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Q&A IEC Telecom Group
- page 10...



Q&A Walton De-Ice
- page 18...



Q&A Dragonfly Aerospace
- page 28...



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What lies ahead

2022 was a wild ride. We started off on an optimistic note with lots of money pouring in and rosy predictions for a robust global satellite and space economy. The James Webb Space Telescope returned its first exciting images and wet dress rehearsals for Artemis I were taking shape. Astronauts were going back and forth between the Earth and the ISS, and everyone was excited about returning to the Moon and paving the way to Mars.

Then came the invasion of Ukraine which toppled the cooperative and mutually beneficial relationship that the global satellite and space industry had with Russia and caused no end of disruptions affecting finance, energy production, and supply chains worldwide. We started to feel the pinch of inflation and the tightening of budgets. Serious issues came into focus including satellite and space security, congestion and space debris, situational awareness and keeping assets in orbit safe.

Nonetheless, forward motion won the day. More rockets (some reusable) with more sophisticated payloads than ever launched. Earth observation satellite imagery was used to track troops and refugees, fight wildfires, augment the food supply, and so much more. The industry touted the use of greener fuels, and many players reiterated their commitment to net-zero emissions by 2050. We even witnessed the world's first planetary defense technology demonstration, DART, crash a box-shaped spacecraft into an asteroid.

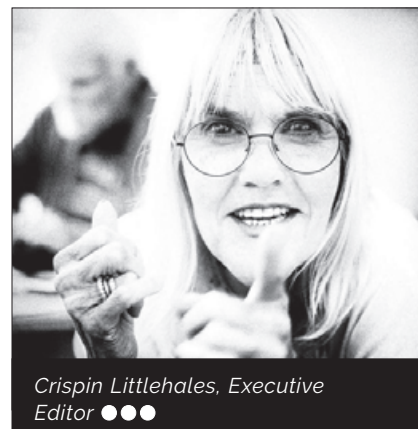
The success of the Artemis I mission reminds us that we are, indeed, on a trajectory to the Moon and beyond with the aid of satellites, rovers, orbiters, telescopes and all the rest. Of course, there are many challenges ahead. Some of them are technical: how will we get rid of space debris; refuel and repair spacecraft in orbit; create habitats on the moon? Others are ethical: how do we keep the peace, collaborate, and behave responsibly?

Courtesy of Henry David Thoreau, here's a little something to ponder as we face our future: "What lies behind us and what lies ahead of us are tiny matters compared to what lives within us." Here's hoping that we figure out how to make sure that the use of space continues to benefit humankind.

In this issue of Satellite Evolution Global, Ray Powers, Director of Sales and Marketing for Walton De-Ice, gives us the inside story of how a 43-year-old company is able to stay on the leading edge. Nathan De Ruiter, Managing Director for Euroconsult Canada delves into the current trends affecting the market and takes a look at the opportunities looming on the horizon. In addition, Charlton Haupt, Founder of Bad Astro Society offers insights on the crypto market and commercial space travel.

In his interview with Daria Boiko, Vice President of IEC Telecom Group's Commercial Division, Laurence Russell explores the myriad efficiencies that automated technologies can empower. He also talks with Bryan Dean, CEO and Co-founder of Dragonfly Aerospace, to learn more about the future of the Earth observation industry.

Wild ride though it has been, our industry is poised to reach new heights in the year ahead. Stay tuned. ●



Crispin Littlehales, Executive Editor ●●●



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Regulars

Satellite News & Analysis

Executive Movers & Shakers

Features & Market Reports

2022: A challenging year for investors

Travelling to space through crypto



Executive Q&As

- | | | |
|----|--|----|
| 6 | Daria Boiko, Vice President of IEC Telecom Group's Commercial Division | 10 |
| 32 | Ray Powers, Director of Sales and Marketing, Walton De-Ice | 18 |
| 14 | Bryan Dean, CEO and Co-founder of Dragonfly Aerospace | 28 |
| 24 | | |



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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

Executive Editor
Crispin Littlehales
crispin@dsairpublications.com

Business Development Manager
Belinda Bradford
belinda@dsairpublications.com

Managing Director
David Shortland
david@dsairpublications.com

Associate Editor
Laurence Russell
laurence@dsairpublications.com

Publisher
Jill Durfee
jill.durfee@dsairpublications.com

Circulation Manager
Elizabeth George
admin@dsairpublications.com

Publishing Director
Richard Hooper
richard@dsairpublications.com

Marketing Production Manager
Jamaica Hamilton
jamaica.hamilton@dsairpublications.com

Production
production@dsairpublications.com



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Vodafone Cook Islands to deliver 4G+ networks throughout the Cook Islands

SOUTH PACIFIC: Customers of Vodafone Cook Islands will be able to experience 4G+ networks and high-performance internet connectivity across the outer islands due to a new O3b mPOWER agreement signed with SES. O3b mPOWER is SES's second-generation medium earth orbit (MEO) system which sets a new standard of high-performance services for governments and enterprises around the world.

During O3b mPOWER launch from Cape Canaveral, Florida, USA, both companies announced that Vodafone Cook Islands will leverage SES's Mobile Backhaul mPOWERED service enabled by O3b mPOWER satellites to deliver increased access to online services in health, education banking, and commerce for the residents, giving the islands' tourism a major boost. Mobile Backhaul mPOWERED delivers guaranteed, multi-gigabit per second connectivity. This expanded partnership is also part of Vodafone's plan to extend the same level of services to the outer islands and will see islands such as Manihiki enjoy improved broadband and mobile network access.

Furthermore, it will also incentivize people to live and work in the outer islands.

Vodafone Cook Islands was the first customer in the region to use SES's current-generation O3b satellite system at medium earth orbit (MEO) in 2014 to deliver 3G/4G services to the remote nation. With Mobile Backhaul on O3b mPOWER, Vodafone Cook Islands will be able to better support its customers with groundbreaking high-throughput, low-latency connectivity.

O3b mPOWER offers more than 100 times the throughput of GEO solutions, making it a performant solution capable of accelerating the transformation of the Cook Islands into a digitally empowered economy.

"The new agreement with Vodafone Cook Islands is our latest win in bridging the digital divide for remote communities across the world," said John Turnbull, Fixed Data Director for Pacific at SES. "With this agreement, residents on the Cook Islands, including those in some of the most remote locations like the outer islands, will be able to enjoy access connectivity that is comparable to anywhere else in the world. Mobile Backhaul will allow them to stay connected with their loved ones and the greater world beyond the islands. With this, we continue to champion connectivity for millions of people that lack stable Internet access, ensuring they have access to the same opportunities as the rest of the world."

"We are glad to continue partnering with SES to bring the second-generation MEO satellite constellation O3b mPOWER to the Cook Islands, helping to improve



Vodafone Cook Islands to Deliver 4G+ Networks throughout the Cook Islands using SES's O3b mPOWER ●●●

connectivity to the outer islands and further contribute to the islands' socioeconomic growth," said Phillip Henderson, CEO at Vodafone Cook Islands. ●

Microsoft and Viasat announce new partnership to deliver Internet access to underserved communities

NORTH AMERICA: Microsoft and Viasat have announced a new partnership to help deliver internet access to 10 million people around the globe, including five million across Africa. Viasat, a global communications company, is the first satellite partner to work with Microsoft's Airband Initiative and together, they will deepen Airband's work in the Democratic Republic of the Congo, Nigeria, Guatemala, Mexico and the United States, as well as prioritize expanding the program, Senegal, and Angola to deliver much needed internet connection, often for the first time.

This first of its kind global partnership for Airband is an important step in reaching the Initiative's expanded goal (<https://bit.ly/3FwLCOT>) of delivering internet access to a quarter of a billion people across the world, including 100 million people on the continent of Africa, by the end of 2025.

According to the International Telecommunication Union at the UN, an estimated 37 percent of the world's population – or 2.9 billion people – have still never used the Internet. Satellite allows internet access to reach remote areas that previously have had few, if any, options for conventional connectivity. Working together, the companies will combine expertise and assets to help enable telehealth, distance learning and education, precision agriculture, clean power, and other services to reach new areas through the transformational provision of power and connectivity. The companies will collaborate to provide and pilot technologies including, but not limited to, satellites (both Geostationary Orbit and Low Earth Orbit (LEO)) and fixed wireless.

"While the African opportunity is immense, one of the challenges facing the continent is infrastructure expansion which would enable the acceleration of digital transformation and facilitate a connected African continent. Critical infrastructure enablers are needed to accelerate digital transformation and the adoption of digital technologies. The Airband Initiative is vital in helping to accelerate broadband access for rural communities," says Kunle Awosika, Managing Director, Africa Transformation Office.

Nearly one third of the world's population is lacking online access to education, better

medical care, business opportunities, connection with family, and more. And most of this population lives in just 20 countries across Africa and the Global South. Universal, affordable internet access is part of the United Nations' Sustainable Development Goals (SDGs), and by focusing a large portion of this new partnership on Africa, Microsoft and Viasat are working to deliver connectivity and digital literacy for better education, healthcare, and economic opportunity in critical markets.

"Connecting the world is an expansive and challenging goal, and we believe it is equally important that it is done in a way that is sustainable, responsible, and inclusive," said Mark Dankberg, CEO and Chairman of Viasat. "Viasat's mission is to keep space safe and accessible for everyone by responsibly using it as a shared resource to benefit humanity. The partnership with Microsoft is another important step in bringing affordable internet service across Africa, Latin America, and the US, as both companies continue breaking down barriers to bridge the

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digital divide and make significant progress towards digital equity and inclusion."

Through Airband, Microsoft has already delivered high-speed internet access to more than 51 million people globally, including over four million in unserved US rural communities and an additional 47 million in 16 unserved and underserved countries outside of the US. Launched in 2017, Microsoft's Airband Initiative works through partnerships with local and regional internet and energy access providers, telecom equipment makers, nonprofits, as well as governmental and nongovernmental organizations, to advance access to affordable internet and relevant digital skills around the world. Microsoft believes access to the Internet is a fundamental right for everyone as it delivers access to education, information, and personal needs fulfillment.

Viasat is a global communications company and an innovator in satellite communications technologies and services, focused on making connectivity accessible, available, and secure for all. Today, Viasat is connecting unserved and underserved communities around the world, many for the first time ever.

This partnership builds upon the existing relationship between Viasat and Microsoft Azure Space (<https://bit.ly/3WmbYEU>) to deliver advances in satellite connectivity and furthers Microsoft's mission to connect anyone, anywhere on the planet. To learn more about the partnership and keep up to date with our projects and initiatives, visit <http://www.Microsoft.com/airband>. ●

NASA launches International Mission to survey Earth's water – observing climate change

NORTH AMERICA: A satellite built for NASA and the French space agency Centre National d'Études Spatiales (CNES) to observe nearly all the water on our planet's surface has been successfully launched. The Surface Water and Ocean Topography (SWOT) spacecraft also has contributions from the Canadian Space Agency (CSA) and the UK Space Agency.

The SWOT spacecraft launched atop a SpaceX rocket from Space Launch Complex 4E at Vandenberg Space Force Base in California with a prime mission of three years. The satellite will measure the height of water in freshwater bodies and the ocean on more than 90 percent of Earth's surface. This information will provide insights into how the ocean influences climate change; how a warming world affects lakes, rivers, and reservoirs; and how communities can better prepare for disasters, such as floods.

After SWOT separated from the second stage of a SpaceX Falcon 9 rocket, ground controllers successfully acquired the satellite's signal. Initial telemetry reports showed the spacecraft in good health.

SWOT will now undergo a series of checks and calibrations before it starts collecting science data in about six months.

"Warming seas, extreme weather, more severe wildfires

– these are only some of the consequences humanity is facing due to climate change," said NASA Administrator Bill Nelson. "The climate crisis requires an all-hands-on-deck approach, and SWOT is the realization of a long-standing international partnership that will ultimately better equip communities so that they can face these challenges."

SWOT will cover the entire Earth's surface between 78 degrees south and 78 degrees north latitude at least once every 21 days, sending back about one terabyte of unprocessed data per day. The scientific heart of the spacecraft is an innovative instrument called the Ka-band radar interferometer (KaRIn), which marks a major technological advance. KaRIn bounces radar pulses off the water's surface and receives the return signal using two antennas on either side of the spacecraft. This arrangement – one signal, two antennas – will enable engineers to precisely determine the height of the water's surface across two swaths at a time, each of them 30 miles (50 kilometers) wide.

"We're eager to see SWOT in action," said Karen St. Germain, NASA Earth Science Division director. "This satellite embodies how we are improving life on Earth through science and technological innovations. The data that innovation will provide is essential to better understanding how Earth's air, water, and ecosystems interact – and how people can thrive on our changing planet."

Among the many benefits the SWOT mission will provide is a significantly clearer picture of Earth's freshwater bodies. It will provide data on more than 95 percent of the world's lakes larger than 15 acres (62,500 square meters) and rivers wider than 330 feet (100 meters) across.

Currently, freshwater researchers have reliable measurements for only a few thousand lakes around the world. SWOT will push that number into the millions.

Along the coast, SWOT will provide information on sea level, filling in observational gaps in areas that don't have tide gauges or other instruments that measure sea surface height. Over time, that data can help researchers better track sea level rise, which will directly impact communities and coastal ecosystems.

Such an ambitious mission is possible because of NASA's long-standing commitment to working with agencies around the world to study Earth and its climate. NASA and CNES have built upon a decades-long relationship that started in the 1980s to monitor Earth's oceans. This collaboration pioneered the use of a space-based instrument called an altimeter to study sea level with the launch of the TOPEX/Poseidon satellite in 1992.

"This mission marks the continuity of 30 years of collaboration between NASA and CNES in altimetry," said Caroline Laurent, CNES Orbital Systems and Applications director. "It shows how international collaboration can be achieved through a breakthrough mission that will help us better understand climate change and its effects around the world."

SWOT measurements will also help researchers, policymakers, and resource managers better assess and plan for things, including floods and droughts. By providing information on where the water is – where it's coming from

and where it's going – researchers can improve flood projections for rivers and monitor drought effects on lakes and reservoirs.

"SWOT will provide vital information, given the urgent challenges posed by climate change and sea level rise," said Laurie Leshin, NASA's Jet Propulsion Laboratory (JPL) director. JPL developed the KaRIn instrument and manages the US portion of the mission. "That SWOT will fill gaps in our knowledge and inform future action is the direct result of commitment, innovation, and collaboration going back many years. We're excited to get SWOT science underway."

Wyld Networks and Astrocast sign a multi-year contract

EUROPE: Astrocast and Wyld Networks (Wyld) have signed a multi-year contract with an ambition to target a joint business of over 200 million messages. This will extend Wyld Networks' capacity and coverage to deliver satellite IoT (SatIoT) data to its customers expanding operations in the most remote areas of the world.

Astrocast's SatIoT communication technology is powered by a fully operational constellation of currently 14 satellites and provides users with data connectivity in areas where terrestrial coverage does not reach. Data from this SatIoT network will be transmitted through Wyld

Networks' system for distribution/connectivity to its end customers' applications. This approach complements and extends Wyld's current satellite IoT offering to clients.

With 85 percent of the globe lacking terrestrial coverage, Astrocast's Satellite IoT solution will provide Wyld's customers greater coverage in regions that are typically remote, as well as a scalable solution to blend IoT operations and application usage across the globe. Notably,

Astrocast's technology is cost effective for low data-rate use cases; provides bidirectional communication that allows devices to send commands to/from assets; and ensures that applications have the capability to last remotely for many years thanks to low power consumption.

"The power of IoT to transform business operations is irrefutable," said Alastair Williamson, CEO, Wyld Networks. "Millions of sensors and devices are being added to the Internet of Things and the rate continues to accelerate. Wyld's partnership with Astrocast will extend our ability to deliver additional coverage, use cases and data to businesses of all sizes who will benefit from the power of Satellite IoT."

"83 percent of organizations claim improvement in efficiency when introducing IoT technologies into their businesses correctly. Our partnership with Wyld Networks represents a step further: to facilitate global IoT access. We're looking forward to working together and a prosperous and innovative working relationship," adds Fabien Jordan, CEO and Co-Founder, Astrocast.

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● ● Daria Boiko, Vice President of IEC Telecom Group's Commercial Division

Satellite Evolution Global

Q&A

How remote technologies and their networks unlock the potential of automation ● ●

The autonomous revolution that utopian thinkers have long theorised stands atop dozens of complementary technologies, not least of them IoT-connected remote systems that expand the reach of AI sophistication across the breadth of the globe. Daria Boiko, Vice President of IEC Telecom Group's Commercial Division explains the industry she sees, and the myriad of efficiencies automated technologies can empower.

Laurence Russell, Associate Editor, Satellite Evolution Group

Question: As the world gets back on its feet, digitalization and remote connectivity have become a big opportunity for fuelling growth. What do you believe will be the sectors driving the most demand for these technologies in 2023?

Daria Boiko: As we're getting more and more connected, there remain opportunities being missed. From a satellite perspective, we're still seeing the same industries voicing demand, such as maritime, where there are still many unconnected vessels making do traditionally. This is to say nothing of the opportunity for entirely automated vessels which are becoming quite a big thing as this sector grows.

Mining and agriculture sectors are still developing their taste for



IEC connects remote industry. Photo courtesy IEC Telecom ● ● ●



Decarbonisation efficiencies make maritime green. Photo courtesy IEC Telecom ●●●

internet of things (IoT) and machine-to-machine (M2M), which we can expect to mature into an even greater market share before too long, and relief and NGO demand remains reliable.

Question: With industries becoming increasingly automated, what's possible in a world of connected AI and automated systems?

Daria Boiko: The world of artificial intelligence (AI) is all about operational efficiency. With a range of processes handled without human involvement, companies can optimize their costs and speed up their business cycles. As more organisations take advantage of AI capabilities and cloud technologies, they report 27 percent of earnings being attributable to benefits from AI, according to a 2021 McKinsey report.

From increased access to data and automated processes to reduced safety risks for remote workers and real-time security measures, AI adoption is up from 45 percent in 2020 to 57 percent in 2021 in emerging economies. Big data analytics are being driven by artificial intelligence for faster data crunching and processing. AI-driven systems can make short work of analysing billions of datasets. Furthermore, their machine-learning capabilities pave the way for efficient, safety-driven automated responses.

Question: When it comes to bringing IoT connectivity to systems, automated or otherwise, what are the biggest obstacles to overcome? What's stopping us from connecting everything everywhere?

Daria Boiko: Often, IoT systems are used specifically in remote areas to optimize processes and reduce unnecessary expenses. While in cities, the availability of seamless connectivity is not an issue, achieving an uninterrupted data flow in remote areas remains a challenge.

This is where satcom solutions come to the rescue. In the past, access to satcom was limited due to the considerable cost of

both airtime and equipment. This has dramatically changed over the past ten years. Servicing IoT devices can be achieved via compact and affordable terminals, offered with tariff plans at a cost on par with the Global System for Mobile Communications (GSM).

With IoT sensors, enterprises can ensure complete visibility of their assets. In the maritime sector, tracking devices empower vessel owners with comprehensive onshore management and monitoring of offshore assets from damage and unauthorised movement. As a case in point, IoT over seamless connectivity can support digital cargo optimization by reducing empty space from 40 percent to below 15 percent.

IoT technology takes this process from a physical space to the digital realm after collecting data on container types, weight, engine performance, destination, and more. This critical space and transportation capacity decision-making is easily enabled by offering remote control to the vessel operator.

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Wide reaching connectivity serves first responders when they need it most. Photo courtesy IEC Telecom ●●●

Question: You recently announced a partnership with Intelsat as a solution partner for their FlexMove High-Throughput Satellite system. What does their technology bring IEC?

Daria Boiko: Intelsat FlexMove is 20x faster than current mobile satellite solutions. We are thrilled to enhance our customers' productivity and help them decrease their operational expenses with this state-of-the-art solution for communications-on-the-move (COTM) and communications-on-the-pause (COTP). FlexMove empowers users with unprecedented flexibility for large remote operations no matter where they take place over a Ku-band satellite fleet. So, our customers can benefit from reliable connectivity in areas with limited to no GSM coverage and also access a powerful backup solution in urban locations.

Several state-of-the-art satellite terminals can be paired with FlexMove. Compact and portable, the StarWin terminals for stationary use and Kymeta terminals for vehicular use do not require a complicated set-up. This makes them ideal for special missions and humanitarian actions, whose operations depend on a swift response. With optimized applications by IEC Telecom, our customers can benefit from remote maintenance,

surveillance, telemedicine, and more value-added services over FlexMove connectivity.

Question: Are remote connections less secure? Do a great number of end-points create more opportunities for cyber-attacks? How can we assure security as we expand the scope of our connectivity?

Daria Boiko: There is no particular sector of the industry that is more exposed than any other. It's the systems and access points that create the issues.

In a corporate environment, most of the cyber threats come from unintended contamination from a personal device. IEC Telecom solves this problem with the OneGate network management system.

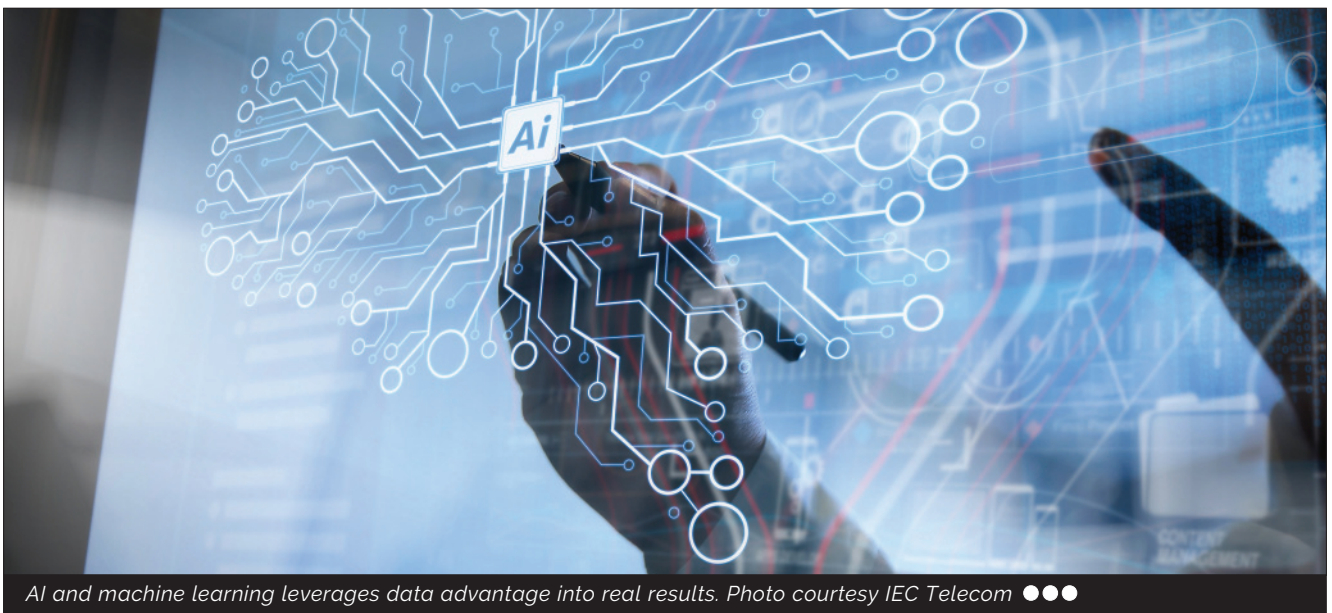
The terminal allows the separation of operational networks. Hence even if one of those gets infected, the rest remain secure and operational. It is especially important for the maritime market, where onsite maintenance is not an option available anytime. Our typical solution for this use case is the separation of corporate and crew welfare environments.

As such, even if the social network is down with a virus intentionally released via a personal device, critical infrastructure remains intact.

OneGate allows for network monitoring and set-up to be performed from onshore via a cloud-based control panel. ICT managers based in HQ can keep an eye on remote operations via an easy-to-use local dashboard. In addition, OneGate assures continuity of service by enabling advanced cyber security. The terminal segregates crew and corporate networks, eliminating the risk of cross-contamination.

Question: On the subject of digitization, what is digital decarbonisation? Can the sustainability gains of connected systems add up to make a real impact for the world's net-zero targets?

Daria Boiko: Connectivity has a direct impact on decarbonisation. Digital technologies are forecasted to



AI and machine learning leverages data advantage into real results. Photo courtesy IEC Telecom ●●●



Photo courtesy Fit Zstudio/Shutterstock ●●●

achieve 76 percent of the decarbonisation efforts mandated by the International Maritime Organization (IMO) targets, i.e., reducing carbon emissions by 40 percent by 2030, for possibly one-tenth of the cost. With IoT, smart mobility, and artificial intelligence, the maritime sector is empowered to optimize routes, decrease fuel consumption, track asset performance, and reduce idle time and inefficient processes – resulting in the prevention of millions of tons of CO₂.

Shipping companies across the globe are supporting

digital decarbonisation efforts with The Getting to Zero Coalition – an alliance of 150 companies. The goal is to develop and deploy zero-emission vessels by 2030. There are already reports of CO₂ emissions savings of 18 percent or more across early digital decarbonisation adopters. With digital decarbonisation being a growing US\$11 billion market, optimizing conventional ships with digital decision support can result in up to 38 percent reduction in greenhouse gas emissions by 2050, according to an Inmarsat report.

Question: What can we expect from IEC Telecom in 2023?

Daria Boiko: We are committed to bringing the benefits of digitalization to the communities in which we operate. From humanitarian field missions to e-government and remote maintenance to real-time maritime updates, we believe that satellite connectivity empowers businesses and communities with services that may otherwise be unreachable.

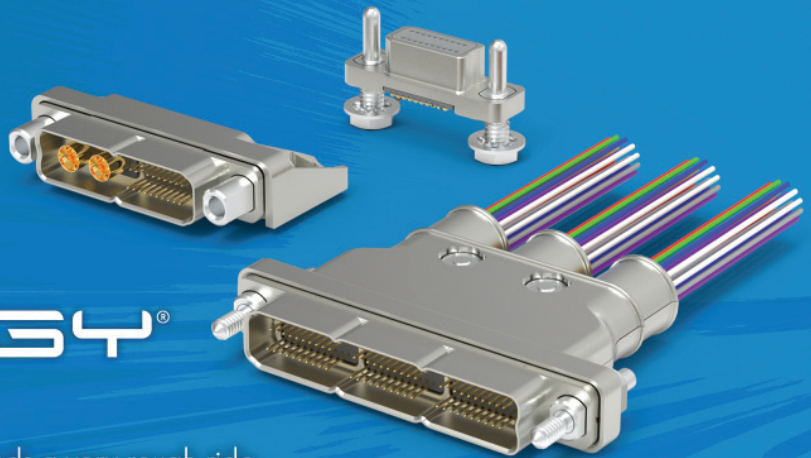
In 2023, IEC Telecom will continue to expand its portfolio and develop new partnerships to support global business operations as well as regional set-ups.

We aim to expand our geographic presence, especially in the Middle East. Our integrated and scalable satellite communication solutions optimize e-business services, offer a reliable backup for the GSM network, and ensure business continuity in the rapidly developing business landscape in the Middle East and North Africa (MENA) region. ●

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2022: A challenging year for investors ●●

During the last year, the satellite and space industry has been very dynamic with a lot of action, but the overall pace of investment has slowed down in comparison to 2021. Although SpaceX raised some US\$2 billion in 2022, the second largest round of funding went to Chinese satellite industry start-up, Galaxy Space, which raised US\$150 million. Other big players, including Amazon and Eutelsat/OneWeb, are well-funded but Telesat is still working on getting financing for its multi-billion projects.

Nathan De Ruiter, Managing Director, Euroconsult Canada

We are facing global inflation. Understandably, this situation has dampened the appetite of a number of investors who are now paying more attention to the high levels of risk and intensive costs involved in our industry and measuring those factors against the long-term returns. Still, the amount of money raised this year is pretty significant considering the macroeconomic environment. There has been a lot of early-stage activity but companies seeking later-stage funding are having some difficulty. When additional money is needed to complete large projects like launching constellations, we're already seeing a shakeout as investors scrutinize such deals far more carefully. This is particularly true for smaller companies that are feeling the headwinds right now, in terms of additional capital. Many of them are raising money but in smaller amounts.

KEY TRENDS AFFECTING THE MARKET

Human spaceflight has become the highest-funded space application by government. This is due to several factors. One of them is our return to the Moon and geopolitical tensions pushing spacefaring nations (particularly the US and China) to heavily fund such missions. Another reason is that we have new entrants in this arena. In the past,

emerging space countries focused their efforts on Earth observation, Satcom, and technology programs. Now those players are also developing space exploration missions to bolster international cooperation, visibility, and sovereignty.

One example is the UAE which not only has this vision to diversify but also has a lot of money to invest. The UAE launched its ambitious Hope Probe in 2020 becoming the fifth nation in the world and the first Arab country to launch a space mission to Mars. In addition, the UAE recently launched its Rashid rover Moon mission on a SpaceX Falcon 9. India has also demonstrated a great deal of potential. The Indian Space Research Organization (ISRO) has been outsourcing more and more activities and they have accumulated quite a bit of space heritage and capability. The fact that they launched 36 satellites for OneWeb in October shows that they can play a more significant role internationally.

Space militarization is growing as well with more and more countries investing in this area for military and sovereignty purposes. Beyond the spacefaring nations, we now see that other countries want to develop their own capabilities. For instance, the government of Australia recently awarded a US\$1.18 billion contract to Lockheed Martin to establish the Southern Positioning Augmentation Network (SouthPAN) to enhance precision and safety-of-



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Nathan De Ruiter, Managing Director, Euroconsult Canada ●●●

life navigation and positioning. With growing geopolitical tensions, this trend will certainly be confirmed this year.

The war in Ukraine has demonstrated that some countries were strongly dependent on their international partners to conduct their space program and now wish to obtain their own space assets—either launchers or satellites. The EU launched the European Space Program last year covering a broad range of objectives ranging from protecting the environment to increasing security with a budget of €14.88 billion between 2021-2027. Additionally, the UK's National Space Strategy aims to foster leadership in the industry by strengthening its launch heritage and encouraging public and private investment. Earlier this year the UK announced plans to invest US\$1.9 billion to support its military space programs. The country has also been

Challenging Year for Investors

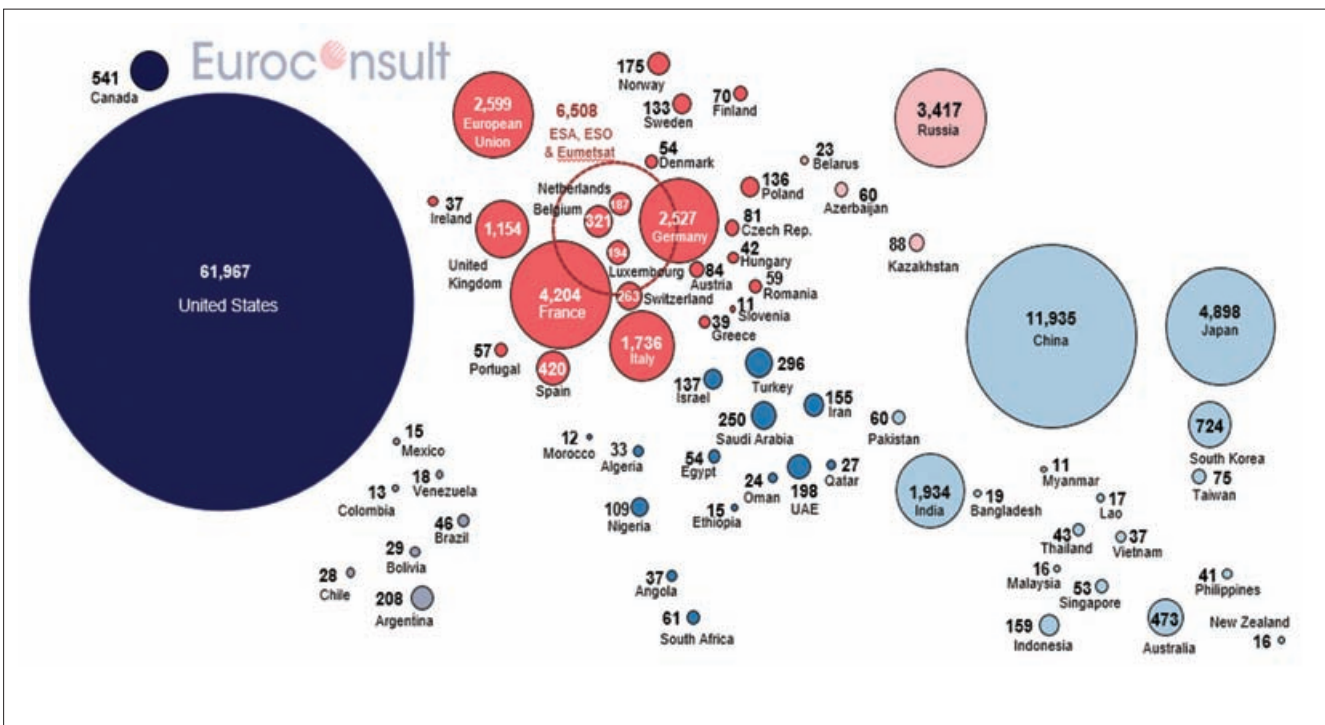
working with a number of start-ups in support of NewSpace development.

The US topped the charts in terms of government expenditures in 2021, followed by China (see sidebar: China's commitment to satellite and space), Japan, France, Russia, and Germany. This order is not likely to change this year, although we expect a decrease in spending from Russia, especially on the civil side due to the current crisis. For the moment, we do not see a significant impact of the COVID pandemic on government space expenditures, but it might happen. What we are seeing is that some very small countries such as Laos seem to have abandoned their space programs but others, including Armenia and Zimbabwe are entering the sector because access to space is becoming more affordable. Ten years from now, you will see a bigger push from the UAE, Saudi Arabia, India.

REALISM SETS IN AS OPPORTUNITY KNOCKS

Last year, the sector was hot. Investors saw it as a kind of Gold Rush. It seemed that everybody wanted to have a space company in their portfolio. Then reality hit. Many of the space plays that went public in 2021 fell short of expectations in terms of revenue projections. What's more, there has not been a big exit to demonstrate a big return. From an investment perspective, that's an issue.

That said, opportunities are emerging. The government as a customer is becoming more important and more valued. National space initiatives, particularly in the US, are outsourcing projects to start-ups in areas like Earth observation. In addition to benefiting from additional revenues, these companies have been able to demonstrate the importance of satellite imagery, not only in Ukraine but also in places prone to drought, floods, and



World government expenditures for space programs in 2022. Image courtesy Euroconsult ●●●

wildfires. Another exciting area is direct-to-satellite mobile phone service. This year we saw several interesting developments. SpaceX and T-Mobile announced an alliance that would if all goes well, enable global roaming, although initially only for text messaging. Apple also unveiled the new iPhone 14 which will support an emergency text message service using Globalstar's satellites. VC-backed Lynk has developed space cell tower technology that uses nanosatellites to perform global emergency texting, broadcast warnings, and instant backup communications for first responders after a disaster. AST SpaceMobile, which went public in 2021, has forged partnerships with telcos Rakuten and Vodafone to connect its satellites directly with a handset.

The question now is how to scale up the satellite/telecom market. Bringing these worlds together in a seamless way is really breaking some important barriers for the industry. At first, it's probably going to be used to complement existing networks, but it may also be useful for enabling observation-type imagery to be utilized in daily activities.

WHY AND WHEN TO MERGE

When we look at the Satcom industry, we see two types of M&A's. One is where the operator embraces the integrator to get closer to the customer. This usually happens when the satellites are launched, and services are going to be provided. It is at that point that satellite communications become a commodity. In order to differentiate and create value by offering more and better services, the operator needs to get closer to customers, so they acquire companies that have a service layer.

At the other end of the spectrum is horizontal consolidation. This is all about building scale and synergies. The market is very fragmented, especially the vertical operator mid-market. There are lots of companies and countries that have launched their own satellites and many of these players operate one or two satellites, which is an inefficient business model to build scale.

To compete in today's market, Satcom players need to transform by bringing assets together to create larger and more effective networks and/or by offering more service capability. The proposed Eutelsat/OneWeb merger exemplifies this concept with the combined company's plan to provide a hybrid GEO/LEO infrastructure, making it the first multi-orbit satellite operator. LEO provides great global coverage and low latency through the use of cloud applications. GEO offers more high capacity at certain demand hotspots. Although it is great to have an expanded toolbox, it's important also to consider the trade-offs because this expanded capacity comes at a cost.

There is merit as long as the LEO/GEO infrastructure is able to bring efficiency to users without a prohibitive price tag. So, getting all of this to work will be one of the key technology pushes of the near future.

ON THE HORIZON

It's probable that the industry will witness more consolidation going forward. There have been a lot of rumors about Intelsat and SES, but that deal has yet to

materialize. Still, the same underlying drivers that propelled M&A in 2022 are likely to intensify as the economic environment becomes more challenging. Valuations of a growing number of companies are going down and we are just at the start of the decline. This is happening not only in Satcom but also in Earth observation where there are a lot of small companies. Building skills will require some integration. Then too, as companies struggle to raise more money, we will see the bigger strategic companies taking an interest in acquiring capabilities that are complementary to their own.

There will be caution on the part of investors due to the high CAPEX requirements up front, the uncertainty about space, and the longer amount of time it takes to realize a return on investment. The launch segment in particular may have a tough time raising capital given the difficulty from a technical perspective and the thin profit margins. This may well lead to a stronger focus on the companies that are providing applications and services.

The satellite industry is expected to see a tangible return on investment. However, 2023 may be a bit early for that big exit to take place since many companies are still facing supply chain issues and macroeconomic headwinds as well as the threat of another COVID outbreak. Nonetheless, global communications, data processing on the edge, and even the lunar economy all hover on the horizon. ●

CHINA'S COMMITMENT TO SATELLITE AND SPACE

Chinese commercial space companies raised about ¥6.5 billion (US\$900 million) in funding through the first 10 months of 2022, which was a bit less than the ¥7 billion raised in 2021, but clearly on pace to overtake 2021. Overall, the past five years have seen around ¥7 billion on average invested pretty consistently (a low of ¥4.1 billion in 2018 and a high of ¥9.2 billion in 2020).

2022 investment was allotted to the usual suspects, but notable was the total of ¥2.4 billion (around 35 percent of the total) by CASIC into two main subsidiaries, launch company Expace (¥1.6 billion) and satellite manufacturer Space Engineering Development Corporation (¥800 million). Other than that, most funding has gone to industrial manufacturers at a systems level, and increasingly some focusing on subsystems technologies such as laser, ISL terminals, star trackers, and the like.

A lot of investment is driven by government initiatives. For example, the National Development and Reform Commission added Satellite Internet to their list of "new infrastructures" and then a lot of commercial companies end up using that as a value proposition when raising funds.

These initiatives are also supported at a provincial and city level, with the most effective Chinese commercial companies (from an operational and fundraising perspective) combining competencies and resources from local/provincial government, state institutions (SOEs and Chinese Academy of Sciences), and private capital. ●



● ● Ray Powers, Director of Sales and Marketing, Walton De-Ice

Satellite Evolution Global

Q&A

Experience is the best teacher ● ●

Walton De-Ice has taken an evolutionary approach to antenna protection, creating novel solutions for emerging needs. Its varied offerings are keeping communications up and running in some of the harshest and most remote regions on Earth. Ray Powers, Director of Sales and Marketing, tells us how a 43-year-old company is able to stay on the leading edge.

Crispin Littlehales, Executive Editor, Satellite Evolution Group

Question: Walton De-Ice has been the leader in protecting satellite antennas from harsh environments for 43 years; to what do you attribute your long-term success?

Ray Powers: Our founder and president, Bill Walton, believes that if we take care of the customer, the customer will always take care of us. That sentiment has paid off. It speaks volumes that he was the first-ever recipient of the World Teleport Association's Lifetime Achievement Award.

Our products have evolved as technology in Earth station antennas has evolved. For example, we have adapted our hot air de-ice systems to align with new manufacturing processes and frequency changes in Earth station antennas. In addition, we are the only de-ice systems manufacturer that meets MIL-SPEC thereby making our products widely available to the military.

Question: Briefly describe the evolution of your product offerings and tell us which ones are the most popular today and why?

Ray Powers: At the start, 43 years ago, everything was primarily in the C-band spectrum which had tremendous advantages in that it's a very broad spectrum. This meant that receiving and transmitting that radio frequency (RF) wasn't hindered so much by the environment save for having snow and ice moisture on the reflector of the feed itself. So, we developed our first product to keep snow and ice off of those big reflectors.

Over time, Ku-band emerged. While this was superior to C-band in many ways, it was more susceptible to rain, cloud cover, and other weather conditions so we adapted our product to suit those needs.

Then came the Ka-band which has a very narrow spectrum but allows tremendous amounts of data to be transferred. That presented a whole new set of challenges because Ka-band is not only susceptible to weather conditions, but the reflectors themselves react to temperatures. We then had to develop our product to control the expansion of the different metals used in the antennas, all of which expand at different rates. This required working with the manufacturers directly to ensure that when they use our hotter de-ice systems, they do not have a negative impact on the physical antenna. We actually do infrared testing after installation to ensure that the heat is distributed evenly on the reflector.

It's not really necessary to air condition the reflector. Let's say it's mid-summer with the sun moving throughout the day and it focuses on different points of the reflector itself which can actually cause distortion in the metals. What is vital is to maintain an even distribution of heat. We have temperature balance control within the plenum that we build in a structure behind the reflectors. We take that ambient air and move it so

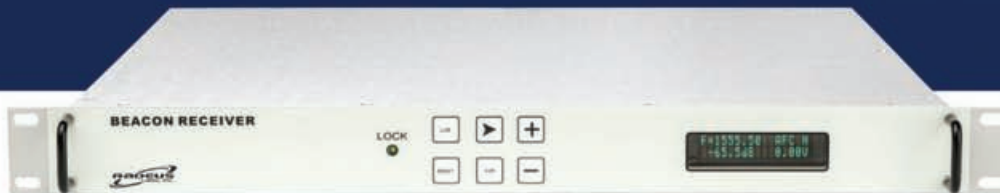


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Plenum enclosure where gas heaters are installed. Photo courtesy Walton De-Ice ●●●

that it is evenly distributed regardless of temperature. This control operates when the heaters are not operating.

The expansion of LEO satellites and ground station antennas that are tracking these moving satellites as well as the increased use of transportable, coms-on-the-pause (COTP), coms-on-the-move (COTM), first responder and particularly military applications presented another challenge since many of the antennas are being set up in places that are in remote areas where the weather can be extreme. To address this, our vice president, David Walton invented and holds the patent for a portable radome that is resistant to high winds, sandstorms, rain, and ice. What's more, it can be air conditioned and therefore able to keep equipment cool in areas that are very hot.

Then, with the advent of 5G, the use of large C-band antennas has been on the rise in the last 18 months, so our product evolution has come full circle. The reason for the expansion is because of the sheer volume of data that are required to be transmitted and stored when using 5G. That is, of course, where satellite enters the picture. This is the first time in history that the telcos need satellite technology to help move and store those data.

In the US, the expansion of 5G has already begun and now other parts of the world have plans in place for their 5G implementation. Then too, there is the advent of the metaverse and the virtual world which is in its infancy but

will ultimately require even more backhaul and satellite capacity.

Question: With so many different sizes and shapes of ground systems in such a wide variety of locations, every installation must be a little different. What are a couple of the most challenging ones in which you've been involved?

Ray Powers: Different locations present different demands. One of the first questions we ask is about power availability. Do they have a fuel source? Is it electric, or is it gas, or LP? Once we know that, we can develop the appropriate system. Every region has a different set of rules, so we have to work within those parameters as well.

Next comes geography. Where is the antenna located? If an antenna is built on the side of a mountain, the bottom is much lower than the terrain, so you are working off a slope and you need to use 120-foot lifts.

We built a de-ice gas heater system for a 32-meter antenna. Initially we put 12 heaters on this, making this the largest single installation in our history. Not long after completing the project, the customer requested we return to add 6 more heaters for redundancy. When we arrived on site, there was a couple of feet of snow accumulation from the feed down to the edge of this large reflector. The access was a road below the reflector that circled back around and so bringing the trucks and equipment into this area was in and of itself precarious. Once we were done adding the heaters, we fired up the system and the snow on the reflector loosened, launching a gigantic avalanche that completely blocked the access road so the trucks couldn't move. As a result, we had to call in some tractors to dig us out.

Question: Some of your customers are switching from electric heaters to gas heaters. What are the benefits to doing that and is it an easy swap?

Ray Powers: Easy is a relative term for us, but, yes, I would say it is an easy swap since we are simply taking one kind of system out and putting the other one in its place. Much of the time, the customer leaves the electric system in place as a backup in case of failure.

The customers that are switching absolutely love the transition from electric to gas or LP. This kind of change is getting to be a bit more popular in Europe which mostly has electric systems. As teleports expand, they are often in areas that are not able to have large amounts of power transmitted to them. Currently these teleports are at the limit of how much power the municipality can supply, and they all have backup generators.

By doing a conversion over to gas or LP, these teleports are able to reduce electric power requirements by 80 percent. That's because gas delivers the necessary BTUs required to heat a structure much more quickly and less frequently than electricity. As a result, these customers are able to save money. What's more if they can switch to gas, it's clean-burning natural gas which is more friendly to the environment.

We did a conversion on an older 18-meter antenna running on electricity in Bulgaria. The teleport could not expand because no additional power was available. By

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switching the systems over to natural gas as the heat source, the customer was able to greatly reduce the energy required to deliver the de-icing process.

Question: There is a big emphasis on LEO constellations and addressing the digital divide. How are these trends affecting your business?

Ray Powers: We have been approached by some of the companies that are really pushing for these LEO constellations which require numerous tracking systems on the ground. These are smaller antennas and are therefore perfect candidates for the portable radomes and snow shields which use an architectural fabric to shield the reflector from moisture caused by rain, ice, and snow.

Then, too, there are options that can be passive or heated where we're using gas or electric heaters and pumping heat in under that snow shield cover. The other option is our patented Ice Quake which is a small vibrating motor that uses a Teflon paddle to drum the cover and create a subtle shedding action so that nothing accumulates on the cover itself. There is a very large telecom near Kansas City that has a large antenna farm which uses both our heated and Ice Quake solutions on 29 of their antennas.

Question: What kind of maintenance is required to keep your products operating properly over the long run and who performs that maintenance?

Ray Powers: We recommend an annual maintenance of going through the entire system to make sure that it is

operational. This is usually performed in late summer and fall, prior to any winter activity. In addition to checking out the condition of the heaters and the controls, it's important to confirm that the physical system itself is in good shape with ducting intact and any critter damage repaired. We have full-time field technicians who know how to properly maintain equipment and there are customers who maintain their own equipment.

Question: What regions have the highest concentration of Walton De-Ice products today and how has that changed from the early days of the company's existence?

Ray Powers: Early on companies were putting antennas up here and there: one on a mountain, two in a prairie, that kind of thing. Then, as both the telephone and satellite industries evolved, antenna farms and teleports were created.

Our biggest concentration of de-ice systems is all up and down the East Coast of the US from Florida, where government organizations have them installed in case of an emergency, right up into Maine. There is a large concentration of our systems in Washington, D.C. which is considered a "blast zone" with all the RF instigated by government activities. In addition, we've installed lots of systems in the Rocky Mountain region and a massive collection in Washington state. We also have hundreds of systems installed throughout Europe: Italy, Germany, Switzerland, France, the UK and even throughout the Balkans. ●



Electric heater installed at Horizon teleport in Moosburg, Germany. Photo courtesy Walton De-Ice ●●●



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Travelling to space through crypto

Since the dawn of time mankind has wanted to visit the stars. With the space industry's rapid growth, we are on track to send more people each year than the year before. These lucky few will experience what human history had only dreamed about. They are the elite of society who can afford such a price. However, a commercial space flight program built around non-fungible tokens (NFTs) could allow everyday civilians to embark on their journey to outer space for the price of the NFT they acquire.

Charlton Haupt, Founder of Bad Astro Society

In the 20th century, the space race was all about what government could reach the moon first. In the 21st century, it has evolved to represent a race between several privately-owned corporations to determine who can operate the first commercial space flights at scale with a reasonable price. While the current price tag for space tourism is far out of range for the average American, technological innovators are developing exciting new ways to fund commercial space travel.

Many people dreamed of being able to visit outer space when they were children, but for most of the lifetimes of those currently alive, the only people who would ever go to space are elite astronauts and scientists. Now, companies like Elon Musk's SpaceX, Jeff Bezos's Blue Origin, and Richard Branson's Virgin Galactic are investing in space travel technology and making it available to the public — albeit at a prohibitive cost for a significant majority of general consumers.

One of the main methods space tourism companies use to help build the visibility of their services is celebrity trips. When these high-profile public figures venture into outer space, it tends to generate extensive media coverage, bringing awareness that commercial space travel is not just within reach but entirely possible. And as is the case with so many trends in our culture, when the masses see someone famous doing or buying something, that thing becomes trendy and desirable.

Now that space travel has become desirable, the next step is to make it more accessible to the general public.

THE CRYPTO MARKET AND COMMERCIAL SPACE TRAVEL

Some people have looked to the crypto market as a way to make space more accessible, but critics have claimed that the crypto market is too unstable to be the foundation of something as important as the future of space travel. Admittedly, we are currently in a bear market that has



Charlton Haupt, Founder of Bad Astro Society ●●●

driven the prices of cryptocurrencies down. However, the financial aspect of the crypto market does not delegitimize the benefits of blockchain and crypto technology in developing a system to go to outer space.

The underlying technology of the blockchain market allows communities, regardless of their size, to create payment systems without the involvement of a middleman. Buyers and sellers alike are incentivized by the greater trust and lessened friction of a blockchain-based economy.

While economic conditions in the crypto market might seem bleak at the moment, it is only a bear market, and bear markets do not last indefinitely. The average crypto bear market lasts anywhere from 12 to 18 months, and there is much that can happen during that time. Throughout this current bear market, the space industry is continuing to improve its technology, meaning commercial space travel can become cheaper and more accessible to the everyday consumer.

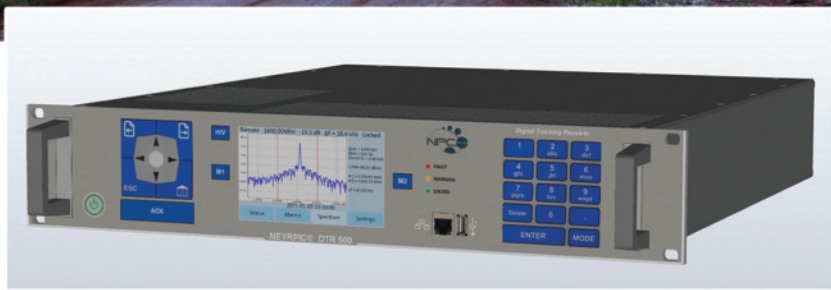
One exciting potential application of blockchain in space tourism is using NFTs as tickets for commercial space flights. When an NFT program has its initial mint, the funds are raised, but the treasury is further grown through staking and royalties. This cycle allows the NFT program to continue to fund the cause it was designed to support — in this case, space travel.

MAKING COMMERCIAL SPACE TRAVEL ACCESSIBLE TO MORE PEOPLE

Ultimately, commercial space travel aims to make outer space more accessible to the masses. In the past, space was reserved for governments and scientists. Now, wealthy individuals have been added to the mix. While utopian sci-fi visions of communities living in outer space might still be quite a way out for the time being, current technology has reached a point where the general public can safely and comfortably reach space — at least for a brief trip. Current initiatives involve getting it to where more people can travel to space by lowering the prices of commercial tickets.

The main factor causing space tourism to become more affordable is the competition between several companies working to beat each other into the frontier of space. Presently, the earliest commercial space flights cost as

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Photo courtesy Bad Astro Society ●●●

much as US\$450,000 per passenger. But due to the heightened competition they now face, these major companies are effectively racing to develop the best, most affordable technology to get more civilians into outer space. With this, the major companies in the commercial space tourism sector speculate that they will be able to get the price down to \$250,000 a person, with Elon Musk's SpaceX claiming it could even be as low as US\$100,000.

Understandably, overhead costs for commercial space programs are currently extremely high, but space companies are looking at this spending as an investment in the future. Any vehicle built to withstand the extreme environment of space is undeniably expensive, but every penny spent on research and development for a new commercial space shuttle gives us knowledge that can be used to improve shuttles for scientific or military

purposes. In other words, by making space better for some people, we are making space better for everyone.

THE BENEFITS OF MAKING OUTER SPACE MORE ACCESSIBLE

While the price to go to space won't be as low as the cost of, say, a standard domestic airline ticket anytime soon, it could be as low as two Ethereum (ETH) — a significant difference from the US\$450,000 that the major space companies are currently charging prospective buyers. These lower prices will enable more people beyond wealthy celebrities and business people to experience the final frontier.

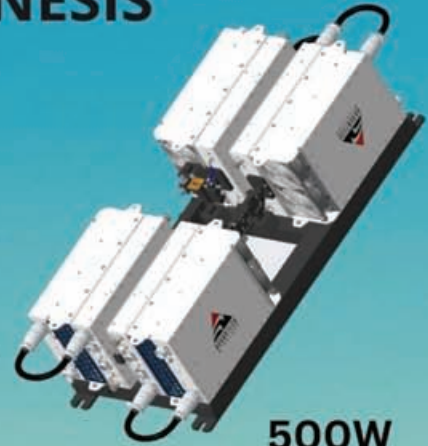
The first step in making space more open for the world is to make access more equitable and affordable. NFT technology is a necessary part of a significantly more affordable recreational space experience. ●



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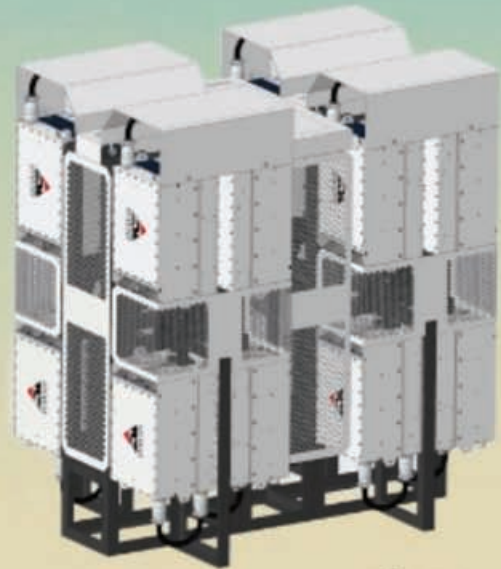
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● ● Bryan Dean, CEO and Co-founder of Dragonfly Aerospace

Satellite Evolution Global

Q&A

The data revolution in the stars with Dragonfly Aerospace ● ●

The language of artificial intelligence is data, and nowhere in the satellite industry is more data produced than in geospatial and Earth observation (EO). In the few short years that the space market has existed, we've seen this fledgling economy expand dramatically to become an essential tool of the modern world. We spoke to Bryan Dean, CEO and Co-founder of Dragonfly Aerospace, a rising star in Earth observation, about the future of the industry.

Laurence Russell, Associate Editor, Satellite Evolution Group

Question: The Dragonfly Aerospace-built EOS SAT-1 has recently left its manufacturing facility for Cape Canaveral for its launch with SpaceX where it will form a constellation serving agriculture and forestry industries for EOS Data Analytics. Could you outline the satellite's capabilities?

Bryan Dean: The EOS SAT-1 has two identical large cameras side-by-side. This doubles the width of the images it collects, which is about a 44-kilometre span in a 1.4-metre resolution. It also runs eleven spectral bands which are matched to the European Space Agency (ESA)'s Sentinel-2 which is a de-facto standard for image processing downstream companies.

Question: Could you recap Dragonfly Aerospace's activities in 2022? What have been some achievements and challenges for the year?

Bryan Dean: At the time of asking, the satellite has just shipped. This is



Engineers performing environmental tests at Dragonfly Aerospace's facilities in Stellenbosch, South Africa. Photo courtesy Dragonfly Aerospace ● ● ●

certainly one of our biggest achievements. We've been working towards it for the last two and a half years during which we've built it from the ground up, developing all the avionics for the platform in-house which represents the third generation of our electronic avionics' technology.

On the camera side, we've secured a few contracts for constellations. We've sold cameras for two years now though usually in orders of one and twos, but we're finally at a place where we're selling in double digits, which is a fantastic leap forward.

Question: According to Straits Research, the satellite Earth observation market is projected to reach US\$7.88 billion by 2030, up from US\$4.14 in 2021. What's driving those expectations of demand?

Bryan Dean: In any business, you can never have enough information. That's the short answer.

In the past revisits of a certain site for Earth observation would be in the metrics of days, weeks, and even months. That turnaround is coming down to daily revisits, but the trend is driving that even further to an hourly rate and beyond with much more technological sophistication to explore on the horizon.

The other aspect of growth is in the different sensor types that are necessary, from colour photographs, to multispectral and even hyperspectral over 148 bands in the visual spectrum. Beyond that, there's demand for infrared and thermal, around which we're seeing intentions to build entire specialized satellites.

Similarly, we've seen an explosion of companies in the NewSpace sector moving into X-band radar over the last 5-10 years. Traditionally this collects data by bouncing off the first surface it encounters, just like light from the sun,



Engineers performing assembly tasks on the EOS SAT-1 at Dragonfly Aerospace facilities. Photo courtesy Dragonfly Aerospace ●●●

but as you go into longer frequencies, you can penetrate these surfaces, breaking past cloud layers, tree canopies, and even detecting through the soil, which can be used to locate sources of water underground. A useful capability given the strains on water resources climate scientists have predicted for us.

An advertisement for Azure Shine International Inc. The background is a composite image of a city skyline at night and a satellite view of Earth. In the foreground, there are three large satellite dish antennas. The text "也翔國際股份有限公司" and "AZURE SHINE INTERNATIONAL INC." is at the top left. The text "Eutelsat / Intelsat Type Approved VSAT ANTENNA SYSTEM DTN ANTENNA SYSTEM" is in the center right. At the bottom right, there are logos for Eutelsat and Intelsat, and the website "http://www.azureshine.com.tw".

Question: What rising technologies can we expect to support this auspicious industry as it expands?

Bryan Dean: In the Earth observation industry, there's a lot of data being generated, which has players in the space increasingly invested in cloud storage and processing. Even now I'd say the majority of EO providers use the cloud.

However, only a small fraction of this massive data burden will be used, which substantiates the great bottleneck of getting data down to the ground. With the advent of space-based internet with high throughput LEO networks, we could see that paradigm shift drastically, placing cloud storage and processing at the edge, in space itself, so that the only information that needs to be sent down to the ground is the useful bits—the bottom lines and smoking guns at the end of all the data crunching.

Question: Our rapidly digitizing world has experts predicting a data revolution to reshape the way we conduct industry and live our lives. How much of a role does satellite geospatial and Earth observation tech play in that new world?

Bryan Dean: The data gathered from mobile phones and social media concerns the lion's share of the meteoric rise in data acquisition. Hourly Earth observation data would be an enormous amount of data to add on top of that.

Being able to recognize more of what's happening on the planet, and how it relates to us on expedient timescales would have a spectacular effect on our lives. We would be able to recognize, adapt, and react on an unprecedented scale.

Question: How do AI and automated systems interact with these technologies to process them into powerful new efficiencies? Will the sophistication of these high-

tech solutions drive data democratization and transparency, or compound the already asymmetrical power dynamics between big-tech and ordinary people?

Bryan Dean: The ability to process huge amounts of data is indisputably done better by machines and their algorithms than by a human. Machine learning plays a huge part in Earth observation and image processing, which is only going to increasingly become the case, particularly because of what we've discussed with the cloud. The whole thing is a positive feedback loop.

The data infrastructure to store and process huge amounts of data is naturally going to be led by governments and big tech companies, who are not only the most capable of seizing it but those who stand to benefit most from it.

There's no reason to assume that the trends in data and privacy we've seen developing in recent years won't continue along the same trajectory.

Question: What can we expect Dragonfly Aerospace to bring to the industry in the years ahead?

Bryan Dean: We're looking forward to increased production. It's already been advancing nicely with our camera business and with satellites. We're gearing up for manufacturing three satellites a year in the short term and moving to ten a year in the foreseeable future.

In terms of imaging, we have high-resolution optical and hyperspectral images ready. The next step for us is moving into synthetic aperture radar (SAR) and infrared. We're very close to releasing our first infrared product. All this is in the works as we evolve to sell data as a product to analytics groups. We're also going to pursue owning and operating our own spacecraft. But that'll be a big leap forward, and there's plenty of work to be done before then. ●



An engineer performing mechanical machining tasks at Dragonfly Aerospace's facilities. Photo courtesy Dragonfly Aerospace ●●●

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Philip Harlow joins Telesat Government Solutions as President

Telesat has appointed Philip Harlow as President of Telesat Government Solutions, a US-incorporated, wholly-owned subsidiary of Telesat that is focused on providing resilient and secure satellite solutions to the US Government and allied nations.

With over 25 years of leadership experience, Mr. Harlow joins Telesat Government Solutions with deep knowledge and expertise in delivering SATCOM solutions to government users, including the US Department of Defense and law enforcement and emergency services personnel. He most recently was the President and CEO of DTC Communications, where he was brought in to define the corporate strategy, team and technology infrastructure for short and long-term growth.

Prior to that, he was the Vice President of the Global Solutions Group for SES Government Solutions, where he spearheaded business development capture activities and engineered trusted solutions for government and defence customers. From 2010-2018, he served as President and Chief Operating Officer of XTAR, LLC, designing innovative ways for military and government users to access commercial space platforms. Prior to XTAR, Mr. Harlow held a variety of executive and engineering roles with leading defense integrators and satellite operators, including Caprock Communications, DRS Technical Services, Intelsat General and Esatel Communications.

"Philip's distinguished career in delivering best-in-class solutions to the US Government and defense sector spans leadership roles with satellite operators, SATCOM integrators, and military service. He's the right choice for executing our vision of delivering assured, cutting-edge solutions to support the US Government and allied nations' defense missions," stated Dan Goldberg, President and CEO of Telesat.

"This is a transformative time in the satellite industry, and the perfect time to join Telesat Government Solutions as we execute pathfinder programs to make the DoD's proliferated LEO vision a reality," stated Philip Harlow. "The upcoming Telesat Lightspeed network is a game-changer for government customers - far more advanced than any other LEO system - and will deliver enterprise-class LEO connectivity for unsurpassed flexibility and resiliency to meet mission requirements in a contested space environment."

Mr. Harlow will replace Tom Eaton, who announced this past summer that he would be retiring from the company at the end of the year after serving as President of Telesat Government Solutions since October 2021, in addition to seven successful years as Telesat's Vice President of International Sales.

Goldberg continued, "I'd like to thank Tom for his trusted leadership and significant contributions to Telesat



Philip Harlow, Telesat Government Solutions ●●●

and Telesat Government Solutions, including the recently announced contract awards for the NASA Communications Services Project (CSP) and the Defense Advanced Research Projects Agency (DARPA) Space-BACN program. Tom has been a tremendous colleague and we wish him all the best in his well-deserved retirement." ●

Ball Aerospace names Dr. Alberto Conti Vice President and General Manager of Civil Space

Ball Aerospace has selected Dr. Alberto Conti, to serve as vice president and general manager of the company's Civil Space Strategic Business Unit (SBU), effective immediately.

In this role, Conti will lead the Civil Space SBU and will be responsible for a portfolio that spans across all science fields, operational weather and Earth observation, as well as advanced technologies and development.

He will partner with customers and stakeholders to achieve mission priorities and define next-generation architectures through the development and implementation of strategies aligned with the Ball Aerospace strategic plan.

Conti previously served as Ball Aerospace's director for New Business and Innovation Solutions in the Civil Space SBU.

Prior to joining Ball, Conti served as the innovation manager for Civil Space at Northrop Grumman. Previously, he served as the James Webb Space Telescope (Webb) innovation scientist at the Space Telescope Science Institute, the current science and mission operations center for Webb. Earlier in his career, he was the Hubble Space Telescope chief engineer for Data Management, the development manager for the Community Missions Office, and the project manager for the data archive of the Galaxy Evolution Explorer space mission. ●



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Spire Global appoints Frank Frulio as General Manager of Space Services

Spire Global has appointed Frank Frulio as General Manager of Space Services. With more than 25 years of experience in the telecommunications industry, he has a proven track record of sales, operations, and business development leadership in regional, national, and global markets. Mr. Frulio will be responsible for guiding and executing on the business growth strategy and product roadmap for Spire Space Services, which allows organizations to deploy and scale their own constellation at maximum speed and with minimum risk, all through a subscription model that eliminates the high upfront cost of building and maintaining infrastructure in space. He is relocating to Glasgow, Scotland where the Company's satellite manufacturing facility is located and will report to Chief Operating Officer Theresa Condor.

"The Space as a Service model has unlocked a massive opportunity for companies to develop new applications in space to solve problems and gain a competitive edge. With Frank's decades of experience leading business development and driving new product adoption at multinational corporations, he brings the expertise and skill set needed to commercialize this offering at a global scale and help organizations realize the opportunities at play here," said Ms. Condor.

Previously, Mr. Frulio was the Managing Director and Region Head for the Americas and Europe at Singtel, a Singaporean telecommunications conglomerate. Prior to that, he held numerous leadership positions at telecommunications companies including XO Communications, CenturyLink Business, and AT&T. Mr.



Frank Frulio as General Manager of Space Services ●●●

Frulio received a Juris Doctorate from ??Southern Methodist University and a Master of Business Administration from University of Central Florida. He has served on the Board of Directors for United Way, Volunteer Center of North Texas, and Methodist Health Systems.

"I am excited to join the booming and dynamic new space industry, tapping my background in telecom to help organizations understand the role that space-based applications can increasingly play in transforming every aspect of our world, from helping businesses improve their bottom line to preventing and mitigating the impacts of climate change here on Earth," said Mr. Frulio. "Having grown up a stone's throw away from the Kennedy Space Center, where my father worked on the NASA Space Shuttle program, I feel right at home joining Spire."

Spire co-founder Joel Spark, who recently served as General Manager of Space Services and successfully led the rapid growth of the business, will transition back to his roots within engineering and focus on advancing its next-generation spacecraft as Chief Satellite Architect. ●

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