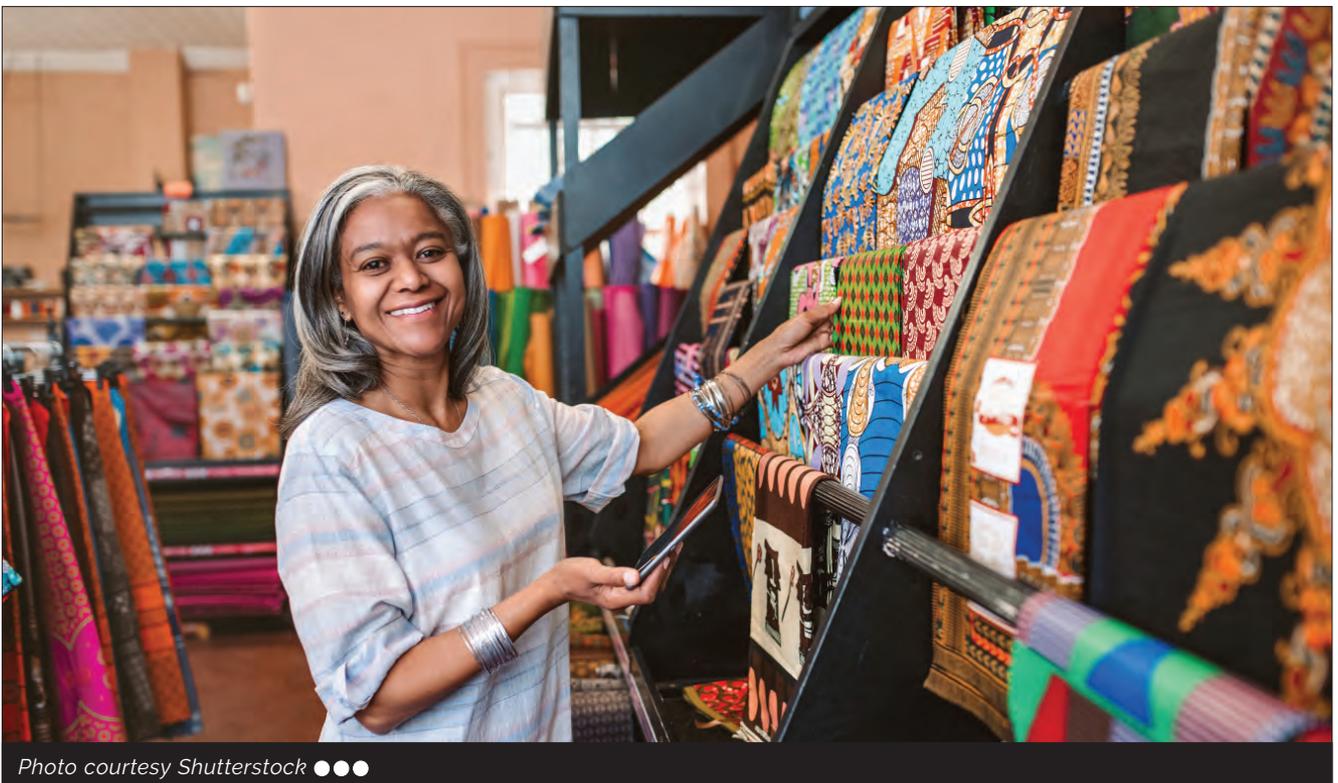


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businesses in their attempts to maximise their use of these resources.

Economics relates to the financial resources needed to access and utilise digital technologies and encompasses such things as the cost of devices themselves, as well as internet subscriptions and other associated expenses.

FOCUS ON ACCESSIBILITY

While these issues are all interrelated, accessibility is the area where Telenor Satellite is able to make a greater impact. This is where we have the expertise to help bridge the divide and empower societies in remote locations. Accessibility serves as the foundation for resolving digital inequality as, without adequate accessibility, the potential for growth and development will remain out of reach for many individuals and communities.

For those communities that lack accessibility, some of their greatest challenges revolve around the absence of online services, whether for education, healthcare services or economic opportunities. This in turn perpetuates the isolation of these communities and limits the inhabitants' potential for interaction with the global community.

There are many countries around the world, for example within parts of Africa, South America and Asia, where they simply do not have the infrastructure needed for fixed communications. Although fibre may have reached the coastal regions of these countries, inland they still rely on satellite to enable the development of a network. By making use of mobile backhaul, the service operators are able to build a network connecting remote base stations via satellite connection. In effect, satellite here is the enabler for other technologies, particularly via mobile phone networks which provide internet access to users who don't have the means to pay for broadband connections.

The introduction of 5G will increase the requirement for high-speed broadband so a multitude of mobile base stations will be essential if these communities are to attempt to gain a level footing with the rest of the world.

IMPROVING COMMUNICATIONS IN REMOTE REGIONS

Thankfully there are ways in which we can improve accessibility in remote regions, but it requires a concerted effort on the part of governments, Non-Governmental Organisations (NGOs) and the global community, not to mention satellite services providers such as Telenor Satellite. In these situations, we are working towards using the mobile networks to expand broadband infrastructure and internet connectivity, while local authorities are focused on reducing costs as far as possible and making sure that devices are affordable to the population.

The situation has improved enormously with the advances in mobile phone technology over the past years and it is now possible to buy or lease a smart phone at an affordable and easily accessible price giving internet access over the mobile network to other data connections. This is starting to bring the internet to less affluent communities where citizens can't afford to pay for dedicated broadband access. Telenor Group is very active in these communities, bringing satellite connectivity to hundreds of millions of consumers who would otherwise be cut off from the digital shift the world is experiencing.

There have been a number of developments in technology that support accessibility. Satellites have a greater reach, mobile devices have been developed to increase the options available, while other progress has brought enhancements such as screen readers and voice recognition software to benefit those individuals with disabilities who have previously been disenfranchised.

COMMUNITY LIFE

At an individual level, it is easy to understand how accessibility can improve lives, but it is at the community level where the greatest impact can be seen. Access to online educational resources and remote learning platforms plays a vital role in breaking down the educational and skills gaps that can sometimes be found in remote regions thereby increasing opportunities for the population. Telenor Satellite has provided satellite links to remote universities giving students access to research papers, and also enabling them to make their own research available. What's more, video conferencing with peers in other countries allows them to pool knowledge and resources and play an active role in the global academic community.

Another notable benefit is the increased access to expert medical care via telemedicine so that populations can receive medical consultations and advice without the need to travel great distances.

New LEO systems are also bringing easily accessible connectivity to these remote areas. However, it is still at a higher cost for the individual user than accessing internet via mobile networks since the cost is carried by the broadband subscriber rather than shared between all users of the mobile network. For this reason, it is likely that communities will continue to rely on mobile phone connectivity for some time to come.

ENTERPRISE

Enterprise is an additional area where accessibility can have an enormous impact, particularly with the business

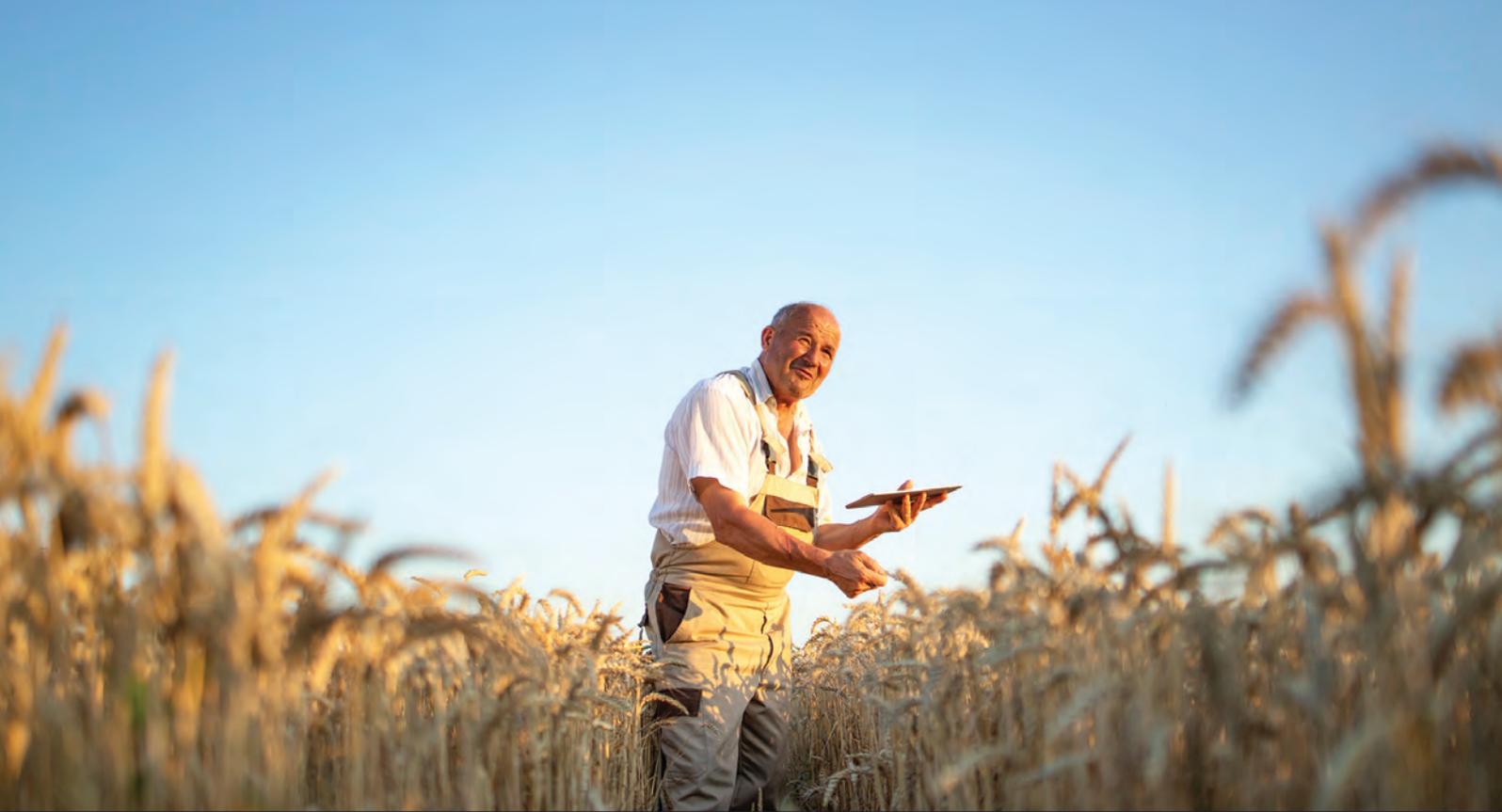


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world's adoption of the virtual workplace which came about as a direct result of the COVID pandemic. Enterprises whose services can be easily transmitted via the internet can now operate from anywhere in the world provided there is reliable connectivity. This opens up the possibility of e-commerce to many otherwise isolated communities.

Supporting remote enterprises and those who work for them is the financial sector and, in fact, Telenor Group operates a bank specifically developed for remote communities enabling them to manage their money better, pay electronically, receive their salary directly into their account, and even offer the opportunity to take out personal or business loans. With the use of the app, these communities can handle their banking online via their mobile phones even where broadband is unobtainable or too costly. Enterprises as well as individuals can also benefit from the digital literacy that can develop within society once the accessibility issue has been overcome. Just a few individuals with a desire to understand and navigate the digital landscape can become catalysts for knowledge throughout the community, making businesses more efficient and paving the way for remote working in an array of industry sectors.

AID ORGANISATIONS

NGOs and aid organisations are frequently called upon to provide relief in remote areas where there is no terrestrial network and so rely on satellite communications to support their efforts. However, there are times when a crisis arises in a relatively well-developed community such as the recent Turkish/Syrian earthquake. In these cases there is a need to switch on satellite connectivity at short notice.

Fortunately, the agencies providing these aid services are well geared up to arrive on the ground with a communications kit ready to go. They can set up a remote base station at a moment's notice, often travelling with a

complete communications system onboard including a generator which is ready to link up with the satellite.

WHY SORTING ACCESSIBILITY IS THE KEY

Access to digital platforms, such as Facebook, Instagram, and WhatsApp enables members of the community to participate more fully in the global economy, and with that comes the potential for commercial growth and the subsequent influx of money into the area. It isn't only the higher-tech enterprises that reap the rewards, increased wealth in a region also benefits the more traditional rural businesses. The benefits continue as the increase in economic growth facilitates the investment in additional digital infrastructure which opens the door to new technologies providing even more opportunities for the population.

Finally, as more technology is acquired, individuals are personally empowered with the opportunity to hone their skills, not only digital competencies but also their practical skills, through the use of self-education clips on platforms such as YouTube and academic qualifications through online college and university courses. By taking advantage of these opportunities, citizens enhance their employability, allowing them to make a greater financial contribution to society.

CONCLUSION

In an increasingly interconnected world, the importance of addressing the digital divide cannot be overstated. Among the three pillars of the divide – accessibility, usability, and economics – accessibility is the cornerstone for progress. By ensuring that all individuals and communities, no matter their location, have equal opportunities to access and benefit from digital technologies, we can create a more inclusive and empowered global society. ●



The next generation of RF power

Genesis, from Advantech Wireless, is a fresh, new approach to satcom power amplification. From a feature-rich standalone amplifier to a sophisticated, modular, soft fail redundant system capable of generating thousands of watts of transmit RF power with an availability approaching a million hours.

Question: Advantech has been producing solid state amplifiers for the better part of three decades, so what prompted the decision to launch Genesis?

Answer: It's true that Advantech has amassed a substantial product portfolio over the years, and as a result, our install base is massive. We have over 300 products in our library, products that are present in a large portion of the satellite ground stations around the world. While that's great from a marketer's perspective, modifying product platforms that have been in service for many years and still working fine can be problematic, especially when they're part of an existing network or being used in a certified terminal that required an enormous investment to complete the certification process.

But the natural evolution of technology, both in and around the satcom domain, has prompted the need to accommodate this evolution by incorporating new features and capabilities if one is to remain relevant. We felt that the best way to achieve this without interfering with our legacy lines was to launch an entirely new platform that's based on the latest technologies – to take our offerings to a whole new level.

Question: What does the Genesis product line look like?

Answer: Our initial Genesis offering consisted of 200W and 250W SSPA/SSPBs that operate in the Ku-band. They've

been in production for almost a year and have seen deployments in environments that are pretty hard on electronics of any kind. The power supply is field-removable, and the I/O section has every conceivable interface.

The 200/250W platform has been expanded into a 400W/500W variant that is based on the same architecture. All of the key components are to be common across the entire product line. The next release will be a C-band 500W GaAs amplifier to address multi-carrier applications. This will allow an 8 or 16-module Summit system to reach transmit power levels well into the thousands of watts.



Question: What is unique about Genesis that sets it apart from Advantech's legacy product lines?

Answer: Since Genesis was a 'start-from-scratch' endeavor, the recipe includes all of the features operators are looking for in a high-end amplifier, together with special features and capabilities that raise the value-proposition

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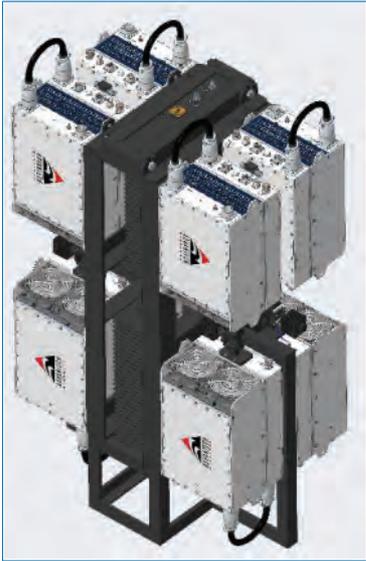
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- Custom Deployables Including Antennas and Solar Arrays
- Wide Variety of Propulsion System Solutions

bar even higher. Genesis operates on a CANBus platform that was years in the making, resulting in fast communication and the ability to conduct monitoring and diagnostics routines down to the device level. Our Summit soft-fail redundancy logic is also integral to every Genesis amplifier shipped, so stacking them up to generate much higher levels of RF output power is as simple as adding an interconnecting cable and some waveguide.

Question: I've seen numerous articles describing Advantech's Summit amplifier systems. How does Genesis fit into the family of Summit packages?

Answer: The idea behind Summit is to provide customers with high levels of RF transmit power using a bank of smaller amplifiers (modules) that are phase-combined, with inter-connected comms such that the operator sees a single functioning amplifier over the M&C. But for Summit II and Summit III, a few mouse clicks will take the operator down to the device-level of any amplifier in the bank.



The original Summit was introduced back in 2012 and was based on our legacy SapphireBlu amplifier. Summit II came along in 2020 and was built around our Taurus amplifier that was upgraded with a new CANBus operating system. Genesis enabled the launch of Summit

III. With its compact size, powerful processing and SNMP V3 security, Summit III is an excellent choice for 8-module and 16-module configurations – where the loss of a single amplifier has a negligible impact on overall system output. Individual modules are easier to handle and less expensive to spare.

Question: For years, the satcom industry has looked for ways to make products smaller and lighter, particularly high-power amplifiers. What was Advantech's approach with regards to the packaging of the Genesis amplifier product line considering this market trend?

Answer: Our team spent a considerable amount of time with thermal modeling during the prototyping phase for Genesis, resulting in one of the most compact designs in its class. In addition to producing a package that is modular for lean manufacturing, much attention was given to the tradeoff between package size and performance across the thermal spectrum. When it comes to solid state power amplifiers, getting heat out of the transistors is of paramount importance, because high-heat and long-life are inversely proportional.

Amplifiers that are extremely light in weight are excellent for mobile terminals, like Flyaways and Manpacks – systems that are rarely up and running 24x7. But for applications where amplifiers are subjected to high ambient conditions, driven hard, and run constantly, you have to be careful not to under spec the amplifier's ability to extract heat. It's up to the manufacturer to balance the product's size and weight with materials, heatsink design, FET placement, and biasing schemes to achieve the highest longevity in any climate.

Question: Do you expect Genesis to eventually replace the legacy Advantech amplifier product lines?

Answer: While Genesis gives us the opportunity to retire some of our oldest designs, the bulk of our portfolio is, and will continue to be produced in our Canada factory. Our design and manufacturing capabilities in Montreal are both strong and vast. A 60,000 square feet production facility with a dedicated machine shop, a dozen CnC machines, and over a dozen temperature chambers for burn-in, enables us to handle a sizeable production flow at any amplifier band or power level.

Our US operation is heavily focused on producing the latest digital controls including our soft-fail and CANBus operating platforms first introduced in Summit II. Upgrades



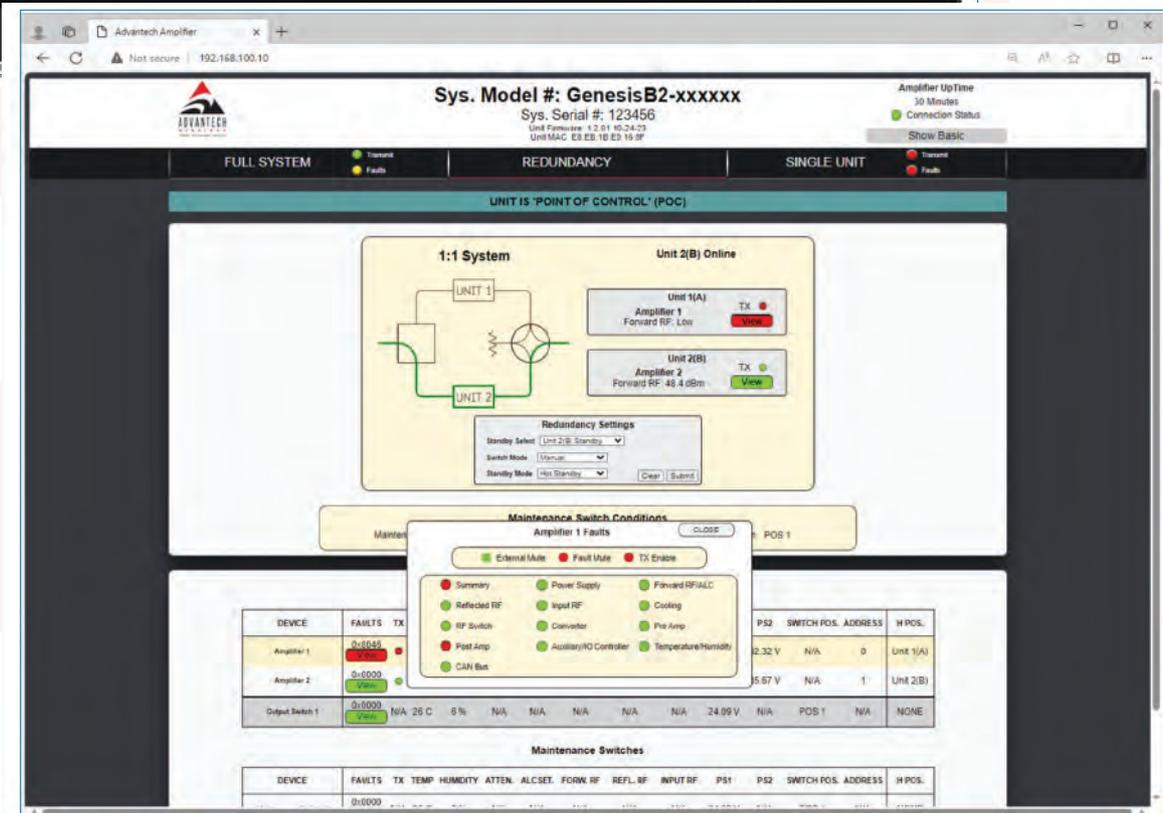
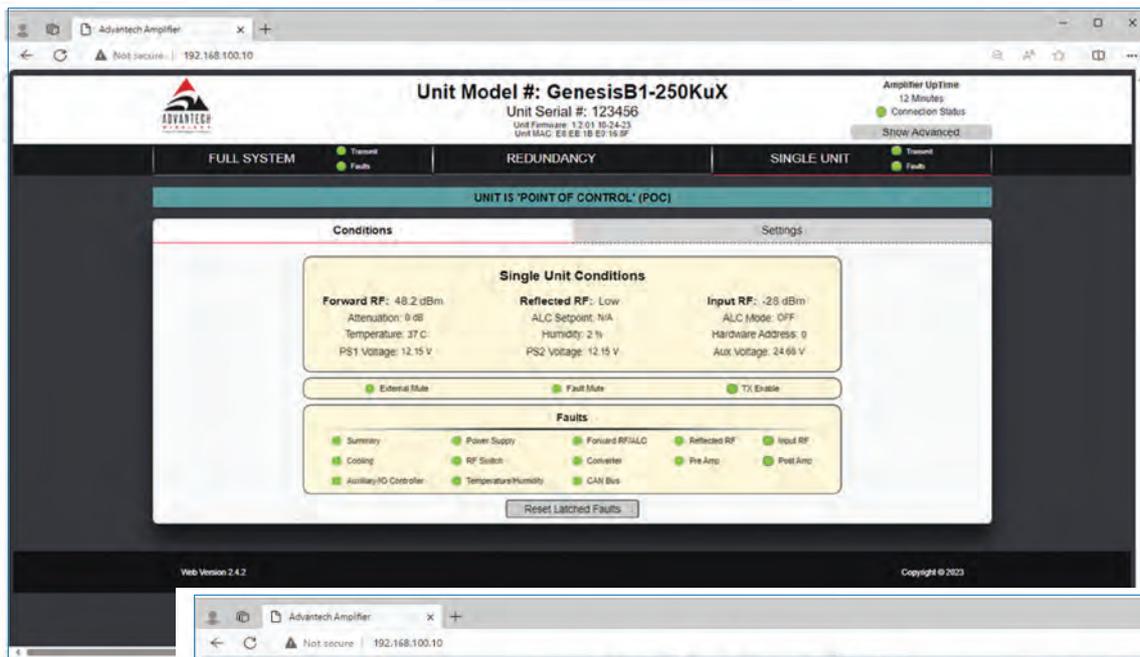
and refinements to the digital sections of our products produced in Canada are done in collaboration with the US engineering team.

Genesis M&C represents our highest tier of controls sophistication with features that are being migrated into our Canada-produced amplifiers. The diagnostics capabilities of the Genesis M&C are the best in our industry.

Our embedded M&C controller contains not only the Summit Soft-Fail logic, but redundancy switch control logic as well. This added benefit means that external controllers are not required for a redundant system to function. The result is a reduction in the single points of failure because

every amplifier in the system has 'Point-of-Control' capability which can be handed off automatically in the event of a failure. SNMP V3 and Web interface is standard in all Genesis products – empowering the user to interact both at the single amplifier level and system point of view via a common MIB file or webpage.

Genesis, as the name implies, is a fresh, new approach to satcom power amplification. From a feature-rich standalone amplifier to a sophisticated, modular, soft fail redundant system capable of generating thousands of watts of transmit RF power with an availability approaching a million hours.





Libby Barr, COO, Avanti Communications ●●●

How satellites can break down barriers preventing South Africa's most vulnerable from accessing education and healthcare

In recent years, access to the internet has become a crucial contributor to the progression of modern societies. Finance and commerce have shifted online, and mobile apps are being used as primary means of communication. Remote working has become a core way doing business, while internet usage within emergency and healthcare systems is significantly reducing mortality rates. However, in some parts of the world, access to the internet is not always easy to obtain.

Libby Barr, COO, Avanti Communications

In South Africa, the entire population is suffering from a severe shortage of connectivity. A failure to add generating capacity and a low level of renewables has led to a series of national power grid failures, resulting in 28 percent of the South African population being left without internet access, and many being left in the dark for up to 10 hours a day.

Electricity Minister, Kgosientsho Ramokgopa has attempted to solve the issue through load shedding which involves turning off the electricity supply to ease pressure on a failing power grid. When load shedding hits, cellular towers and fibre networks are forced to use backup power to keep people connected to the internet. However, these backup systems are very expensive, meaning cellular and fibre providers regularly run at significantly reduced

capacity during these periods and the people are left to suffer.

South Africa's national connectivity crisis is causing detrimental socioeconomic effects. Businesses are losing large amounts of revenue due to their inability to stay connected, whilst thousands of people are left turning to prepaid internet packages at night as they can no longer afford daytime broadband.

School children have no choice but to stay up late to complete their studies, which has been projected to have catastrophic effects on their health and well-being. Increased user reliance on mobile banking after the pandemic means that individuals are unable to handle their personal finances. This year alone, connectivity failures are set to reduce the country's economic growth by two percent. It is about time that this country is brought out of the dark.



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IBUC 2



IBUC 3



GEOGRAPHICAL BARRIERS TO CONNECTIVITY

South Africa is a country characterized by geographical diversity, with many communities located in rural and isolated regions. The challenge with these areas is that they often lack the necessary infrastructure to facilitate traditional connectivity solutions, leaving them vulnerable to the opening chasm of South Africa's digital divide.

When primary communications networks are overloaded or suspended during crises, they cannot always be relied upon to deliver the vital connectivity that a population needs. At Avanti, our RESILIENCE service offers secondary satellite links to support critical enterprise applications in the event of primary network failures. We deploy diverse routing from base stations to enable secure access to vital information in the wake of national emergencies and natural disasters. This provides an automatic switch to a satellite link to enable fibre-like throughput without the dependence on terrestrial networks to support enterprise and communication applications.

We already work in close partnership with our customers in Niger, Kenya, and Nigeria to deliver RESILIENCE and are in the process of using this robust connectivity solution in South Africa to provide critical infrastructure so that connectivity can be maintained during periods of load shedding.

BUILDING RESILIENCE TO IMPROVE SECURITY AS BASE NETWORKS

The ability to stay connected when there is a disruption or failure of this kind is no longer a "nice to have" in modern societies, it is essential. At Avanti, our satellite technology is a viable alternative that can overcome the barriers preventing South Africa from becoming a more consistently connected nation. What's more, across the continent, an increasing number of sectors are looking to these technologies as a solution to the digital divide.

Instances of vandalism and theft at base sites have put pressure on the margins of the nation's telecom industries, with some reports recording a 250 percent increase in loss of generators as a result of these occurrences. In contrast, our hybrid network capability combines both terrestrial and partner satellite networks to deliver innovative and future proof solutions within regions that have a tendency to suffer from instability.

HOW SATELLITE CONNECTIVITY IS PROVIDING EDUCATION TO THE MOST VULNERABLE

The right to basic education is ingrained in South African law and policy. In a world increasingly reliant on technology and connectivity, quality education has become synonymous with having readily available digital resources. However, for South Africa's most vulnerable populations, including those living in remote and underserved areas, I have seen first-hand how accessing quality education remains a significant challenge.

Fortunately, satellites offer a promising solution to bridge this educational gap. At Avanti, we provide high-speed satellite technology, ICT devices, and educational content to schools to boost pupils' learning, well-being, and future prospects. To date, we have connected more than 1,000 villages and schools across Africa, providing



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services in Nigeria, Kenya, South Africa, Tanzania, Senegal, Ghana, Angola, Côte d'Ivoire, Cameroon, and South Sudan. Millions of lives across Africa have been impacted, and over the next 5 years, our ambition is to connect a further 10,000 sites, enabling even more communities to enjoy a connected life.

WHY SATELLITE CONNECTIVITY IS THE KEY TO IMPROVING THE HEALTH OF THE SOUTH AFRICAN NATION

Without a universal healthcare system, South Africa has a crippling healthcare crisis. Economic inequalities mean that most of the population who rely on the public sector are suffering.

The global telemedicine market was valued at \$50 billion in 2019, with a projected growth potential of \$460 billion by 2030. Satellite-enhanced telemedicine can help provide reliable, secure, and cost-effective communication and allows healthcare providers to provide quality care to patients in remote and underserved areas.

At Avanti, we have been running an e-health pilot in the DRC to provide connectivity to rural maternity clinics. Kingandu is home to the district hospital, providing healthcare support to 18 rural and remote health centres and 121,000 people. To establish reliable connectivity between the local clinics and the hospital, Avanti installed VSAT equipment and satellite WiFi in three pilot rural clinics, alongside its partners IRISTICK, USAID, DFUD, and the ESA.

Having seen the widespread benefits that satellite technology can provide to healthcare, there is huge potential for these technologies to reduce the healthcare gap in South Africa.

A BRIGHTER FUTURE: A CONNECTED SOUTH AFRICA

Avanti Communications is determined to work with industry partners and the people of South Africa to empower growth, protect communities, and help the most vulnerable. By bringing together innovative technology and strategic partnerships, we can reduce South Africa's burdening connectivity crisis to ensure its people are equipped for a successful, brighter, and connected future. ●

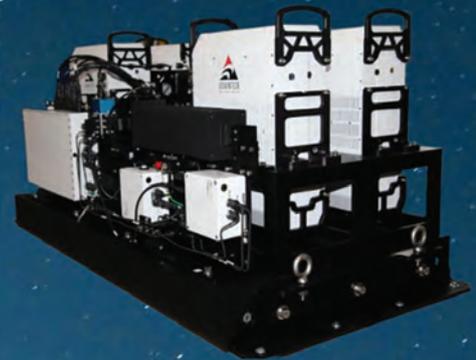
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4kW Redundant SSPA System for Artemis II



The final frontier: Taking 5G into space

As 5G networks proliferate around the globe, the industry is increasingly looking to take the technology into new and remote areas, where previously coverage has been uneconomic or unviable. To deliver this, operators and vendors are looking at the possibilities of using satellites to deliver 5G service.

Dave Harvey, Principal System Test Engineer, AccelerComm

Traditionally, satellites have played pivotal roles in fields as varied as weather monitoring, television broadcasting, and global positioning systems (GPS). However, satellite technology has faced significant limitations in terms of data rates, cost, and latency making it less suitable for communications, especially for mobile networks.

Nevertheless, recent developments, particularly regarding Low-Earth Orbit (LEO) satellites, are reshaping the way we think about the role of satellites in the 5G era.

There is increasing evidence of growing integration between satellite and traditional cellular industries, with a recent report from the Global mobile Suppliers Association (GSA) detailing that, by the end of July 2023, it had identified 70 publicly announced partnerships between operators and satellite vendors across 42 countries and territories. While a further 48 operators in 37 countries plan to launch satellite services within the next 24 months.



Dave Harvey, Principal System Test Engineer, AccelerComm ●●●

THE SHIFT TOWARDS 5G IN SPACE

Satellites, with their unique ability to provide wide coverage areas, have emerged as a key potential enabler of 5G in remote and underserved regions. They offer an economical solution for extending cellular voice and data coverage across the Earth, including areas where terrestrial backhaul is limited or unavailable. This expansion will not only bring high-speed internet connectivity to previously inaccessible regions but also foster the development of essential applications such as telemedicine, education, and banking.

Over the past year, there has been a significant push to propel cellular technologies, and 5G in particular, into space. Industry players have joined forces to revolutionize global connectivity and improve communication capabilities by leveraging the power of satellites to provide



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additional flexible spectrum for everything from voice and data services and IoT/M2M applications to rural and enterprise broadband, mobile backhaul, and even direct-to-handset services. These initiatives show great potential, especially in extending coverage to remote and underserved areas, providing a strong alternative to traditional terrestrial networks.

LOW-EARTH ORBIT SATELLITES: A GAME-CHANGER

The critical distinction between satellite technologies lies in their orbit altitude. Traditional Geostationary Orbit (GEO) satellites orbit at an altitude of approximately 35,000 kilometers above the Earth's surface. Recent developments in Ka-band transceivers and spot beam technology have empowered High Throughput Satellites (HTS) to cover vast areas, including entire continents. However, the inherent distance between GEO satellites and the Earth's surface introduces issues such as signal attenuation, path loss, and blind spots which can affect capacity and reliability of services. Moreover, they suffer from substantial signal latency, with round-trip latencies often exceeding 1,000 milliseconds which is too slow for many applications.

In contrast, LEO satellites orbit much closer to Earth, typically ranging from 160 to 1600 kilometers in altitude. This proximity results in lower signal attenuation, bringing more robust service, and significantly lower latency, with end-to-end delays of between 6 and 30 milliseconds. However, operating across such large distances with equipment which is moving at around ten thousand miles per hour also brings some significant technical challenges.

THE ROLE OF TECHNOLOGY IN SATELLITE INTEGRATION

The key to the success of 5G satellite services is the performance of the network. It is very likely that those providers that do not achieve the required latency, coverage, and throughput to match the expected service requirements will fail. Therefore, it goes without saying that to integrate satellites into 5G networks, you need the right technology. To maximize spectral efficiency, it is necessary to select the right antenna technology, radio front end, and the physical layer processor to ensure a high-reliability link without resorting to lower coding rates and low-order modulation schemes. This is particularly important in satellites where channel capacity is highly constrained compared to terrestrial networks.

The physical layer is a complex component containing all the real-time electrical, mechanical, and logical interface to the antenna. This includes resource-intensive processes such as channel coding and decoding, and other low-level functions. A key component of the 5G baseband processor is the forward error correction (FEC) algorithm which in 5G is implemented using LDPC --a linear error correction scheme which helps to clean up things such as noise and interference that get in the way of reliable 5G data transmission. LDPC accelerators are used to greatly reduce power consumption and processor requirements for the 5G physical layer. However, the algorithm and architecture used to implement an LDPC decoder can change its performance dramatically. This can be vital in satellite systems, where channel conditions pose greater



challenges compared to terrestrial networks, and Hybrid Automatic Repeat Request (HARQ) retransmissions need to be avoided as they will dramatically reduce spectral efficiency.

TESTING THE NON-TERRESTRIAL 5G ENVIRONMENT

Integrating satellites into 5G networks for non-terrestrial applications also introduces a set of unique challenges, with testing being a paramount concern. Unlike terrestrial scenarios, where radio engineers can be dispatched for on-site troubleshooting, the cost and risks associated with launching and maintaining satellites make it impossible to rely on traditional fixes. Furthermore, the non-terrestrial environment introduces a wide range of factors, such as varying link delays and pronounced Doppler effects. These factors dictate the redesign of HARQ systems, leading to the delay of system timers for more reliable operation and data transmission. In addition, the optimization of Modulation and Coding Scheme (MCS) within the framework of HARQ becomes a critical performance feature. Balancing throughput and re-transmissions are essential to ensure efficient data transfer.

Another challenge in non-terrestrial 5G deployments is the limited connection time of User Equipment (UE), typically lasting only 7-8 minutes during a single LEO satellite orbital transition. This constraint demands robust link setup and maintenance, requiring specific selective Physical Random-Access Channel (PRACH) formats. These complexities amplify and complicate the testing process.

This scarcity and cost of commercial testing equipment can pose significant hurdles for industry players looking to develop, test, optimize, and deliver their satellite solutions effectively. This means that they need to build their own custom test environments to transmit and receive signals at specific times and locations within each slot on a per-slot basis to conduct thorough testing and analysis of the 5G physical layer. However, as the landscape matures, more solutions are coming to market, which will gradually ease these challenges.

LOOKING AHEAD

While the 5G satellite market is still in its infancy, it's clear from the current momentum in the market that the industry is very focused on delivering cellular services using LEO satellites. The area is not without its challenges, many of which stem from the unique conditions involved in operating at such speed and distance. However, there are considerable market opportunities, delivering a range of benefits across geographies and vertical segments. As with the terrestrial cellular market, the key to successfully delivering for mobile operators and equipment vendors alike will be in working with a broad ecosystem of partners to ensure that the best possible performance is designed, tested, built, and delivered. ●

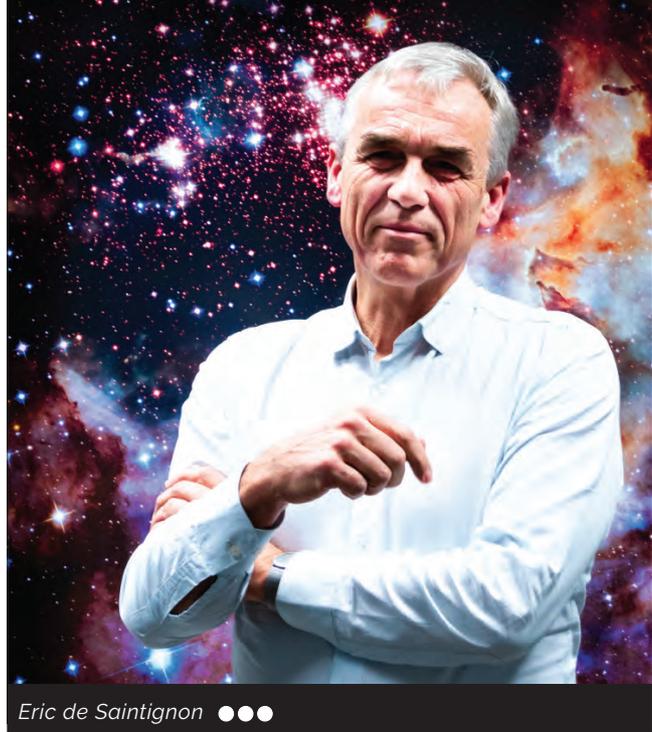
Anywaves is accelerating its growth and appoints Eric de Saintignon as General Manager

Building on its recent commercial successes and the development of new innovative products, Anywaves continues its market expansion. Through EdSpace, Eric de Saintignon is appointed as the General Manager to support the space antenna specialist in its upward trajectory. This appointment will enable Nicolas Capet, the Founder and President, to prepare the future of Anywaves through the Strategy Department, for which he assumes responsibility. With over 30 years of experience in the space industry, Eric de Saintignon has notably excelled by taking the helm of OneWeb Satellites at its inception in 2015.

A true expert in industrial development and structuring, he is now applying his expertise to the benefit of Anywaves to firmly establish the SME as a leading player in the space equipment sector. Furthermore, through EdSpace, a company he recently established to support the French and European space industry in its transformation towards the space industry of the future, Eric de Saintignon is entrusted with the role of General Manager at Anywaves.

"Throughout my career, I have witnessed the evolution of the space industry. Today, with the advent of the new space era, it is undergoing a metamorphosis. Therefore, I have chosen to leverage my experience to support those who wish to be part of this transformation. So, what could be more natural than turning to a young pioneering equipment manufacturer in this endeavor? With its ambitions and upward trajectory, Anywaves is a clear champion, and it is with conviction and enthusiasm that I now take on the role of General Manager of this promising company". Eric de Saintignon.

"For almost seven years now, Anywaves has been dedicated to meeting the market's needs by developing

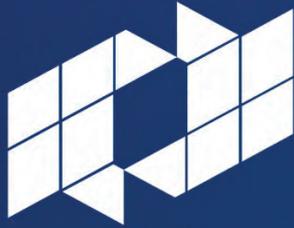


Eric de Saintignon ●●●

innovative space antennas that align perfectly with the industry's expectations. Milestone after milestone, with the trust of our clients and partners, we have achieved numerous successes. The appointment of Eric is both natural and obvious: his extensive knowledge of the space industry is a significant asset for refining our operational efficiency. I entrust him with the role of General Manager of Anywaves with complete confidence, while I will focus on shaping the future and accelerating our growth through the Strategy Department, for which I assume responsibility today," Nicolas Capet, PhD, Founder & President.

A graduate of the Polytechnic Institute of Grenoble, and with prior experience at Matra Marconi Space, Astrium, Airbus Defense and Space, Airbus OneWeb Satellite, and more recently Actia and Comat, Eric de Saintignon is now taking on the role of General Manager at Anywaves. He will join forces with the company's Founder and President, Nicolas Capet, PhD, forming a technical and operational excellence duo with the aim of propelling the company to new heights.

An advertisement for Proactive International PR. The background is a dark blue gradient with a digital dashboard overlay showing various charts, graphs, and data points. In the top right corner, the Proactive International PR logo is displayed, consisting of a stylized 'P' icon followed by the text 'PROACTIVE INTERNATIONAL PR'. At the bottom, the text reads: 'What do you want from your PR?' in large white font, followed by 'To find out more contact: James Page, Agency Director: hello@proactive-pr.com' in a smaller yellow font.



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Intelsat Names David J. Broadbent New Head of Government Business

Intelsat, operator of one of the world's largest integrated satellite and terrestrial networks and leading provider of connectivity to the US Government, has appointed David J. Broadbent as its new President, Government Solutions. Broadbent is responsible for Intelsat's government business globally and joins the company's seven-member Management Committee. He reports to Intelsat Chief Executive Officer David C. Wajsgas.

Broadbent comes to Intelsat from Raytheon Technologies, where he served most recently as president of the company's Space Systems business unit. Broadbent had been with Raytheon for 21 years in various senior business development, program execution, contracts, supply chain management and financial planning roles. Before joining Raytheon's Integrated Defense Systems team in the UK in 2002, he worked with Vickers Defence Systems in engineering design, supply chain, and program management in both Germany and the UK.

"Dave Broadbent has spent his entire, successful career navigating complex US and international government business environments, and he has a strong track record of delivering exceptional results at every level," Wajsgas said. "Dave is the right leader for our Government Solutions team at this juncture, with his demonstrated history of building highly effective teams and customer relationships, capturing new business and driving continuous improvement in execution and operations."

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David J. Broadbent, President, Government Solutions ●●●

Intelsat's connectivity solutions across all domains: air, land, sea, and space. The company has a fleet of nearly 60 satellites providing coverage to 99 percent of the earth's populated regions, as well as over 100,000 miles of terrestrial fiber optic cable, and strategically located teleports worldwide. Intelsat provides broadband connectivity, video communications, and mobility services for government applications ranging from homeland security and remote military operations to disaster preparedness and recovery.

"This is a great time to join the Intelsat team," said Broadbent. "The company has a strong global presence and a distinguished history of innovation, customer focus and delivering on its commitments. With an exciting multi-orbit strategy and technology roadmap, we are incredibly well positioned for growth in the rapidly evolving SATCOM and services sector." ●

NASA names new highest-ranking Civil Servant, Head of Exploration

NASA Administrator Bill Nelson has announced Jim Free's promotion to associate administrator for the agency at NASA Headquarters in Washington, effective when his predecessor Bob Cabana retires on Sunday, Dec. 31. Since September 2021, Free has served as the associate administrator for NASA's Exploration Systems Development Mission Directorate (ESDMD).

Nelson also announced Free's deputy, Catherine Koerner, will succeed him as the next head of the mission directorate.

"So many of us in the NASA family have worked with Jim and have been inspired by his character and intellect. Pam, Bob, and I strongly believe that his wealth of experience and expertise will bring exceptional guidance and perspective to our leadership team in his new role as associate administrator, enhancing our collective efforts toward achieving bold goals for the benefit of all humanity," said Administrator Nelson. "Cathy's experience as the ESDMD deputy associate administrator – including her leadership in establishing and defining future space exploration architectures while overseeing the development of our deep space transportation systems – has prepared her for this new role as associate administrator for ESDMD. Cathy's leadership will help NASA continue to extend humanity's reach in the cosmos. Congratulations, Jim and Cathy!"

As associate administrator, Free will become NASA's third highest-ranking executive, as well as highest-ranking civil servant. This role serves as a senior advisor to Nelson and Deputy Administrator Pam Melroy. When he assumes his role, Free also will lead the agency's 10 center directors, and five mission directorate associate administrators at NASA Headquarters. He will act as the agency's chief operating officer for more than 18,000 employees and an annual budget of more than \$25 billion.

Before his appointment to associate administrator of Exploration Systems Development in 2021, Free spent several years in various private sector roles. He left NASA in 2017 after serving as the agency's deputy associate administrator for technical in the Human Exploration and Operations Mission Directorate at NASA Headquarters.

Prior to joining NASA Headquarters, he worked his way up to center director at NASA's Glenn Research Center in Ohio, where he was responsible for planning, organizing, and directing the activities required in accomplishing the missions assigned to the center. ●

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