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January 2022

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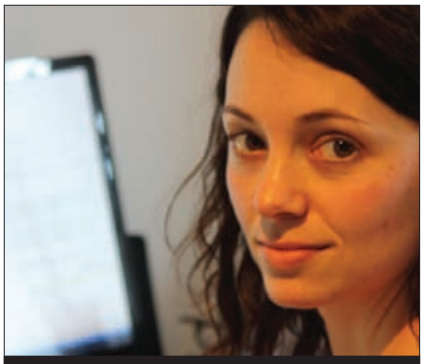


Editor - Amy Saunders

New year, new us

Welcome to 2022. As the satellite industry becomes less regional and more global in its outlook, here at the Satellite Evolution Group we have made changes to our portfolio line-up. From this month we will be merging Satellite Evolution Asia, Satellite evolution EMEA, Satellite Evolution Americas and NewSpace International into one magazine – Satellite Evolution Global.

Our new format will see us cover everything aerospace, from every corner of the globe, every single month.

We are also pleased to welcome Crispin Littlehales as the Global Contributing Editor. Crispin is a seasoned journalist who has been writing and editing articles for more than 30 years. After graduating from Princeton University, she served as a legislative aid in the US Senate, followed by a decade of writing copy for advertising and public relations firms in New York and San Francisco. With her diverse portfolio in the commercial sector, she became a highly respected freelancer, producing application articles for dozens of tech companies including Perkin-Elmer, Hewlett-Packard, and Silicon Graphics. Crispin will be taking the helm while I am on maternity leave until July.

When it comes to new formats, Meta (formerly Facebook) is no stranger. The company rebranded in October 2021 to 'reflect the company's perceived growth opportunities beyond its namesake social-media platform.' Meta is now focusing on the collaborative development of the metaverse, having announced a US$50 million investment in global research and programme partners last year. The metaverse is where physical and digital worlds come together, in which avatars interact for work, recreational, social, and general life experiences; attending concerts or trying on clothes, anything is apparently possible. Obviously virtual and augmented reality will play a key role, but importantly, no one company will own or operate it, rather, users will be able to move seamlessly between Apple, Facebook, or Google worlds, for example.

Of course, nothing of this magnitude is built overnight. It's expected to be at least 10-15 years before anything resembling a metaverse comes to fruition and relies on the heavy investment of other tech companies to ensure full interoperability and best working practices. Complicated questions around human rights and civil rights must also be answered along the way to ensure the metaverse is fully inclusive. All this aside, it'll be an incredible feat of technological ingenuity to follow in the years to come.

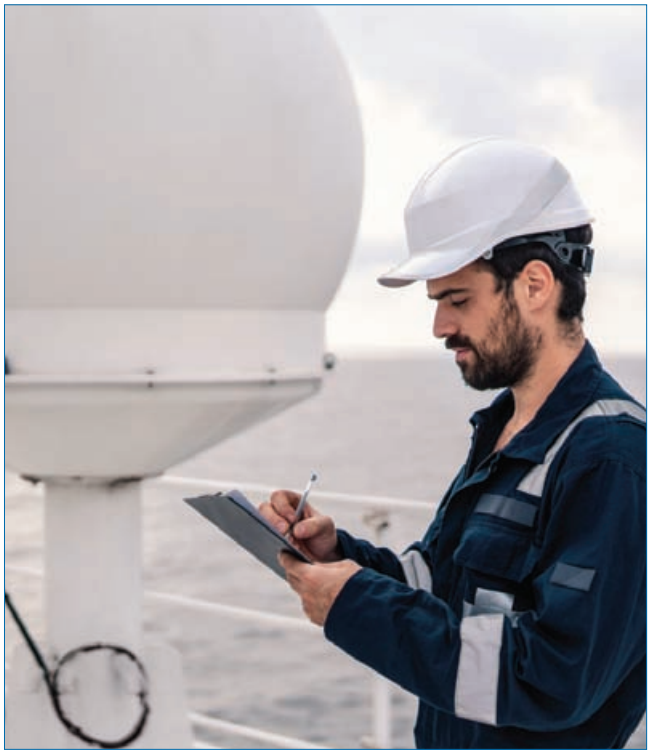
Moving on: In this New Frontiers Special Issue, we've spoken with Alastair Bovim of Insight Terra, who shares his views on heavy industry interests and the IIoT; and also, with Tom McCarthy from Motiv Space Systems on the demands of the emerging space economy areas. Satcoms Innovation Group's Helen Weedon opines on the impact of new satcom technologies on the maritime sector, while Paul Gouws from ETL Systems and Atlantic Microwave outlines the frequency challenges and opportunities of the now, including the move to Q/V-band. Stéphane Estable, PERIOD project Coordinator from Airbus Defence & Space discusses the complexities of establishing a satellite factory in space, while James Harrison from Telstra ponders the 'network of tomorrow.' Finally, we've explored the distant possibility of 6G mobile connectivity, and how space robotics are revolutionizing the stability of the NewSpace sector.

Lastly, we'd like to wish a Happy New Year to all our readers.

Regulars

Features & Market Reports

Executive Q&As



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DS Air Publications
1 Langhurstwood Road, Horsham, West Sussex, RH12 4QD, United Kingdom
T: +44 1403 273973 | F: +44 1403 273972 | Email: admin@dsairpublications.com | www.satellite-evolution.com

Editor
Amy Saunders
amy.saunders@dsairpublications.com

Business Development Manager
Belinda Bradford
belinda@dsairpublications.com

Managing Director
David Shortland
david@dsairpublications.com

Assistant Editor
Laurence Russell
laurence@dsairpublications.com

Publisher
Jill Durfee
jill.durfee@dsairpublications.com

Circulation Manager
Elizabeth George

Contributing Editor
Crispin Littlehales
crispin@dsairpublications.com

Publishing Director
Richard Hooper
richard@dsairpublications.com

Production
production@dsairpublications.com

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OneWeb confirms successful launch

LEO CONSTELLATIONS: OneWeb has confirmed the successful deployment of 36 satellites by Arianespace from the Baikonur Cosmodrome. This latest launch, the Company's twelfth overall and ninth since December 2020, brings OneWeb's total in-orbit constellation to 394 satellites. This represents over 60 percent of OneWeb's planned 648 LEO satellite fleet that will deliver high-speed, low-latency global connectivity.

This launch caps off a successful 2021 in which OneWeb gained significant momentum across the board. With strong shareholder support, the business is now fully-funded with US$2.7bn raised since November 2020 and no debt issuance. In addition, OneWeb continues to see growing demand for its services. In the past month, OneWeb has signed distribution partner agreements with Airbus to provide LEO services for military and governmental use in Europe as well announcing a new Canadian-headquartered distribution partner, Network Innovations, and Vocus to expand enterprise connectivity in Australia.

These agreements, along with other recent strategic partnership announcements with AT&T, Hughes Network Systems, BT, and Leonardo DRS, will further OneWeb towards its goal of bringing improved digital communication services to some of the hardest to reach parts of the world. Additionally, OneWeb acquired TrustComm in 2021, now OneWeb Technologies, which is focused on meeting the complex needs of government customers.

Liftoff of the latest launch occurred on 27 December at 13:10pm BST. OneWeb's satellites separated from the rocket and were dispensed in nine batches over a period of 3 hours 45 minutes with signal acquisition on all 36 satellites confirmed.

OneWeb will enter the new year in a position of strength, as it plans to launch global service by the end of 2022 and as demand continues from telecommunications providers, aviation and maritime markets, ISPs, and governments worldwide for its low-latency, high-speed connectivity services to provide businesses and consumers.

Sunil Bharti Mittal, OneWeb Executive Chairman, said: "OneWeb now has over sixty percent of its global satellite fleet in space. It is an extraordinary achievement for a company that was reborn just a year ago. OneWeb's shareholders, Management, Staff and Distribution Partners all share a common goal – connecting communities everywhere. Together we are delivering on our promise to achieve digital transformation on a global scale, through our robust, secure and resilient satellite broadband network."

Neil Masterson, OneWeb CEO, commented: "The launch is a great way for OneWeb to complete a highly successful year. With more than sixty percent of our constellation now in space, the business is fully-funded and we have a growing workforce of more than 400 people. I have been immensely proud to lead the business and our team over the last year as we continue to make substantial progress launching our global network, and I look forward to building on this momentum in 2022."

One of the world's largest MNOs to deploy Gilat's 4G cellular backhaul over satellite technology

CELLULAR BACKHAUL: Gilat Satellite Networks Ltd., a worldwide leader in satellite networking technology, solutions, and services, has announced that one of the world's largest Mobile Network Operators (MNOs) will deploy 4G cellular backhaul over satellite technology from Gilat.

The top-tier MNO, serving hundreds of millions of subscribers in Asia, will implement Gilat's SkyEdge II-c system and Capricorn Outdoor VSATs, which will enable improved Voice and Data over LTE services for its mobile subscribers. This 4G cellular backhaul solution over satellite is expected to be deployed in the first quarter of 2022.

SpaceBridge proud to expand connectivity to Colombian aviation authority AeroCivil

COLOMBIA: Aerocivil Colombia, Colombia's Civil Aviation Authority, is expanding its network in a continued successful partnership with SpaceBridge Inc. In 2015, Aerocivil and SpaceBridge launched a joint project to ensure continuous connectivity between aircrafts and ground air traffic control. SpaceBridge implemented dual star and mesh technology infrastructures, allowing aircrafts and airports to communicate with each other while significantly decreasing the overall round-trip delay. "Having this type of connection is dire for Aerocivil Colombia to mitigate the potential dangers that could occur during flight," explains David Gelerman, CEO of SpaceBridge.

This project was implemented as many Colombian airports are located in regions that are geographically outside the range of cellular tower connection. As such, these airports can now rely on satellite connection thanks to the partnership between Aerocivil Colombia and SpaceBridge. SpaceBridge has provided two geographically redundant gateways; one in the major city of Bogota and one in Barranquilla. This ensures that in the event a natural disaster affects one gateway, the other gateway will automatically take over to maintain constant connectivity. CEO David Gelerman explains this is the reason SpaceBridge's state-of-the-Art point-to-point Mesh Satellite connectivity was implemented, as it is ensuring reliable, constant connectivity.

DEWA signs agreement with NanoAvionics

UAE: Dubai Electricity and Water Authority (DEWA) has selected NanoAvionics, a leading smallsat manufacturer and mission integrator company, to design, build, test, and manage the launching of two nanosatellites 3U (IoT payload) and 6U (earth observation payload). The services supplied by NanoAvionics also include operation, knowledge transfer and training. This is part of DEWA's Space-D programme that seeks to enhance operational efficiency and reliability, and promote preventive maintenance for the planning, generation, transmission and distribution of electricity and water networks.

Through this programme, DEWA aims to lead the industry in improving the operations, maintenance and planning of its networks with the support of nanosatellite technology. Space-D supports DEWA's grid digitalization programme by using Internet of Things (IoT) and remote sensing technologies.

Also through this programme and the expertise of NanoAvionics, DEWA intends to enhance its flexibility and agility in monitoring and managing its electrical and water networks. With Space-D, DEWA expects to reduce costs, improve its asset utilization and provide sustainable, efficient and reliable power and water services to its customers.

HE Saeed Mohammed Al Tayer, Managing Director & CEO of DEWA said: "His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and ruler of Dubai, launched DEWA's space programme, Space-D. The programme aims to build DEWA's capabilities and train Emirati professionals to use space technologies to enhance its electricity and water networks. The programme will take advantage of Fourth Industrial Revolution technologies such as the IoT, artificial intelligence (AI), and blockchain to exchange information with the help of satellite communications and earth observation technologies.

"DEWA's space programme will contribute to enhancing the UAE's global competitiveness and strategic partnerships in the national space sector as well as paving the way for a new phase of Emirati capabilities in space exploration, technology and related industries that will be used to strengthen electricity and water networks in Dubai. The programme will enhance the performance and efficiency of the photovoltaic solar panels at the Mohammed bin Rashid Al Maktoum Solar Park, the largest single-site solar park in the world. The project also supports the National Space Strategy 2030, which aims to realise the leadership's vision by using space sciences, technologies, applications and related services to enhance development."

In line with its digital transformation, DEWA will use a 3U satellite with an IoT payload as well as a 6U satellite with an earth observation (EO) payload from NanoAvionics. Using satellite network connectivity, IoT terminals, satellite imagery and applying AI to the captured data will bring greater efficiency and effectiveness to DEWA's operations, maintenance and planning. The agreement with NanoAvionics also includes launch management, construction of the ground station, and an extensive training programme for Emirati professionals to facilitate know-how transfer and support in expanding DEWA's future space capabilities.

"This is a fantastic project for NanoAvionics to be involved in and a great example of how satellite technology improves our lives and helps us to become more sustainable," said Vytenis J Buzas, co-founder and CEO of NanoAvionics. "The knowledge transfer, in addition to satellite integration and mission operations for DEWA, also shows the capabilities and value that our expert team can bring to our customers. Our team has been part of more than 90 missions, including four successfully launched missions this year, and has previous experience in sharing its skills and knowledge through programmes with other international customers."

DEWA's Space-D project includes the launch of a satellite constellation to support its primary satellite. These will be manufactured by Emiratis at the Research and Development (R&D) Centre of the Mohammed bin Rashid Al Maktoum Solar Park. The system features a ground station at the solar park as well as IoT and AI technologies to support ground communication transmission stations in electricity and water networks. By deploying this infrastructure, DEWA seeks to increase the efficiency and effectiveness of its planning and operations, and enhance preventive maintenance at its production, transmission, distribution divisions as well as its smart grids, and electric vehicle charging stations. Multi-spectrum, high-resolution thermal imaging devices such as those used on board spacecraft, specifically designed for use in electricity and water networks, will be deployed to detect thermal fingerprints in high voltage transmission lines, substations, buildings and solar power stations.

Deadline approaching for ManSat scholarships to United Space School

ISLE OF MAN: Sixth-form students can win scholarships to represent the Isle of Man at the 2022 United Space School in Houston, Texas. The annual United Space School takes place from July 24th to August 8th with the ManSat Group awarding up to three scholarships to Year 12 and 13 students in the Isle of Man.

The successful scholars will travel to Houston and work alongside peers from around the world to plan a space mission, with support from NASA astronauts, engineers, and scientists. The Space School is run by the Foundation for International Space Education (FISE).

The scholarships are awarded in cooperation with the Department of Education, Sport and Culture, with the first recipient, in 2000, being Dr Jennifer Stone, who is now Chief Technical Officer for ManSat.

Jennifer said: "ManSat has run this competition every year since 2000, with 44 Isle of Man students having attended Space School. Because of the pandemic, the 2020 and 2021 space schools were both held online. We hope the 2022 edition will be back in Houston, with a final decision on whether it will be held in-person or online to be made by the end of March.

"Usually, our scholarships are open to Year 12 students, but this year we are extending our competition to both Year 12 and 13 so that all sixth-form students will have had the opportunity to apply to go to Houston during their school career."

Skyrora builds largest hybrid 3D printer in Europe

UK: Skyrora has created Skyprint 2, the largest hybrid printer of its kind in Europe, to optimize the speed and efficiency of manufacturing rocket parts. By allowing printing and machining on the same bed, it will drastically reduce process complexity, cost and printing time by around 30 percent compared to other printers. Another key advantage of Skyprint 2 is that it can manufacture via subtraction or addition processes, which means it can repair parts and machine items that were not originally printed. Following on from Skyprint 1, and when it starts production in Q2, the bespoke Skyprint 2 will offer a cost-effective, bi-metallic, hybrid manufacturing service to meet the growing demand for small satellite launches and enables Skyrora to take full control of the manufacturing process.

Skyprint 2 will use Inconel, a superalloy known for its mechanical strength at high heat which comprises most of the mass of Skyrora's rocket engines and makes use of the Directed Energy Deposition (DED) process. This is an additive manufacturing process in which focused thermal energy is used to fuse materials by melting as they are being deposited. One of the key features of Skyprint 2 is its 'near net shape' process of DED, which minimizes material usage. Any residual material that would be otherwise lost due to blowout is instead collected and recycled, enabling greater material efficiency and making the manufacturing of parts more sustainable.

With standard, bulk methods of manufacturing Inconel alloy engine parts (oxidation-corrosion-resistant materials well suited for extreme environments subjected to pressure and heat), it can take around 10 weeks from concept to production, not to mention quality modifications. Using Skyprint 2, the time needed to manufacture key rocket engine components has been significantly reduced to only two weeks due to 3D printing's direct forming capabilities. Combined with the increased design dexterity - allowing for greater changes in design between iterations - Skyprint 2 is radically altering what is possible in hybrid manufacturing services.

Volodymyr Levykin, Skyrora's founder and CEO, said: "Skyprint 2 reinforces our ambitions to not only be the first company to launch from UK soil, but also to do so in the most sustainable way possible. By taking greater control of the design and manufacturing process of our parts using our custom-built industry-leading 3D printing technology, we are taking another crucial step closer to offering a significant space service from our own soil. Creating this cost- and time-effective solution encapsulates the innovation and talent that resides at the heart of the UK space industry. As an asset, Skyprint 2 is a real game-changer - it will transform Skyrora's operations and expand the limits of what is possible when it comes to space engineering in general."

Following Skyrora's announcement in October 2021 of a multi-launch agreement with SaxaVord that will enable the company to complete 16 launches a year by 2030, the ability to fully design and print parts using Skyprint 2 will substantially reduce the timeframe needed for Skyrora to manufacture its rockets from 2022.

Earlier this year, Skyrora also successfully completed trials of the third stage of the Skyrora XL rocket, including its orbital transfer vehicle (OTV) - a vehicle that once in orbit can refire its engines around 15 times to complete tasks such as acting as a space tug or maintenance and de-orbiting of defunct satellites.

Photo courtesy metamorworks/Shutterstock

On the horizon: The sixth generation mobile standard

To many consumers across the globe, connectivity is connectivity. Most of us don't really care how it works, as long as it does. Over the past couple of decades, however, our expectation of what connectivity can do and provide has increased, and we are becoming less tolerant of slow or patchy services. Accordingly, as each new mobile generation is realized, our expectations grow.

Amy Saunders, Editor, Satellite Evolution Global

Mobile networks first launched way back in the 1970s, changing the world forever with mobile communications and all the possibilities that brings. While the first generations (shortened to 'G') were fairly simplistic by today's standards, they truly revolutionized the communications landscape and continued to evolve rapidly.

1G: First generation mobile networks utilized analogue radio systems, enabling phone calls and nothing more. Established in 1979, cell towers were built across the world to enable 1G coverage, which was often patchy at best; networks were unreliable and insecure.

2G: Replacing 1G in 1991, 2G was the first digital network, offering improvements in security and capacity over its predecessor. As well as enabling phone calls, SMS and MMS messages were possible.

3G: Launched in 1998, third generation networks are still in use today in areas where 4G fails. 3G was revolutionary, enabling much faster data transmissions, and increased applications such as Internet access.

4G: Going one step further and offering speeds five times faster than 3G, the new for 2013 fourth mobile generation offered massive improvements in latency and enhanced social media and content consumption experiences.

The latest mobile generation, 5G, was launched in 2019, and continues to roll out across the globe today. Like previous iterations, the advantages of 5G compared with previous standards are primarily speed based, with the NGMN 5G network requirements defined as:

- Data rates of several tens of Mbit/s, supported for tens of thousands of users;
- 1Gbit/s offered simultaneously to tens of workers on thesame office floor;
- Several hundreds of thousands of simultaneous connections for massive sensor deployments;
- Spectral efficiency significantly enhanced compared to 4G;
- Coverage improved;
- Signaling efficiency enhanced; and
- Latency significantly reduced compared to LTE.

In addition to the higher speeds and lower latencies on offer to consumers, 5G is expected to enable new

Internet of Things (IoT) applications on a much wider scale. Indeed, proponents claim that 5G will change not just how we use our mobiles, but how we connect devices to the Internet: smart cities, connected cars, autonomous vehicles, and so on.

GREAT EXPECTATIONS

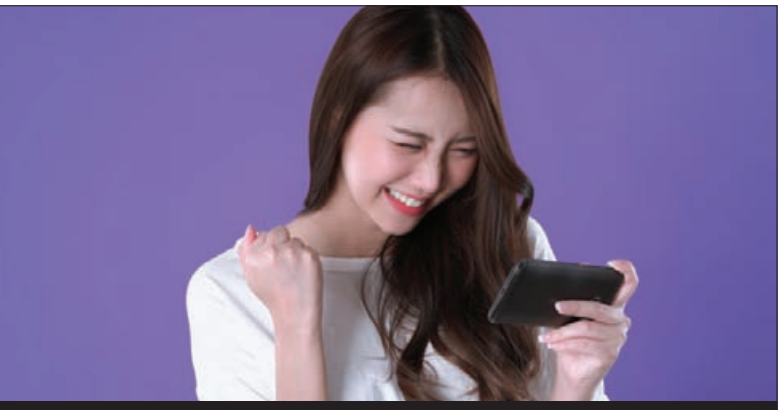
While 5G has yet be fully rolled out, the connectivity sector is already moving onto bigger and better things. The sixth generation, 6G, is currently under development, set to bring higher speeds to support applications such as the Internet of Things (IoT), virtual and augmented reality (VR and AR), and ubiquitous remote communications. With 6G, mobile network operators are expected to adopt flexible decentralized business models with spectrum and infrastructure sharing and intelligent automated management supported by artificial intelligence (AI), blockchain and mobile edge computing.

6G is expected by some, such as IDTechEx, to be a trillion-dollar opportunity, with Korea, China and India all embedded in research already. Finland, too, is surprisingly involved, backed by US$350 million of EU grants. Naturally, 6G must deliver significant advancements upon 5G, including no cell-to-cell handover for mobile devices for the first time. While discussion around standards remain in their infancy, six parameters are being focused on:

- First truly 3D coverage and ubiquity;
- Data rate over 100Gbps and 100 times more capacity;
- Accommodation of edge devices with no power and/or low power, at low cost;
- Always low latency of less than 1ms;
- Reliability 99.99999 percent;
- Secure, private, safe, resilient; and
- Massive connectivity: 10 million devices per square km.

The unallocated frequency band at 275GHz to 10THz, dubbed the 'Terahertz Gap' is expected to be utilized heavily for 6G communications; the higher frequency offers speeds at least ten times greater than 5G, and is already home to several experiments. Naturally, there are great opportunities for materials and hardware suppliers, given that nothing in existence currently operates anywhere near this range.

The question of what 6G actually is or will be continues.



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So early in the development stage, standards have yet to be defined, however, groups are coming together now to explore this very question. One such group is Fraunhofer-Gesellschaft, which at the start of last year launched 6G SENTINEL to develop key technologies for the future 6G mobile communications standard. Under the Fraunhofer Institute for Integrated Circuits IIS, five Fraunhofer Institutes are pooling their expertise to attain a position at the technological vanguard of 6G research. The focus of their work will be on terahertz (THz) technologies and solutions for flexible networks which will facilitate the extremely high data throughputs required for applications such as VR, digital twins, teleoperation, and autonomous driving.

The team is working on the development of radio channel models and link-level simulators for the 100-300GHz frequency range. They plan to develop a prototype of a highly integrated THz transmission module and a suitable transmission method for demonstrating mobile THz connections. The second cornerstone of the project will be the development of software solutions that facilitate the flexible design of networks to align with the application and the current operating conditions. This requires a modular and software-based core network that will be supplemented by secure and trustworthy components for dynamic control, will allow the integration of new kinds of access and backhaul networks, and will support AI-based network automation. The goal is to develop and demonstrate an adaptable architecture for heterogeneous 6G networks in which satellites and airborne platforms will play a role alongside THz technologies. Precise localization will be of overarching importance in 6G because new localization approaches will use information about the radio channel to an increasingly systematic extent in order to improve the accuracy of positioning. To this end, the 6G SENTINEL project team will test concepts and algorithms, integrate them functionally into the core network and further develop them into fully integrated localization solutions for the THz range.

The consortium plans to merge the technologies developed in the project into a coherent architecture that can serve as the foundation for the flexible implementation of a comprehensive 6G system. To achieve higher transmission rates, the 6G system will be characterized by very small cells, the use of THz frequencies and the deployment of antennas with integrated beamforming systems (massive MIMO). At the same time, 6G SENTINEL has placed a special emphasis on the development of solutions for the integration of satellites and other non-terrestrial base stations.

ASIA PAVES THE WAY FOR 6G

Back in November 2020, China launched 13 satellites, including 'the world's first 6G satellite' on board a Long March 6 rocket. However, considering that even 5G remains

in its infancy, and that no standards have yet been established to define 6G, what they've actually launched remains arguable.

Tianyan-5 is a remote-sensing satellite developed by the University of Electronic Science and Technology of China, Chengdu Guoxing Aerospace Technology, and Beijing Weina Xingkong Technology. In addition to Earth observations, the satellite will test a high-frequency THz communication payload that could transmit data several times faster than 5G. Like the mmWave technology that enables 5G, THz or submmWave are extremely sensitive to water vapour in the Earth's atmosphere, limiting applications.

Also exploring 6G technology out of China is Huawei, which was rumoured to be launching two 6G satellites in July in cooperation with China Mobile and a Chinese space company. This news was a next logical step for Huawei, which in 2019 proposed a vision of more than 10,000 small satellites orbiting in LEO to provide 6G services across the globe. No further information on such a launch has been released, however, the company unveiled its 6G plans later in September.

Rotating Chairman Eric Xu Zhiju reported that Huawei aims to launch its 6G products around 2030. Xu stated in an article that the development process is much more complicated than that of 5G, with geopolitical uncertainties hanging over the research. "Whether the industries can achieve satisfying results (in 6G development) around 2030 largely depends on such factors as if the process of defining 6G is open enough, whether the participants are pluralistic, and if the communication is thorough enough," said Xu.

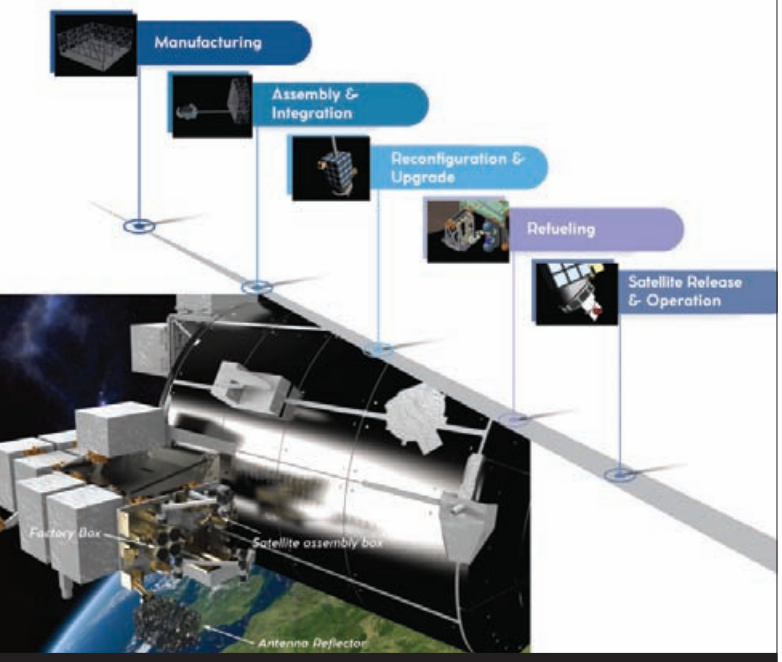
Meanwhile, South Korea reportedly plans to deploy the world's first commercial 6G network in 2028, with the core technologies being developed in the next five years with a US$193 million investment. Joint cooperation with the US on 6G will also be stepped up in the years to come. The Institute for Information communication Technology Planning and Evaluation (IITP), a state body affiliated with the Korean Ministry of Science and ICT, signed a deal with the US' National Science Foundation (NSF) to jointly research 6G technologies. In addition, Korea's LG said it has partnered with US Keysight Technologies and the Korea Advanced Institute of Science & Technology (KAIST) with the aim of carrying out research on future 6G technologies. The three partners will cooperate in developing technologies related to THz frequencies by 2024. LG has established a 6G research centre with KAIST and also signed an agreement with the Korea Research Institute of Standards and Science to study 6G technologies.

THE END OF THE ROAD?

Unlike previous mobile generations where there was little doubt that the new technology would ultimately be realized, 6G faces some pretty heavy doubts and concerns already.

While 5G continues to roll out, some reports indicate that it is so expensive that it may never be fully deployed, without which 6G will never see the light of day. Additionally, unlike every mobile generation before it, 6G will actually require more infrastructure rather than less due to the inherent weaknesses of the THz band – the beams are extremely narrow, weak, easily absorbed by atmospheric particles, and do not go round corners. Smart surfaces for propagation would be required to deliver access everywhere, including in the home, which raises severe doubts about the effectiveness of 6G rollout and affordability. The next few years will be telling; should 5G continue to infiltrate the furthest corners of the world, then the future for 6G becomes that much more likely. However, should 5G falter and stall as some expect, we could be looking at a much longer wait for higher connectivity speeds and ubiquitous global reach.

Huawei rotating Chairman Eric Xu Zhijun. Photo courtesy Huawei



The PERIOD demonstration mission concept

Building a satellite factory in Space

Constructing a factory in space is one of the next big challenges in the aerospace industry, requiring extremely heavy investment and technological feats. The 'orbital factory' envisioned by the PERIOD project will pioneer construction of major components such as antenna reflectors, assembly of spacecraft components and satellite payload replacements, directly in space. This is the precursor to future manufacturing of large structures in orbit.

Stéphane Estable, PERIOD project Coordinator, Project Leader & System Architect, Airbus Defence & Space

A market for in-space manufacturing and assembly (ISMA) and on-orbit services (OOS) is currently shaping which could reach several billions of dollars, with valuations ranging from US$3 billion (SpaceTec Partners, NSR 2019) to US$6.2 billion (NSR 2020) for cumulative revenues to 2030. To capture this market, high investments are needed to develop the related key technologies and perform in-orbit demonstrations (IOD). Potential customers require visibility on the risks to operate such systems and evidence that the technologies and applications are mature.

Airbus and the PERIOD Consortium have been looking at ISMA & OOS with important investments in the past years. However, the barriers for establishing a market are too high due to the immense costs of the mandatory in-orbit demonstration, even for a company the size of Airbus. The European space industry therefore requests EU support for preparing access to this new market. While the US administration has invested in more than US$220 million of contracts in 2019 for in-orbit demonstration of robotic assemblies, Europe needs to develop comparable experience and competencies. Thus, the clear ambition behind the PERIOD project is the creation of independent European capacities for building the future orbital infrastructure; and for being competitive on the ISMA & OOS markets. Such capacities will allow the European space industry to offer new commercial on-orbit services.

NEEDS, TRENDS AND DEMAND

To make the first step towards the creation of independent European ISMA capacities, an in-orbit mission needs to be prepared to demonstrate the capabilities of the (under maturation) technologies for OOS and ISMA. There is no doubt that, despite the various challenges, these technologies have the potential to disrupt and re-define spacecraft production and operations, as well as the future of a self-sustaining orbital infrastructure.

The trend shows it is a key moment for the definition of the role ISMA in the space operations and industry of the future. At the same time, other trends like rapid progress and decreasing costs of conventional on-ground spacecraft manufacturing and launch will influence the spread of ISMA for commercial purposes, so that the unique capabilities and added-value of ISMA applications need to be identified and exploited.

Given the current fast-paced evolution of space operations and its industrial landscape, applications most likely to succeed will be those able to serve various missions with a similar architecture and technological building blocks, as well as those showing resilience against the uncertain variables which will influence those in the upcoming future, like launch price and launcher availability, regulations, space insurance and policy, space debris, military tensions in space, human space exploration, etc. Based on this, PERIOD aims to define:

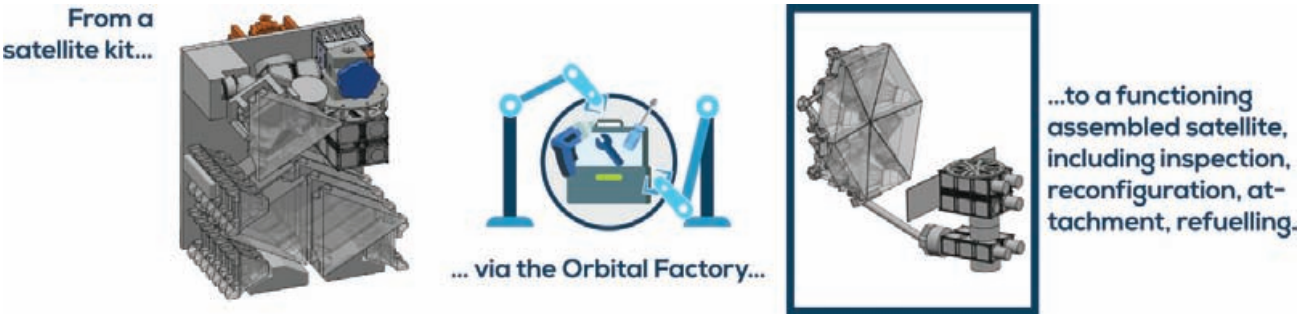
- A demonstration that is capable of convincing potential customers and investors of the ISMA value proposition;
- A demonstration that allows a straightforward deployment into the ISMA commercial cases capable to generate revenues; and
- An orbital factory concept that allows addressing different potential ISMA applications even though the commercial ISMA market is still shaping.

SHAPING THE FUTURE MARKET

The transformation of the lifecycle of space systems means preparing the paradigm shift for changing the way space systems are designed, built, and operated, moving from mission-specific solutions to modular spacecraft optimized for the space environment.

This transformation will lead to in-space services manufacturing and assembly with increased functionalities and capacities of space assets while strongly improving resilience and reducing costs.

The paradigm shift will be achieved with the elaboration of an ambitious mission and the implementation of a



concept that will demonstrate the feasibility to manufacture and assemble structures (i.e., satellite with large antenna) on orbit, as well as to perform other on orbit services (e.g., docking, refueling etc.).

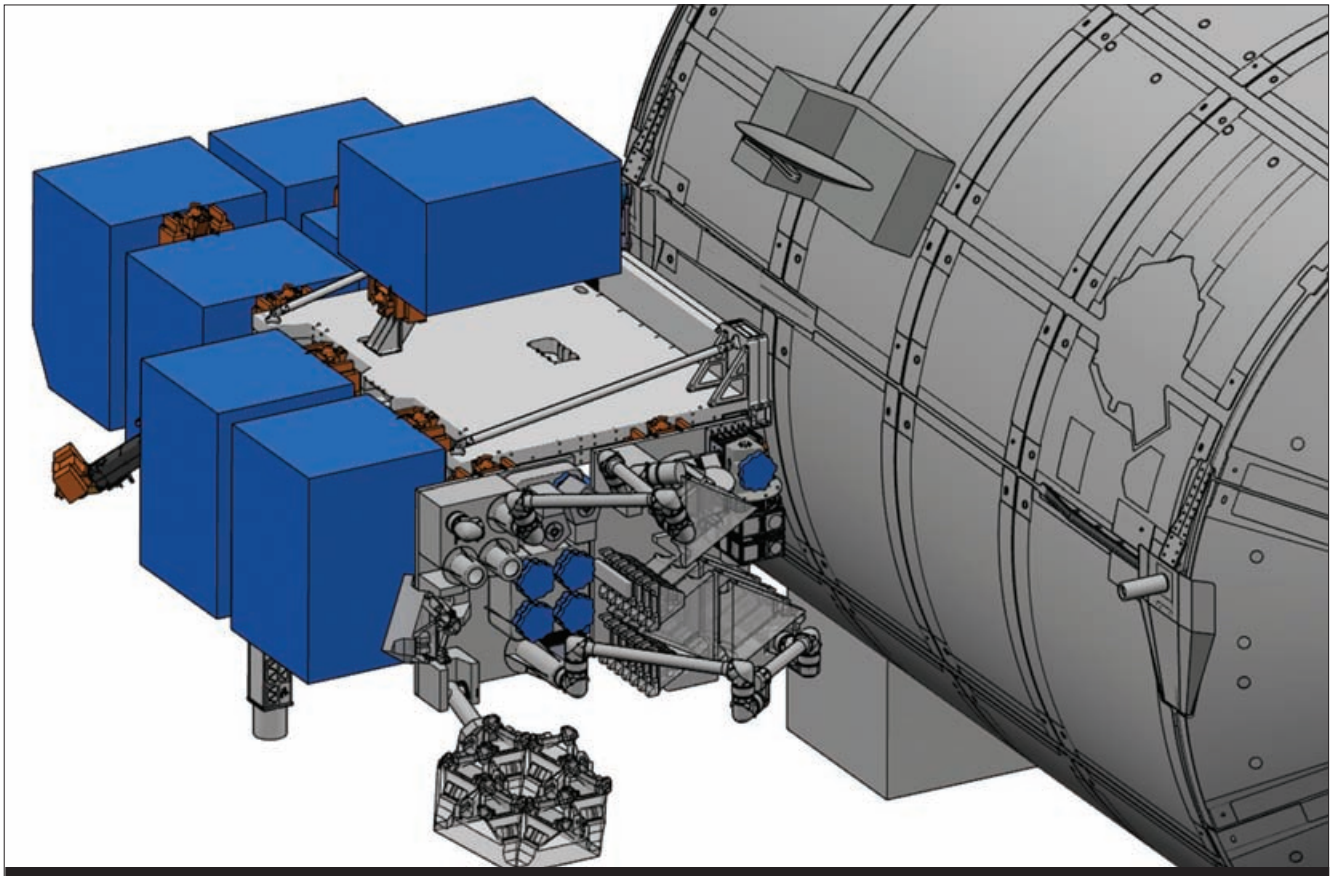
PERIOD is proposing a very ambitious demonstration scenario. A satellite will be manufactured in the envisioned 'Orbital Factory' and will be launched to LEO for operations. The manufacturing includes the fabrication of an antenna, the assembly of the satellite components and its reconfiguration and inspection in the factory. The demonstrator will be upgraded to extend the level of capability validation from assembly and manufacturing of structures to refueling experiments.

CHALLENGES AND EXPECTED IMPACT

Several issues must be properly faced in order to successfully establish an ISMA market.

From the technical point of view, the increase of the maturity of space robotics technologies, the servicing standard interfaces and operations is a key element towards this direction. Over the last few years, many research efforts have progressed in the frame of the EU-funded PERASPERA project aiming to contribute to this field. The further development of these building blocks will provide the necessary technological base for ISMA applications.

In parallel, it's not just dedicated technology that is required to foster business in space, but also the existence of a sustainable, goal-oriented operational and regulative framework which gives enough flexibility to let business arise and grow in this field. In this context, a European Operations Framework (EOF) activity has been introduced with the aim to generate, in collaboration with the involved stakeholders, guidelines and technical standards to be



The PERIOD Orbital Factory on the Bartolomeo platform of the ISS. All images courtesy Airbus Defence & Space

applied during operations in space and to support further regulation, licensing and norming activities by appropriate instances.

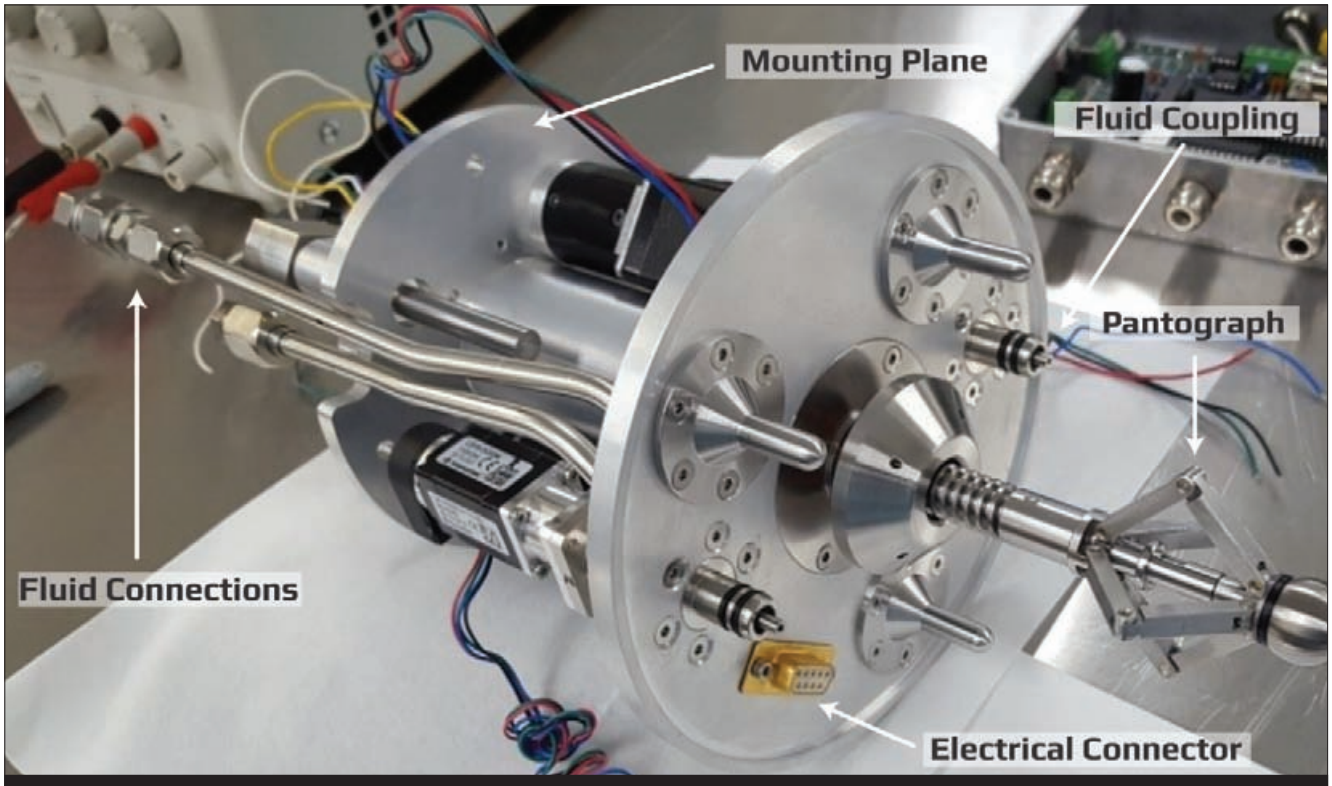
From the potential customer's point of view, a strong level of sensitization and information on ISMA is also required. Currently, potential customers and stakeholders are more seeing servicing at short terms as they are more familiar with its potential, and then assembly and finally manufacturing leading to some skepticism towards ISMA. They are adopting a wait-and-see approach and need a strong level of sensitization and education on the topic. Concerns on profitability, adequate capabilities, technological feasibility, regulations, insurance, and policies have been highlighted by space players. The improvement of the customer's awareness on ISMA real benefits, potential and technological capabilities is an additional focus field.

The PERIOD initiative is about building a technological system, where the simplest form of technology is the development and use of basic tools. One fundamental effect of PERIOD would be to deliver a new category of tool capable of producing new objects in the space environment by assembly and manufacturing. In the digital era and the era of the Internet of Things (IoT), tools are embedded in an ecosystem and a network of physical objects that are equipped with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet. A tool operates in a digital chain starting with smart sensors connected to a network; the huge amount of data produced is processed on high performance computing by AI algorithms able to extract patterns, and with robotic capabilities extended with autonomy, 3D-printing and even block chain to track shipments. In this digital chain, the tool can be continuously improved, as can the product(s) of the tool.

The attempt is to provide tools for the space environment combined with digitization. In history the effects of new tools are well known. The repercussion of having new digital tools for space could be tremendous, like being able to build and maintain very large structures. In this context, PERIOD could provide the first steps and support the definition of the related standards.

The kind of products and services enabled by PERIOD will have an economic footprint as they are expected to change the lifecycle of space assets by increasing their value, capacities and resilience while reducing their costs. This would support the development of an advanced space infrastructure of a new dimension. The economic impact seems to be tremendous according to the market and trend analysis. Additional opportunities are related to the 5G and 6G areas which require more capable telecommunication services to be provided to all European citizens, industries, and governments.

Also, autonomous driving and logistics are a priority in Europe in many different fields of usage, from autonomous driving in urban areas, over the logistic chain (rail, ships, trucks and even aircrafts) up to the usage for agriculture services. The huge amount of data needs either new very large and costly satellites or the establishment of large antennas in orbit which currently cannot be launched. Thus, the capability of in-orbit assembly will provide a cost-efficient possibility to cover these challenging needs for Europe and its citizens.



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Tom McCarthy, VP of Business Development, Motiv Space Systems

Satellite Evolution Global

Q&A

Bringing better automation to Space

Motiv Space Systems is a robotic systems developer and integrator seeking to bring better automation to space to support pioneering exploration efforts alongside ambitious commercial industries in the stars. Tom McCarthy, VP of Business Development, explains how the company serves the emerging space economy, and what demands he anticipates from it in the near future.

Laurence Russell, Assistant Editor, Satellite Evolution Global

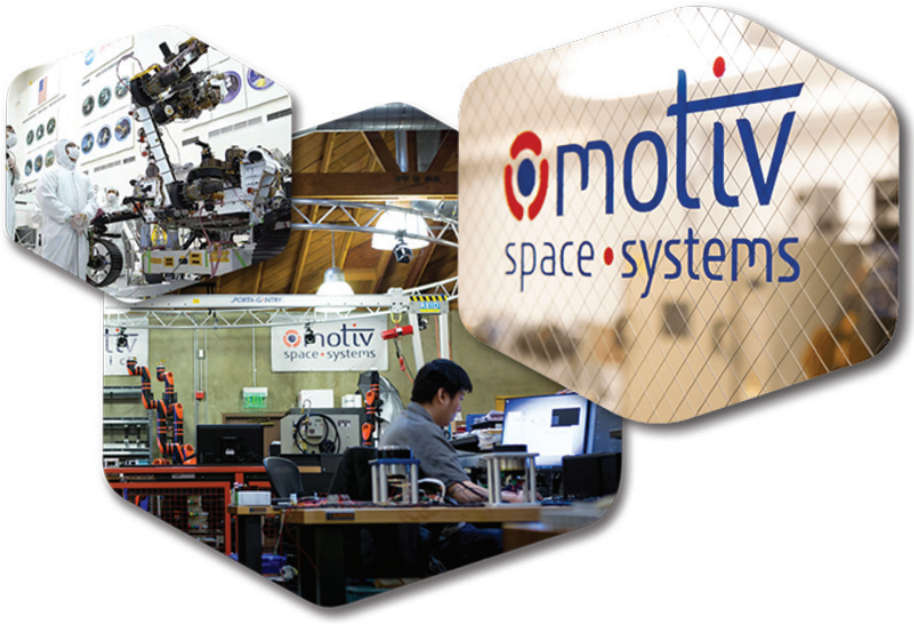
Question: How does Motiv Space Systems view the emerging space economy?

Tom McCarthy: There's an interesting convergence happening right now worldwide, with a robust interest in the space economy from venture capitalists (VCs) and capital investment groups in addition to significant government involvement.

Some of that boom is being driven by competition, or endeavours to get onto the ground floor of new technologies, but it's coming from both governments and commercial interests, which is something of a revolution in our history.

Question: How does Motiv Space Systems compliment that industry in the interest of progressing science and stability?

Tom McCarthy: There's a lot of different applications being developed, some of them in the name of science in terms of space exploration. For us, we just want to be part of an enabling member of that community, driving progress. The technologies that we develop and integrate are best suited to pushing scientific and industrial advancement forward.



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Question: There are a few startups, teams and corporate branches working on robotics for automated servicing in orbit. What will it take for one to start leading the pack?

Tom McCarthy: That's an interesting question. Robotics is this fascinatingly growing field, with the potential to resemble an incredibly diverse application base. A lot of the robotics we're working on concerns manipulation via robotics arms and mobilities for the sake of rovers and other vehicles.

I think we're going to see several companies develop niche capability. What's going to drive the leader of the pack among those is going to be customer experience. How quickly can the technology get to market? How reliably can it perform? How does the application enable efficiencies or deliverables that drive profit?

The big race is in the development of space construction, services, inspection, and planetary observation to name a few. That's an awful lot of ground to cover, and the solutions that make those theoretical markets work well are extensive. It's going to be a long game.

Question: What does Motiv Space Systems see as the biggest and most stable business cases in orbital and lunar environments?

Tom McCarthy: The services model that NASA has been developing over the last couple of years is excellent. The ability to develop an expedient technology development cycle through the CLPS missions, the lunar payload services missions, what that will yield is the ability to test and build upon many of the technologies that have been gathering dust in labs waiting to be proven in the field.

We need those kinds of programmes to accelerate development, and we're passionate about assisting their orchestration.

With different government agencies talking about building a greater presence for science and exploration in space and working together to practice what they preach; we're finding the intersection of needs between public and private expertise. That'll go a long way to bring sustainability to business cases and the market they rely on.

Question: What technologies stand out to Motiv Space Systems as important for commercial activities in space?

Tom McCarthy: We're very interested in upgrading the capability of our systems. On the Moon, for example, we have a unique environmental schedule to work around. It experiences extremes in temperature that by Earth standards resemble incredible degrees of heat and cold.

Those circumstances mean some systems can only operate during lunar day times, so we're working to develop systems that can run day and night up there with full operational efficiency. That means working out how to run our machines without the ever-present benefit of solar power.

Question: With the major space powers investing in ever more elaborate moon missions in the interest of establishing permanent facilities, does Motiv Space Systems recognize a timeline for lunar colonization over the following decades, and if so, how does that influence your plans?

xLink Space-rated modular robotic arm system. Photo courtesy Motiv Space Systems

Tom McCarthy: Lunar colonization appears to be a very tiered system. It's difficult to imagine certain measures occurring before a necessary prior step has been successfully rolled out. To get those first few boots on the ground safely will require an awful lot of infrastructure. Then we're going to need to be there in force in order to go about creating sustainable footholds on the surface to make for sustainable periods of occupation.

It's exciting to see some of the recent awards with the Artemis missions and how this timeline is going to start shaping up. Eventually, we will be looking at landing pads, habitats, power generation systems, and mobility platforms, ultimately positioning humanity for effective exploration even further afield.

The scope of these ideas is incredibly ambitious. As the demand grows with the momentum that's being pushed today, the demand for robotic technology will multiply too. A human operator's time and safety are so crucial that it's highly necessary to make the maximum use out of automated technologies.

Question: What are Motiv Space Systems' long-term goals? What technologies, services and discoveries do you wish to contribute to?

Tom McCarthy: Our long-time goal is to be an enabler for the space development ecosystem that's coming together ever more successfully. We're looking to evolve some paradigms of the past, specifically the kinds of robotics that have been fielded. We believe there are technologies that can be exploited to enable mission architects more flexibility and capability.

We want to see costs and development times reduced for robotic systems, and we want to see those systems get connected to new ventures and startups that wouldn't have usually had access to such technologies, to make their product or service that much better. We don't want them spending time agonizing over whether they can afford that capability, or if they have time for it. We want to make robotic integration as effortless as we can.

Motiv Space Systems wants to balance our competitive nature with our capacity to collaborate with the partners and customers who stand to benefit from our hard work.

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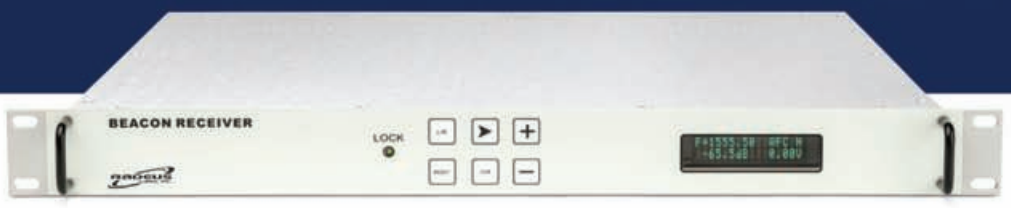

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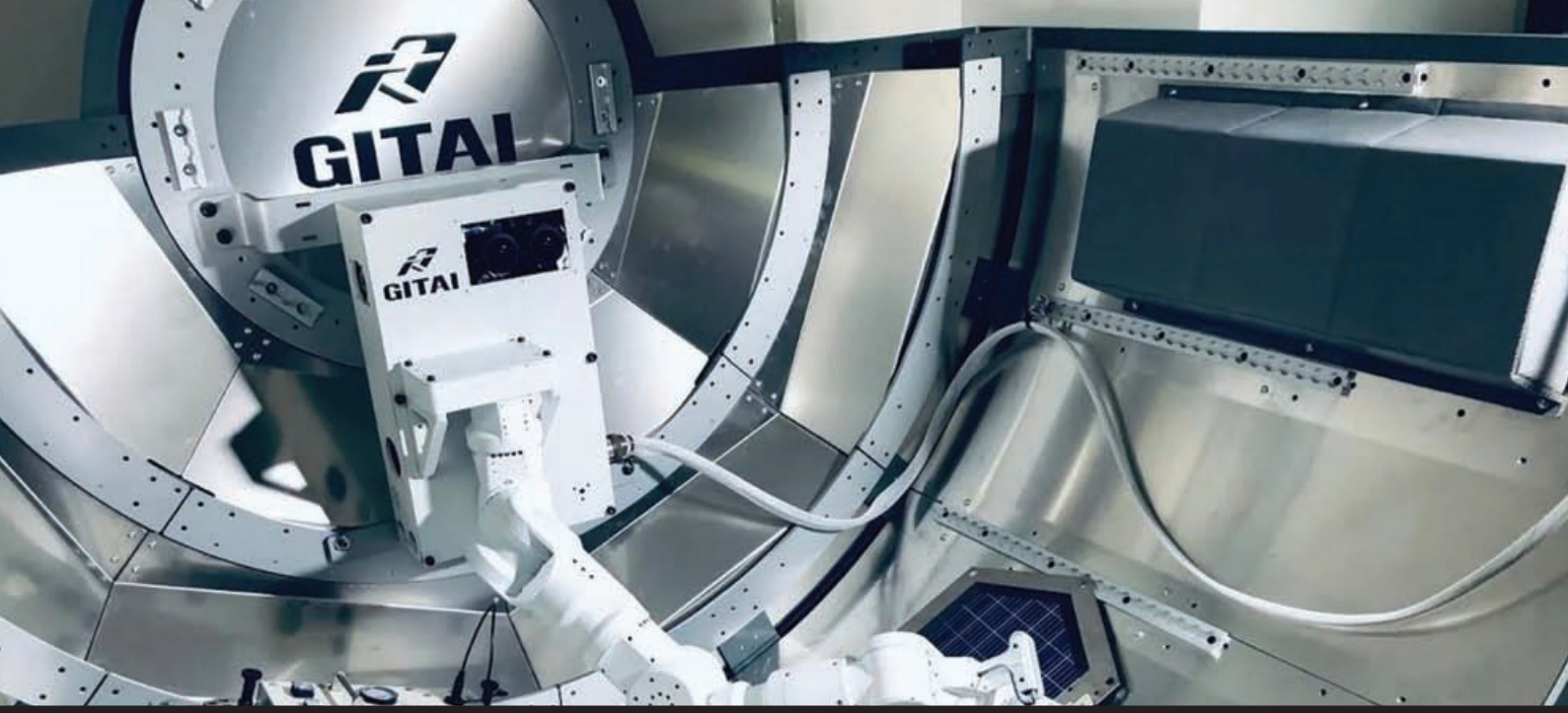

The GITAI S1 autonomous robotic arm was installed into the space station in October 2021. Photo courtesy GITAI

Space robotics are revolutionizing the stability of the NewSpace market

In 2021, SpaceX overhauled their launch system, adding massive automated systems designed to streamline the vertical launch process. The Stage Zero launch tower is yet to be used outside of testing but could set a new standard for launch robotics. The system is emblematic of the heavy adoption of robotic systems in the space industry, all designed to bring operational sustainability and lowered costs to the emerging market.

Laurence Russell, Assistant Editor, Satellite Evolution Global

Among its many prestigious achievements in the ever-growing space industry, SpaceX has been hard at work pioneering in the world of robotics assisting with the process of launching and landing space vehicles.

In late October 2021 at their 'Starbase' facility in South Texas, SpaceX tested the new robotic arms of their 'Stage Zero' launch tower for the first time: A giant set of claws capable of catching reusable space vehicles and rockets returning for a vertical landing via propulsive descent.

"SpaceX will try to catch largest ever flying object with robot chopsticks," Musk explained in a September tweet, helpfully supplying a clip of Mr Miyagi from 'Karate Kid' catching a fly with chopsticks. "Success is not guaranteed, but excitement is!"

Musk supplied the bemusing nickname 'Mechazilla' for the launch tower system, which is poised to be used to catch Starship's Super Heavy booster after it returns to Earth following a future launch test. The technology is intended to be used for Starship and other space vehicles as well as boosters, simplifying the incredibly delicate landing process and ensuring a minimum of damage to their landing gear.

The machinery is even intended to re-assemble launch systems, adhering a space vehicle like Starship onto a reusable booster for a return flight, suggesting a fast turnaround from landing to relaunch. The potential for streamlining spaceport processes through automated technologies to drive efficiencies that could further reduce the cost of launch is exciting, for how it could reduce the barriers to entry for new business cases in space.

Alternatively, the expensive project could be another characteristically Muskean example of an over ambitious project more expensive than its use cases can justify, or simply too reliant on emergent, bleeding-edge technologies to be realistically reliable. Musk himself admitted success is far from guaranteed, after all, and the enterprising company has accrued a long tapestry of setbacks in its pioneering history.

ORBITAL AUTOMATION

The robotics we're starting to see on the ground have many more applications in space, where manpower comes at a premium. With automated systems capable of standing up to the harsh conditions of space, orbital applications can be performed faster and with a much greater degree of safety, safeguarding human lives.

A set of new such systems have recently found their way to the International Space Station (ISS). The GITAI S1 autonomous robotic arm was installed into the space

station in October 2021 after being launched there in late 2020, capable of performing intricate assembly tasks such as constructing solar panels and performing space station repairs. The arm has full autonomy but is naturally also capable of remote tele-operation for unforeseen processes that haven't been programmed ahead of time, allowing a human to walk the machine through an entirely new process step by step.

GITAI explains that with automation where it is, 95 percent autonomous control with five percent human judgement is the most efficient way to work. GITAI looks forward to using what they've learned aboard the ISS to develop extra-vehicular robotics (EVR), capable of docking, repair, and maintenance to serve the emerging on-orbit servicing (OOS) ecosystem.

Similarly, the ISS installed the European Robotic Arm (ERA) in late 2021 – a far larger piece of robotics for external autonomous manipulation, which can operate on the exterior systems of the space station. The ERA is capable of transferring payloads, and even astronauts, in and out of the ISS.

The arm was produced entirely in Europe thanks to a large consortium of space developers led by Airbus Defence and Space Netherlands, who designed and assembled the device for the European Space Agency (ESA).

"During ERA's operational life the robot will help demonstrate equipment and technologies key to future space adventures," explained ESA Director of Human and Robotic Exploration David Parker, "such as the robotic transfer of samples on Mars."

The ERA joins the space station's two other robotics arms 'Canadarm2,' and the Japanese Experiment Module Remote Manipulator System. ERA is unique in that it is the only arm currently capable of reaching the Russian segment of the station, which will help it perform its first task aboard the station, the installation of a large radiator in support of the Multipurpose Laboratory Module 'Nauka.'

OKLAHOMA AIR & SPACE PORT'S PERSPECTIVE

Craig Smith, Executive Director of Oklahoma Space Industry Development Authority (OSIDA), explained that: "To bring that first SpaceX rocket booster back down to the launch site after breaking atmosphere was an incredible feat and a leap forward for launch reusability, and launcher cost-effectiveness. It was a game-changer."

With such an explosive initial foray into automated launch technology, it's only natural that SpaceX felt the need to use its unprecedented wealth of taxpayer subsidies to build on their successes and further lead the field of launch reusability.

"Commonplace space travel is in our future," Smith continued, "that could look like the development of point-to-point travel, the ferrying of goods to and from orbital platforms or the Moon, rollout of space defence assets, or all of the above. That's going to require launch technologies with highly reproducible results."

On the subject of orbital automation, Smith explained: "With servicing robotics in sustainable operation in orbit, repositioning, maintenance and deorbiting could become a lot more realistic, cementing all kinds of capabilities in the NewSpace market, for which there has been long demand."

Experts predict that robotic automation technologies will revolutionize how our economies define labour in the coming fourth industrial revolution, but as momentous as these technologies are on Earth, we may see them go on to form the backbone of our driving systems in space, normalizing mechanical assembly and repair, making the direct action of astronauts in such tasks a last resort emergency manoeuvre. In fact, these technologies could even drive a culture of holistically unmanned space businesses and exploration systems, making capital the sole resource at risk instead of human life - a dichotomy which academics have been recommending for years now.

Michael Porcelain becomes CEO of Comtech

Comtech Telecommunications Corporation has appointed Michael Porcelain Chief Executive Officer as of December 31, 2021, and a member of the Board of Directors, effective January 3, 2022. Mr. Porcelain, who will also remain President of Comtech, succeeds Fred Kornberg, who will serve as an advisor to the Company on technology matters and continue as a director and non-executive Chairman of the Board. This appointment completes the Company's long-term CEO succession planning effort, initiated by the Board of Directors with its appointment of Mr. Porcelain as Chief Operating Officer in 2018 and President in 2020.

Comtech also announced that Wendi Carpenter and Mark Quinlan have been appointed as independent directors of the Board, effective January 3, 2022.

"I'm honored to take on the CEO role at Comtech, especially at a pivotal time for our business and shareholders," said Mr. Porcelain. "The past twenty-four months have seen a significant and generational transformation of both our company and our markets overall. I'm excited to take my own experience with all parts of Comtech's operations and drive a new level of performance alongside our team. I also look forward to working with our expanded, world-class Board of Directors. Together, we'll take Comtech into a new era of commercial success and shareholder value creation."

Mr. Kornberg said, "It has been my distinct privilege to lead Comtech during four historic decades that have seen radical changes in the 911 public safety and satellite earth station technology markets. I want to express my gratitude to our investors for their continued support, our customers for trusting Comtech to address their most pressing needs, and our world-class employees for their steadfast dedication. In Michael, there is no better-qualified leader to take Comtech to new heights. As both a seasoned executive and an experienced operator who has helped define and execute against a long-term strategic plan, our new CEO has earned the confidence of our entire Board and that of shareholders and positioned us for a bright future."

SPACELINK CEO DAVE BETTINGER ELECTED TO MSUA BOARD

SpaceLink, the company building the Communications Superhighway for the Space Economy™, announced its Chief Executive Officer, Dave Bettinger, was elected to the board of directors of the Mobile Satellite Users Association (MSUA). As a leader in the satellite industry, and a business and technology visionary, Dave brings experience and perspective to help guide MSUA in its mission to promote satellite innovation worldwide.

"I'm honored to be selected to join the MSUA board and look forward to contributing to its mission to amplify the voice of satellite mobility users and innovators," said Dave Bettinger. "My passion for the satellite communications industry is driven by a commitment to innovation so helping to guide MSUA's direction is a perfect fit for me."

Dave joins a team of 12 directors made up of satellite industry leaders from a variety of companies including satellite operators, component suppliers, and service providers. By participating, the directors contribute to the growth and success of the satellite communications industry and its users.

USSI GLOBAL PROMOTES AMANDA FLYNN TO VICE PRESIDENT OF CUSTOMER RELATIONS AND BUSINESS DEVELOPMENT

USSI Global, a turnkey provider of customized network, broadcast and digital signage systems and services worldwide, has promoted Amanda Flynn to serve as Vice President of Customer Relations and Business Development. In her new role, Flynn will focus on expanding the manufacturer client base for installation and repair services within the company's Digital Signage and Electronic Business and Consumer Solutions.

Flynn has been working in business development for the company since 2008. Since she joined USSI Global, the company's Digital Signage and Electronic Business and Consumer Solutions sales have increased significantly with the addition of several industry leading worldwide customers. More than three years ago, she was promoted to serve as director of business development and customer relations.

"I appreciate this new opportunity, and I'm looking forward to taking our Digital Signage and Electronic Business and Consumer Solutions to the next level," Flynn said. "We have an amazing workforce, and I want to make sure our processes between sales and operations remain seamless for our customers. From project coordination to installation to service and repair, USSI Global gets the job done, and I'm excited to share that message with more manufacturers."

"Amanda has been an outstanding member of the USSI Global team for more than a dozen years, and in that time she's helped to elevate our high level of customer service standards," said David Christiano, CEO. "We're already a trusted partner for numerous manufacturers that rely on us to repair and replace business and consumer products efficiently. In her new role, Amanda will help recruit even more companies to experience the benefits of our installation services, elevated service level agreements and other solutions."

GILAT NAMES GIL BENYAMINI AS CHIEF FINANCIAL OFFICER

Gilat Satellite Networks announced that the board of directors has approved the appointment of Gil Benyamini as Gilat's CFO - effective February 1st, 2022. Bosmat Halpern will assist the Company in the transition as she steps down from her role as Gilat's CFO.

Gil Benyamini joins Gilat with a wealth of experience most recently from Panaxia Pharmaceutical Industries (TASE:PNAX), where he served for the past four years as CFO. In this position he was part of the core management team successfully leading the company RTO into TASE and its equity and debt financing. Previously Mr. Benyamini held the CFO role at Walla Communications from 2009 until 2016 and at Exent Technologies from 2006 until 2009. Mr. Benyamini is a Certified Public Accountant and holds an MBA (major in finance) cum laude from Tel-Aviv University.

"I want to welcome Gil Benyamini to Gilat's management team. I strongly believe that Gil Benyamini is the right person for the CFO role, as we face major opportunities and expect to take Gilat to the next level, anticipating substantial growth," said Adi Sfadia, Gilat's CEO. "Furthermore, I want to take this opportunity to thank Bosmat Halpern for her invaluable contribution over the past eight years as Gilat's AVP Finance and as Gilat's CFO. Mrs. Halpern has been my right hand during Gilat's incredible journey, and I wish her best of luck as she moves on."

"I am excited to join Gilat as CFO during this dynamic time in the satellite communications industry," said Gil Benyamini. "I am confident in my ability to contribute to Gilat's future growth and look forward to working closely with Gilat's CEO, management team and finance department."

Ground station diversity can be used to increase link availability and mitigate signal deterioration caused by local atmospheric conditions. Photo rdonar/Shutterstock

Who's afraid of the V-band wolf?

As the use of satellites for broadcasting, backhauling, Earth observation, inter-satellite links, IoT and a multitude of other applications increases, so does the demand and competition for its most precious resource - bandwidth. Over time we've seen the industry tackle the problem of available bandwidth by moving into higher frequency bands, from C to Ku and from Ku to Ka. The move to Ka-band did successfully relieve the pressure on available bandwidth, making much more available, however with demand growing for higher throughput and the advent of new constellations, the industry must consider the future.

Paul Gouws, Head of R&D Engineering, ETL Systems and Atlantic Microwave

Since 1962 when the first commercial communications satellite (Telstar 1) was able to relay telephone and television signals, space and the electromagnetic spectrum have been filling up at an ever-accelerating rate. In just over half a century the technology has moved from this single satellite in orbit to over 4,500 active satellites in orbit today - with over 1,400 launched in 2021 alone! All these new satellites, along with higher throughput capability, bring with them an ever-increasing demand for bandwidth. But the total available electromagnetic spectrum remains fixed, driving the need to move towards higher and more exotic frequency bands.

THE CHALLENGE

Global bandwidth usage has grown at an annual rate above 25 percent year-on-year for the last 15 years and rose by a staggering 35 percent in 2020. It now exceeds 500Tbps with the vast majority of the backhauls being via satellite.

Required bandwidth is already exceeding that available via landline or fiber infrastructure, even in many parts of the developed world outside the major cities. As the hunger for data increases further, driven in no small part by consumers' ever-growing appetite for streaming services, the industry will be forced to solve the problem of making more bandwidth available.

If we regard 10GHz as the somewhat optimistic practical limit to terrestrial mobile communication, it's clear that the majority of bandwidth available for current and planned satellite services already occupies most of the space from that point to Ka-band (40GHz).

Frequency reuse via spot beams can mitigate the problem to some extent, but spacecraft power and weight considerations place significant limits on how far this can be exploited. Practical issues such as pointing accuracy and antenna size or beamwidth for ground terminals also place an effective limit on the number of spot beams achievable.

Following the historical trend of increasing our available bandwidth by utilizing ever higher frequency bands, the industry is now looking towards Q/V-band (frequencies between 33 and 75GHz) to unlock the next tranche of bandwidth.

Effective use of these bands has the potential to double the total satellite bandwidth available. The spectrum is currently sparsely used, and the physically smaller antenna sizes have many advantages, not only making the antenna hardware simpler and lighter both for satellite and consumer, but narrower beamwidths also have the potential to facilitate increased frequency reuse, reduced satellite spacing and a lower probability of detection and interception.

Rain fade is one of the major stumbling blocks on the way to achieving commercially and technically viable V-band satellite communications. Photo San Hoyano/Shutterstock

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If Q/V-bands promise abundant bandwidth along with a few other advantages, what is the problem?

THE SOLUTION

The greatest technical barrier to the implementation of these bands for use in satellite communication links is the significant degradation that signals at these frequencies experience as a result of atmospheric conditions, primarily rain.

While rain is often the worst culprit for all high frequency signal degradation, it is particularly detrimental at these frequencies. The reason for this is that the rain drops and the wavelengths at these frequencies are roughly the same size, causing severe scattering, in addition to significant attenuation. This challenge will need to be overcome or at least mitigated if Q/V-band is to achieve its full potential in satcom applications.

One such mitigation technique is ground station diversity. Used in conjunction with careful site selection, the idea is using two or more ground stations at different geographic locations to reduce the probability of poor atmospheric conditions, thus increasing the availability of the link. Other common mitigations may include link power control (increasing transmit power when required) and Adaptive Coding & Modulation (reducing the data throughput as link conditions deteriorate), or at least initially limiting the use of these bands in certain geographic locations due to their rainfall rate.

There are also challenges in the development of the electronic hardware required to support migration to these higher frequencies. Current semiconductor manufacturing techniques, initially pioneered to increase speed and reduce size of microprocessors have seen the size of integrated components shrink by a factor of a thousand over the last three decades, as production process resolutions have improved from 1µm in the late 1980s to sub 1nm today. This progress in the technology has also allowed RF components to be utilized in ever higher frequency ranges. However, for companies such as Atlantic Microwave, developing products for these frequencies is still a significant investment in the technology and test equipment required to succeed in this very promising arena.

Initial users of V-band will inevitably be the world's militaries, taking advantage of the increased security and immunity this new band offers.

Over time, as the industry gets to grips with the mitigation techniques, we anticipate that the future of satellite communication undoubtedly extends into V-band and possibly beyond.

V-band offers the bandwidth we need to meet the next decades' demands. However, the technical challenges are not at all trivial and should not be underestimated. Neither are they insurmountable! With the industry left with little choice, now is the time to invest in the development of these new bands.

V-band use will undoubtedly begin with the world's militaries; there is a way to go before commercial viability can be achieved. Photo courtesy Brent Wong/Shutterstock

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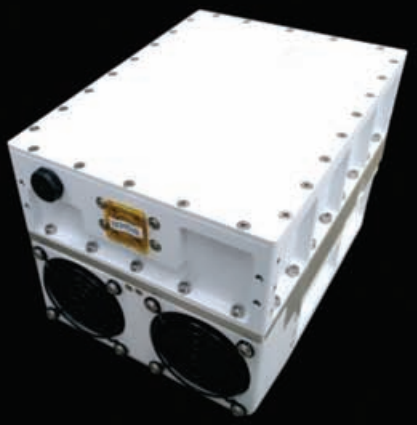
First motorized scooter
1915



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"Our task is not to foresee the future, but to enable it"
Antoine de Saint-Exupéry

Oxford Falls Teleport, Sydney, Australia. Photo courtesy Telstra

A race in space to build the 'Network of Tomorrow'

Satellite technologies are becoming more affordable and thus more widespread than ever before, delivering essential services everyday to billions of users. Now is the time for operators and service providers to foster closer relationships with telcos in order to bring to fruition the future of communications.

James Harrison, Acting Managing Director, EMEA, Telstra

Space may not be the final frontier for telecommunications, but it's certainly a hotly discussed topic here on Earth – and for good reason.

As a connectivity and distribution technology, satellite holds great potential for developing new business opportunities, revenue streams and audiences. In fact, many predict space will completely transform the global connectivity landscape.

To fully realize this significant business potential, satellite operators must work together with traditional telcos to meet the growing need for global end-to-end data connectivity, especially as technology applications such as 5G, edge computing and the Internet of Things (IoT) rise higher on companies' priority lists.

The key is offering high-performance and reliable service and a seamless user experience, bringing together the best of terrestrial and satellite connectivity. Companies that are able to effectively combine assets from both worlds - space-based platforms and software-defined terrestrial networks - stand to benefit the most and will play a larger role in forming the 'network of tomorrow.'

THE WAY AHEAD

In the 1960s, satellites first launched into geosynchronous orbits (GEO) about 36,000km (22,000 miles) above Earth. However, their high costs and latency made them more suited to limited applications such as communications and emergency services in remote areas, long-distance backhaul, maritime and military services, and extractive industries (oil, gas, and mining).

The following decades saw continual advancements in satellite technology, with increased launches into lower orbits, including medium Earth orbit (MEO) and low Earth orbit (LEO), as well as decreased the costs for manufacturing, launches and maintenance.

It has got to the point where satellite technology is more attractive, and accessible, to a wider range of companies for an increasing number of applications. Satellite operators are now seeing opportunities to disrupt the communications sector by harnessing the recent space-based advances and expand their global footprint – especially since only half of households worldwide have access to fixed broadband.

Still, they face many barriers to market entry – both technological and economical – and partnerships with telcos are often ideal solutions.

James Harrison, Acting Managing Director, EMEA, Telstra ●●●

For telcos, satellite technology presents opportunities for a wide array of use cases, including backhaul for 5G, autonomous vehicles, industrial offshore applications, sensors for telemedicine, maritime and disaster relief, and smart cities. As just one example, industry predictions suggest that about 20 million IoT connections will be made via satellite within the next five years.

A key advantage for telcos comes down to the existing terrestrial assets that they own and have already spent decades building up – including fiber networks, IP backbones, satellite teleports and data centers. These all present a massive opportunity for satellite operators for using these networks, which carry data from satellites directly to end users, as neutral teleport options. By partnering with one or more telcos, satellite operators can also reduce the cost of and need for additional personnel required to develop, install, and maintain their own terrestrial infrastructure over the long term.

Satellite operators looking to ramp up a global presence quickly may also encounter major regulatory setbacks if they don't have existing relationships with local governments. This is yet another area, where working with telcos to leverage existing government relationships will come in handy.

A GALAXY OF APPLICATIONS

The applications of satellite technology are diverse and expanding and can often contribute to true enterprise transformation. The connectivity required in specific areas will dictate which of the satellite types are used: GEO, MEO or LEO. For example, LEO is likely to play a role in more densely populated areas for back-up alternatives for many situations including mobile backhaul.

While telcos are continually updating and expanding their terrestrial fiber networks – driven by increasing global bandwidth demands – almost half of the world's population still has no access to the Internet.

Also in many areas, especially remote locations, it's not economical for telcos to invest in high-speed fiber networks. Satellite technology can help fill in these gaps and the anecdotal evidence supporting this is growing almost daily.

Gnangara Teleport, Perth, Australia. Photo courtesy Telstra ●●●

By installing a private IP satellite network, an agriculture and livestock company in remote Australia experienced improved connectivity (including Wi-Fi) and greater access to key main offices services (HR, payroll and telephony), as well as data insights back to the stations/sub-stations and main office.

A regional company in Southeast Asia required improved satellite connectivity for one of its locations in remote Papua New Guinea. This location needed to access their company's business applications and was experiencing constant interruptions due to poor connectivity. The customer was able to obtain an end-to-end solution with terrestrial and satellite services across their six remote sites, upgrade their ICT infrastructure and enable video conferencing capability from their remote locations.

But it's also important to remember that satellite is not just for rural connectivity.

While the use of satellite technology for remote services is still a big part of the telco industry, other opportunities are arising.

As prices and latency drop, satellite services are becoming much more competitive with and complementary to terrestrial telecommunications offerings such as those provided by subsea cable systems.

Although MEO and LEO deployments have different requirements to GEO ones – such as a need for tracking antennas and a higher number of more distributed teleports – co-locating at facilities already owned by an existing company can be a big draw for new providers seeking to establish early points of presence in a market as a faster, lower-cost point of entry than building facilities themselves.

Assets from telcos could also support satellite operators' efforts to open up efficient, adaptive, and flexible transmission pathways to businesses and consumers alike for sending and receiving information and content around the world. In addition to traditional networks, many telcos have established relationships with large enterprises, international governments, major OTT providers, such as Netflix, Content Delivery Networks (CDNs) and cloud players such as Google.

These types of relationships are key elements most satellite operators currently lack, but they are potentially vital in supporting their efforts to establish disruptive commercial deals.

One more reason why working with a telco can open joint ventures and establish a foothold with large enterprises and content providers.

Terrestrial and satellite technologies will continue to advance and give rise to new connectivity model, infrastructures, and services. Yes, there are challenges for each, but also just as many business opportunities. By working together, telco providers and satellite can discover easier pathways into multiple markets worldwide to provide global coverage to more people faster.

Working together with telcos can help meet the growing need for global end-to-end data connectivity. Photo Adobe

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The technical requirements for COTM technology must not be underestimated; it is complex. Photo Adobe Stock

The impact of new satcom technologies on maritime

Communications on the move have been enabled via satellite for decades now, shaping the very foundations of the world we live in. As flat panel antennas and LEO satellite constellations become a viable reality, the maritime sector faces an interesting time, with huge potential advancements in capabilities.

Helen Weedon, Managing Director, Satcoms Innovation Group

The maritime industry has always invested heavily in connectivity; cruise and leisure vessels look to connect their customers whilst merchant shipping, utilities and fishing industries rely heavily on networks to manage internal infrastructures. With the high demand for on-board connectivity, the availability of new technologies within satcom is increasing. This new technology is set to bring plenty of new benefits; mega constellations in LEO will deliver wide coverage and bandwidth and, with space and weight limitations often inhibiting technologies onboard, FPAs are becoming an attractive option within comms-on-the-move.

However, the communications on the move (COTM) sector faces technical challenges when utilizing satcom; moving vessels must be able to track satellites, RFI must be managed carefully, and maintenance can be costly due to geographical restrictions. These complexities must be managed as a priority, as much of the infrastructure on-board is underpinned by satellite communications. The long-standing technical challenges have been recognized within the sector, but what impact will the latest satcom technologies have on maritime?

HOW WILL LEO IMPACT COTM?

The launch of mega constellations into low Earth orbit (LEO) are being penciled as a great opportunity for the comms-on-the-move sector due to the promise of a combination of wide geographical coverage and low-cost services. High quality, low latency connections are becoming increasingly important; many vessels are now utilizing IoT applications for operational means due to its clear benefits in improving efficiencies and minimizing errors. The use of IoT in maritime has been growing steadily for years, however, according to Inmarsat's Industrial IoT report, this growth has accelerated due to the COVID-19 pandemic. It believes that this is due to the remote monitoring and control capabilities offered by IoT.

It is clear that LEO is going to deliver fresh opportunities for the COTM sector to build connectivity and IoT into operations in the near future. Importantly, the industry must acknowledge the challenges surrounding LEO. With satellites orbiting at a lower altitude, ground systems need to be sophisticated to manage the tracking and switching between satellites. Sourcing and qualifying the correct equipment, as well as ongoing testing and calibration, will be critical in managing LEO networks; the effect of an error caused by low-quality equipment with have huge ramifications for service delivery within LEO. Its complex network delivers vast amounts of coverage; however, this could result in errors being magnified.

Through extensive work in monitoring GEO connectivity over the years, we know that high-quality equipment is the answer to maintaining robust and resilient connections. Signal degradation and RFI can often be attributed to poor quality equipment, as well as poor set up and maintenance. Many businesses across satcom have turned their focus to LEO's requirements at the ground; there is little room for error in crowded LEO infrastructures and innovative, LEO-specific equipment, testing and monitoring solutions are being created to enable users to incorporate effective and well-maintained LEO ground segments.

FLAT PANEL ANTENNAS: WHAT SHOULD THE INDUSTRY CONSIDER?

FPAs are increasing in popularity throughout the ground segment of satcom. With space and weight being finite aboard vessels, the industry is being told that FPAs will deliver a lightweight and low-profile solution to teleports. It is therefore unsurprising that the 'Flat Panel Satellite Antenna Market' report states that, by the end of 2027, the FPA market will be worth US$905.6 million, growing at a CAGR of 37.5 percent during 2022-2027. As the rollout of FPAs continues, it is important that the industry reviews their reliability and suitability for their use in COTM.

So, how can maritime satcom users be sure to buy high quality FPAs? FPAs are complex; due to their nature they too must have advanced tracking capabilities to perform as stated. This is complex and often comes at a price. With cost efficiencies often being a priority within the

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manufacturing process, quality can sometimes be neglected. SIG has called for an industry wide approach to the manufacturing and validation of FPAs within satcom to ensure that users have access to high-quality equipment. An industry wide set of standards have been achieved before; GVF's SOMAP group established standardized requirements for antenna performance, allowing manufacturers to produce products which adhere to standards set by satellite operators. Establishing this within the FPA market will enable customers to buy FPAs with confidence in the products' capabilities, as well as meaning that satellite operators can confidently allow access to capacity. This should reduce the number of low-quality antennas on the market, and therefore reduce the number of expensive system failures and instances of RF interference causing service interruptions.

Strengthening standards for FPAs will help the adoption of this technology within the maritime sector; FPAs are hugely appealing within COTM, and an industry-wide approach to their specifications will enable maritime to implement this technology with confidence.

RELIABILITY

With connectivity running through every corner of maritime, never has it been more important for it to be reliable. The newest solutions promise to deliver wide-ranging communications for COTM which will deliver endless new opportunities to improve both operational and cost efficiencies, as well as improve the user experience. However, the technical requirements for this technology must not be underestimated; it is complex.

Utilizing cheaper, poorer quality terminals at the ground segment can quickly undo the benefits of the technology and prevent maximizing new opportunities. It is critical that, as an industry, we have clear standards and guidelines available for the ground segment. This is the most efficient way of ensuring that users of the ground segment maximize the potential of satcom.

The next generation of satcom can enable whole new realms of connectivity, such as IoT and global communications, however we must ensure that we manage a sophisticated and robust rollout. We know the challenges being faced by the COTM sector through years of experience. It's imperative that our knowledge underpins the technological choices being made at the ground segment; industry-wide cooperation will enable services to perform at their best.

The long-term benefits of a quality product far outweigh the lower cost of poor-quality products. The lower performing products have been clearly shown to be a significant contributor to global RF interference. We need to seek ways to help manufacturers test and deliver quality products and reject those inferior products through standardized testing.

With connectivity running through every corner of maritime, never has it been more important for it to be reliable. Photo Adobe Stock


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Alastair Bovim, CEO of Insight Terra

Satellite Evolution Global

Q&A

Bringing IIoT efficiencies to the mining sector

Insight Terra, a platform-as-a-service solution, was launched by Civic Connect with the support of Inmarsat to bring Industrial Internet of things (IIoT) efficiencies to the mining sector via the monitoring of dangerous mine tailings. With the technology showing healthy results and functionality that could easily be applied to other remote industry and critical infrastructure business cases, Alastair Bovim, CEO of Insight Terra, explains the potential of the platform, and what went into making it.

Laurence Russell, Assistant Editor, Satellite Evolution

Question: In this era of rapid digitization, how can heavy industry interests such as mining benefit from satellite IoT technologies?

Alastair Bovim: IoT-over-satellite enables even remote sites in hard-to-reach locations to access the operational advantages and benefits provided by digital technologies like M2M, automation, cloud, and data analytics.

The combination of always-on satellite connectivity with platform-as-a-service providers like Insight Terra lets engineers gather, measure, and analyse important operational and environmental data in real-time, in far more detail and at far greater scale than was previously possible.

The quality of this data is vastly superior to what was previously available to engineers, who before had to rely on multiple spreadsheets of disconnected, siloed data. The data they now have is collected in real-time is granular in its detail and is validated and ready to be analysed.

By having access to this in-depth data, engineers and managers can optimize processes and the performance of machinery, boost operational efficiencies, and significantly improve the safety and security of personnel and the sites where they're working. From a business perspective, by making their sites and facilities demonstrably safer, operators are well positioned to seek reductions in their insurance premiums.

Question: Insight Terra has been launched thanks to Inmarsat's work with growth equity firm Atlantic Bridge and cloud software developer Civic Connect with US$5.45 million at the close of series A funding. How did all that come about?

Alastair Bovim: Inmarsat has worked with Civic Connect since 2016 evaluating opportunities to combine satellite communications with IoT technology in the context of smart cities and urban infrastructure. Civic Connect's own data management platform has been used by numerous cities and public agencies to ingest, validate, and analyse millions of data points.

Both companies began to look at how data management platforms used in the smart city space could be applied in other scenarios, with a special focus on agriculture, transport, and mining.

In particular, tragic accidents at mine tailings dams at a number of sites around the world highlighted the clear need for a solution to reduce the risks of these failures. Tailings monitoring then became a focus.

Inmarsat's specialist insight into the mining sector and its development of hybrid edge IoT/satellite solutions was combined with Civic Connect's

cloud-based data management capability to create the compelling, highly scalable Insight Platform full-stack solution. Uniquely in the market, the Insight Platform gathers data independently from a range of sensors, instruments, and systems, and is capable of addressing the serious issue of mine tailings failures.

As a high-growth technology investor, London-based global equity fund manager Atlantic Bridge clearly sees the wider opportunity for the Inmarsat-Civic Connect platform. Insight Terra was born.

Question: Insight Terra is built upon the Insight Platform, the integrated solution for monitoring mine tailings via satellite. What's the story of the software?

Alastair Bovim: The Insight Terra software platform has its origins in 2012 with the smart city cloud-based platform developed by Civic Connect. Inmarsat's desire to expand IoT-over-satellite into other segments, including agriculture, transport, and mining, led the two companies to explore how to evolve and improve the platform in order to apply it in other markets and scenarios in which the ability to ingest, analyse and visualize millions of data points can make a positive difference.

Inmarsat deployed its first pilot of what was to become the Insight Platform at the end of 2018. What puts the platform ahead of rival monitoring solutions is its scalable enterprise architecture coupled with the ability to receive, ingest, enrich, and store data from any source.

Insight Terra is completely sensor-agnostic. It's able to gather data from all sensors, instruments, and systems into a single management system for analytics, modelling and visualisation.

The platform synthesizes a range of diverse data to deliver real time actionable insights, alerts, and visual guidance to key decision makers in mining operations to field supervisors; operations managers and engineers; sustainability directors; all the way up to the CEO. The effectiveness of the platform is a direct result of direct and meaningful engagement by Inmarsat and Civic Connect with customers and external experts, while also drawing on their own experience.

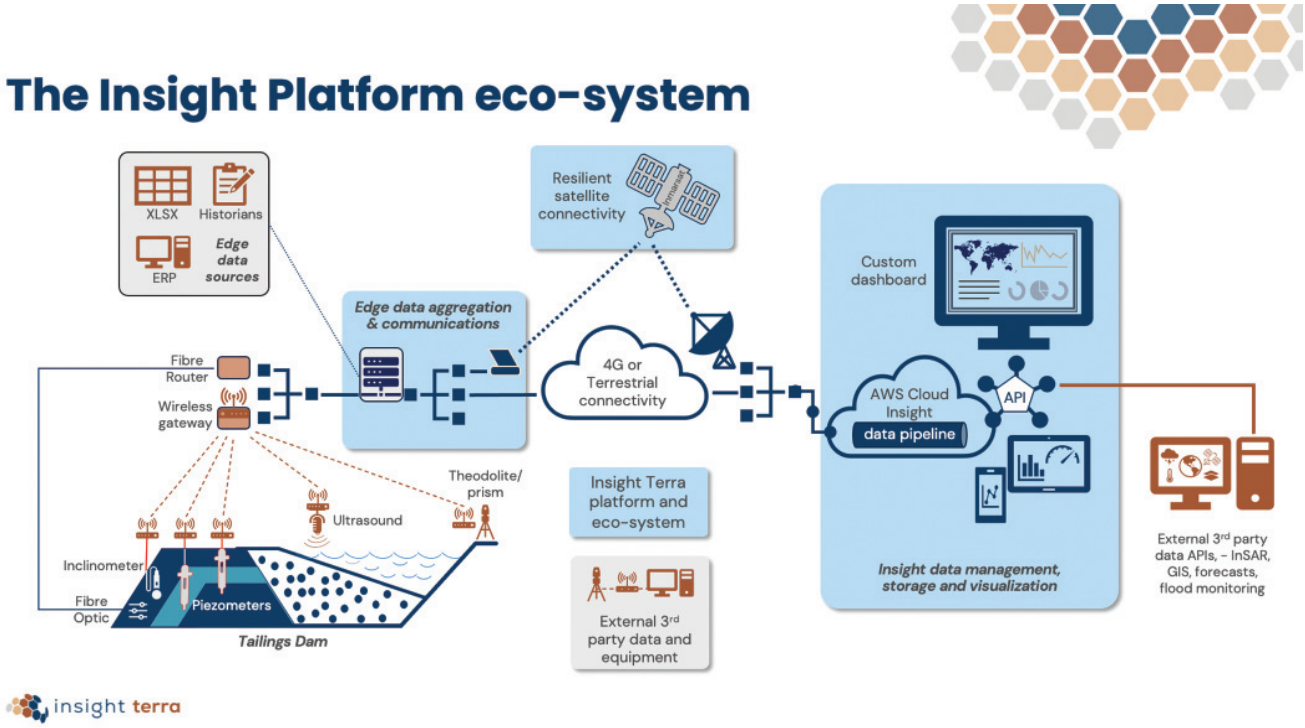
Inmarsat has 20 years of experience in deploying remote applications, including monitoring. Its Broadband Global Area Network (BGAN) satellite service has evolved over the last 15 years to enable and support mission-critical applications, including remote monitoring, remote communications, and remote automation and M2M capabilities.

Insight Terra uses the Inmarsat BGAN satellite network and also the cloud and edge compute technologies to gather, optimize, transmit, transform, and validate data before it's analysed.

The Insight Platform today is a culmination of the expertise and experience of Inmarsat and Civic Connect, supplemented by feedback from mine operators and insight from consulting engineers, creating a full, end-to-end monitoring system that's applicable to mining and other sectors and industries.

Question: Increasing environmental and labour regulations have the potential to catch out any number of enterprise players. How can Insight Terra help them stay ahead of more advanced requirements?

Alastair Bovim: The availability on an ongoing basis of real-time data on critical variables relating to structural integrity and stability of key infrastructure contributes directly to reducing on-site risk, boosting operational efficiencies, and improving safety for workers and the surrounding



environment. Previously, such important data was only available at irregular intervals.

The data and analysis provided by Insight Terra enables companies to operate in a more proactive and transparent manner and comply with all applicable standards, regulations, international laws, and best practice. In so doing, the operating companies are better able to build credibility and trust with local communities: And also demonstrate their ESG credentials with increasingly environmentally conscious governments and investors.

Question: With academics and environmentalists often placing blame on heavy industry for issues of pollution, how vital is it that these companies invest in maintaining stronger sustainability standards?

Alastair Bovim: Sustainability initiatives and efforts are now massively important across every industry. The latest climate report from the Intergovernmental Panel on Climate Change (IPCC) is a sobering reminder of the collective responsibility of global communities – including business and industry - to assist and contribute to the climate recovery.

With greater and greater demand being placed upon natural resources by a rapidly growing global population, businesses operating within heavy industry are under scrutiny in terms of their ESG commitments to 'practice what they preach.' Installing accurate, effective monitoring solutions are integral for businesses to achieve their ESG sustainability targets. Adopting these solutions also encourages other businesses to follow suit and make a positive contribution towards climate change.

Businesses which refuse to acknowledge green initiatives and technologies risk losing trust and may well earn themselves an outdated image from their clients and competition.

With so much scrutiny placed upon businesses and how they operate, transparent and ethical operations are more important than ever. More than ever, companies must now factor into their decision-making the environmental impact of their actions and keeping their carbon footprint to an absolute minimum.

Photo courtesy Oyls/Shutterstock

Question: While the Tailings Insight platform is founded on serving the mining industry, the software is capable of supporting a multitude of environmental and infrastructure monitoring use cases. Could you expand on a few key applications?

Alastair Bovim: A well-designed cloud-based platform is not only scalable but flexible as well. The Insight Platform's ability to continually monitor large-scale infrastructure extends beyond mining. It is currently in use by the Norwegian transport and energy department to monitor the risks of landslides that could endanger lives and disrupt energy supplies and transport networks. And in the UK, the platform is monitoring the structural integrity of one of the UK's largest freshwater reservoirs, Kielder Water in north-east England.

This kind of behind-the-scenes monitoring is vitally important in maintaining a watchful eye on the stability and structural integrity of essential facilities and critical national infrastructure.

Question: How will the Insight Terra platform evolve and grow in coming years? What will it be capable of 5-10 years from now?

Alastair Bovim: The Insight Platform's ability to ingest data from almost any type of sensor or other data source, and to manage, curate and present data in a compelling visual manner, removes the challenge of complex integration faced by companies and critical national infrastructure operators who want to better manage their assets and make them safer and more efficient.

Our plan is for the Insight Platform to evolve, expand and improve in the coming years, with a wider range of functionality that will include machine learning, artificial intelligence, and more advanced predictive analytics. In this way, the platform will become both smarter and applicable for use in a wider range of industries beyond mining.

Intelligent, versatile resources like the Insight Platform will continue to play a critical role in improving infrastructure, improving safety, and protecting the environment across a broad scope of industries and sectors - now and into the future.

Future goals in space technology

Thales Alenia Space, the joint company between Thales (67 percent) and Leonardo (33 percent), logged a number of successes in 2021, including key contracts, major industrial milestones and launches, a series of innovations and new capital investments.

SPACE TO EXPLORE: RETURNING ASTRONAUTS TO THE MOON AND SPACE EXPLORATION ON THE AGENDA IN 2021

Thales Alenia Space confirmed its global leadership in orbital infrastructures last year, by confirming the development contract for the communications and refueling module ESPRIT on the upcoming Gateway lunar space station. This business win followed two contracts signed in 2020 to produce the I-HAB and HALO pressurized modules. Gateway is being developed within the scope of NASA's Artemis program, designed to return astronauts to the Moon by 2024. The lunar space station will also be used as a waystation to prepare crewed missions to Mars.

Thales Alenia Space also announced an order for two more pressurized cargo modules on Cygnus, the resupply vessel for the International Space Station, and won a contract from Axiom Space to build two pressurized modules for the first commercial space station, Axiom.

Thales Alenia Space is also playing a major role on the Orion spacecraft, designed to carry astronauts to the Moon as part of the Artemis program, especially as supplier of thermomechanical systems for the European Service Module (ESM). In 2021, Thales Alenia Space participated in the final integration of critical systems on the second module (ESM 2), and also signed a contract amendment providing for a similar contribution to ESM 4, 5 and 6.

Other highlights in 2021 included significant progress on major programs such as the second ExoMars mission, to be launched in September 2022, and EUCLID, a science mission dedicated to the study of dark energy and matter.

SPACE TO OBSERVE AND PROTECT: SECOND COSMO-SKYMED SECOND-GENERATION SATELLITE READY FOR LAUNCH; SWOT OCEANOGRAPHIC SATELLITE PASSES NEW MILESTONE

The second COSMO-SkyMed second-generation satellite was shipped from the company's Rome plant in December 2021 to Cape Canaveral, where it's now being readied for the planned launch in late January. The second generation of COSMO-SkyMed radar observation satellites is being built by Thales Alenia Space as prime contractor on behalf of the Italian space agency and defense ministry. The payload and platform for SWOT, the French-American oceanographic satellite, were integrated in 2021, a major milestone for this revolutionary satellite, slated for launch in 2022.

Space to Connect: selected for Telesat's planned constellation and a leading position in the geostationary communications satellite market

Capitalizing on its globally recognized expertize in constellations, Thales Alenia Space was chosen by the operator Telesat in February 2021 to build Lightspeed, a constellation of 298 telecom satellites in low Earth orbit (LEO). The Lightspeed network will offer data rates of several terabits/second worldwide, providing secure, high-speed and high-performance connectivity for professional applications.

Also in February 2021, Thales Alenia Space and Satelit Nusantara Tiga (SNT) announced that they had finalized funding for the development of the Satria broadband communications satellite, designed to bridge the digital divide in Indonesia. This key step follows the preliminary agreement to start various activities for the satellite, signed in early September 2020.

Thales Alenia Space won five new contracts in 2021 as prime contractor for geostationary satellites. It will build the SICRAL 3A and 3B satellites for the Italian Ministry of Defense, the HTS 113BT satellite for the Indonesian operator Telkomsat, and the ASTRA 1P and ASTRA 1Q satellites for the operator SES.

SPACE TO TRAVEL AND NAVIGATE: 6 NEW SATELLITES FOR THE NEW-GENERATION GALILEO CONSTELLATION AND UPGRADES TO THE EGNOS SATNAV AUGMENTATION SYSTEM GROUND SEGMENT

At the forefront of satellite navigation in Europe, Thales Alenia Space was chosen by the European Space Agency (ESA) and the European Commission to build 6 of the 12 new satellites in the second-generation Galileo constellation.

Thales Alenia Space also signed an extension of the first-generation Galileo mission and security ground segment contract, to continue increasing the system's operational capacity.

Along with its work on the Galileo satellites, Thales Alenia Space, prime contractor for Europe's EGNOS navigation overlay system, continued to upgrade the ground system to ensure the integrity needed to address ultra-precise and reliable positioning requirements for new and highly demanding applications. These new uses include autonomous road vehicles, as well as autonomous rail and maritime transport systems. The associated high-reliability integrity and "safety of life" services are already being implemented for aviation. At the same time, Thales Alenia Space successfully carried out several flight demonstrations with ASECNA (air navigation safety agency for Africa and the Indian Ocean), in preparation for a satellite navigation system covering Africa.

Several major satellites with contributions from Thales Alenia Space were launched in 2021:

- geostationary telecom satellites: SES 17 and Syracuse 4A, built by Thales Alenia Space as prime contractor for SES and the French Ministry of the Armed Forces, respectively. Both use the Spacebus NEO platform with all-electric propulsion.
- Cygnus resupply vessels for the International Space Station. Since the outset of this program, Thales Alenia Space has supplied all pressurized cargo modules for Cygnus, totaling 20 to date, on behalf of Northrop Grumman.
- CERES military signals intelligence (SIGINT) satellites, with Thales Alenia Space supplying the platforms.

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