



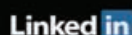
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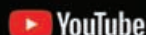
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October 2022

## Making space accessible to everyone

**Plus:**

The critical role of environmental  
assessments in the licensing of  
UK space flight activities

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## Code of honor

Considering our focus for this month is globalization, it's entirely fitting to turn our attention to the Artemis Accords, which have now been signed by Australia, Bahrain, Brazil, Canada, Colombia, France, Israel, Italy, Japan, the Republic of Korea, Luxembourg, Mexico, New Zealand, Poland, Romania, Saudi Arabia, Singapore, Ukraine, the United Arab Emirates, the United Kingdom, and the United States. On September 19, the signatory nations met at the International Astronautical Congress in Paris for their first in-person meeting since the Accords were launched by eight countries on October 13, 2020.

The Artemis Accords are defined as "principles for cooperation in the civil exploration and use of the Moon, Mars, comets, and asteroids for peaceful purposes." As such, they affirm compliance with the 1967 Outer Space Treaty (formally titled the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies) as well as the 1968 Rescue and Return Agreement, the 1972 Liability Convention, and the Registration Convention of 1975.

Although Russia and China signed the Outer Space Treaty, their signatures are notoriously absent from the Accords. This doesn't mean that the two countries are not on board for keeping the peace in outer space, however. Indeed, on February 4, 2022, Chinese President, Xi Jinping, and Russian President Vladimir Putin signed a joint statement supporting the United Nations Committee on the Peaceful Uses of Outer Space and the importance of "preventing an arms race in outer space." According to a translation by the China Aerospace Studies Institute at Air University, both leaders declared their opposition to the US plans to develop global missile defense and "attempts by some States to turn outer space into an arena of armed confrontation."

This may seem strange considering Russia's much-criticized ASAT destruction of Cosmos -1408 last November, but it's worth noting that the US conducted similar tests against its own satellites, most recently in 2008. China did the same in 2007 as did India in 2019. As the world proceeds with space exploration, we might all benefit from a quotation taken from Norse mythology: "To take up great resolutions, and then to lay them aside, only ends in dishonor." It is incumbent upon each nation to play nice or face much worse consequences.

In this issue of Satellite Evolution Global, we interview Augustine Ponturiero, TriSept's Chief Strategy and Growth Officer, who explains how the company has managed to thrive for 28 consecutive years. Tim Chrisman, Founder and Executive Director of Foundation for the Future shares his thoughts on making space accessible to everyone. Ruth Fain, Environmental Consultant, ITP Energised, explains the critical role of environmental assessments in the licensing of UK space flight activities.

Laurence Russell details the efforts of ESA and NASA as they prepare to unlock the mysteries of Jupiter's moons. He also talks with Sethu Saveda Suvanam, Founder and CEO of ReOrbit, who offers his thoughts on how to make our satellites reusable. In addition, Russell catches up with Dr. Kevin Petty, Vice President of Weather and Earth Intelligence for Spire Global who reports on the proceedings before the US Congress and what they mean for the future of atmospheric sensing and weather prediction.



*Crispin Littlehales, Executive Editor* ●●●



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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

#### 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

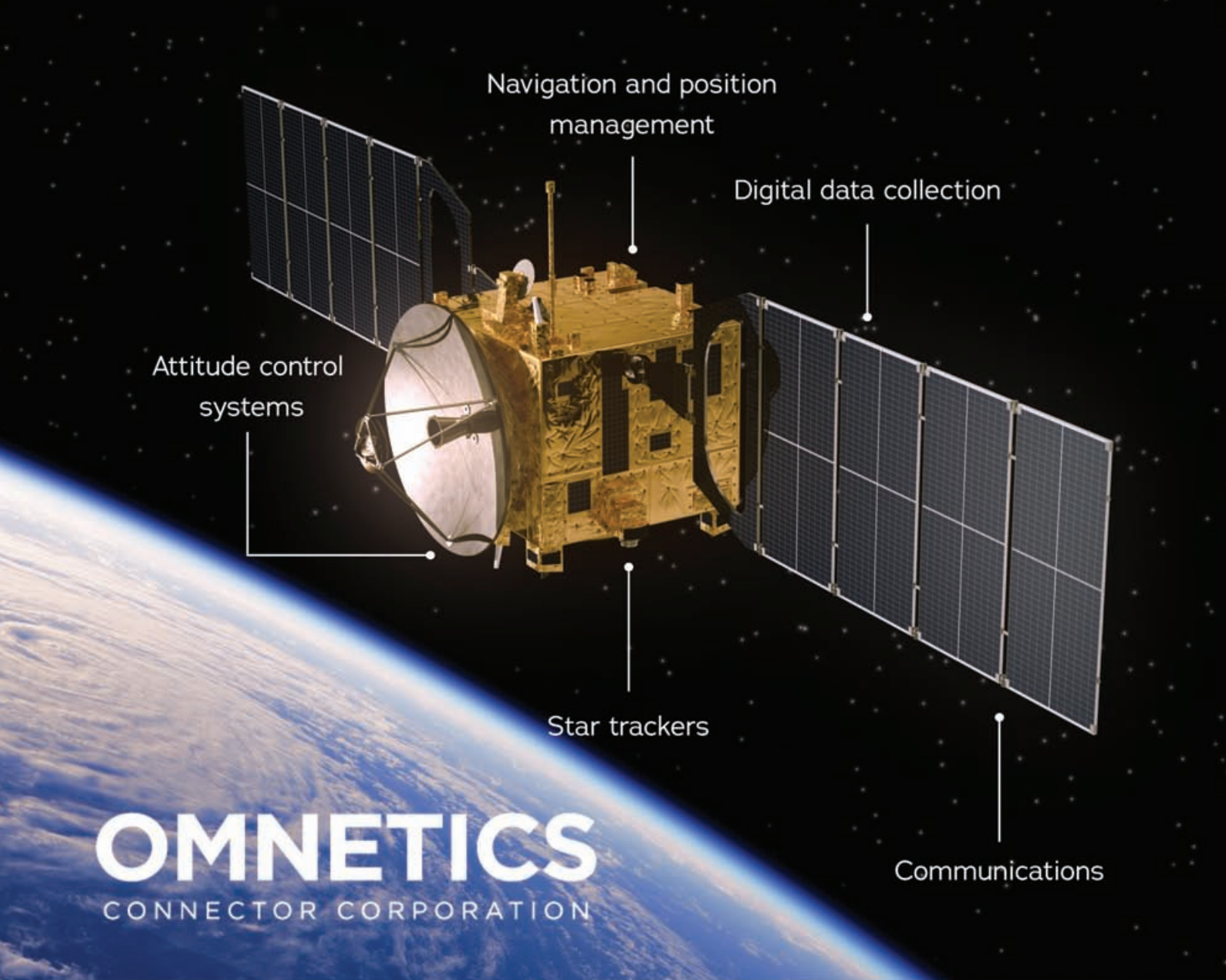
#### Marketing Production Manager

Jamaica Hamilton  
jamaica.hamilton@dsairpublications.com

#### Production

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## e& and SES join forces to offer one-hop connectivity to Microsoft Azure

**MIDDLE EAST:** The Carrier and Wholesale Services (C&WS) division of e& (formerly known as Etisalat Group) has announced its partnership with Microsoft and SES to host the co-located SES O3b mPOWER and Microsoft ground station at Ras Al Khaimah. The first O3b mPOWER ground station in the region will facilitate one-hop connectivity to the cloud from remote sites so that customers can optimize their global business operations smoothly. The partnership will also enable companies - regardless of their location - to accelerate their digitalization plans while unlocking more value for the businesses.

This trio partnership will mean that e& network services can be easily connected and extended via SES's second-generation medium earth orbit (MEO) constellation - O3b mPOWER - which aims to deliver high-speed connectivity services from tens of megabits to multiple gigabits per second to one site. The one-hop connectivity to Azure Cloud and SES's satellite network also enables simplicity, flexibility but also minimizes any network latency delays. The ground station at Ras Al Khaimah is one of the eight initial O3b mPOWER gateway sites which will support both customer data services and the TTC (Telemetry, Tracking and Control) control of the satellite system.

"SES's O3b mPOWER satellite services will enhance cloud-enabled capability to meet critical industry connectivity needs with greater resiliency and enable users

in e&'s customer base to benefit from enabling Cloud applications regardless of where they are located," said William Chappell, Vice President of Azure Global, Microsoft.

"This partnership is an important milestone in providing customers with the ability to optimize business operations in a flexible and agile manner while accessing connectivity to the cloud from remote sites via satellites and leveraging e&'s global network with space coverage. e& will capitalize on the success of O3b mPOWER satellites to deliver fiber-like connectivity to meet growing customer demands globally," said Nabil Baccouche, Group Chief Carrier & Wholesale Officer, e&. "Through this partnership, our international customers will have access to cloud-based services and platforms regardless of their location."

John-Paul Hemingway, Chief Strategy & Product Officer of SES, said, "These are exciting times as the extended relationship with e& will enable all three companies to take another step towards delivering high-performance, low-latency networks virtually anywhere. Regardless of their remote locations, customers worldwide will be able to access and experience cloud-based applications seamlessly. Our ground-breaking O3b mPOWER system will provide new levels of cloud-scale satellite connectivity, intelligent automation and managed services and support digitalization across a wide range of sectors." ●

## Sierra Space Ventures: Enabling the in-Space breakthroughs of tomorrow

**NORTH AMERICA:** Sierra Space has created Sierra Space Ventures, which will open the possibilities of space to the innovators of tomorrow.

Sierra Space Ventures will allow Sierra Space to partner



e& teleport extended from SmartHub Data Center to easily provide global reach and high-quality services. Photo SES ●●●



with pioneering, growing companies for the purpose of innovating their disruptive products on the Sierra Space platform in space. Investments made by Ventures will focus on companies working to enable the next breakthroughs in human health, computing systems, telecommunications and clean energy that can be further accelerated through access to Sierra Space's research facilities in low-Earth orbit (LEO). As part of the announcement, Sierra Space also named Matthew Mejia to the newly created position of Chief Strategy & Development Officer.

"As a fully integrated space technology and business platform in space, our company has a unique ability to advance the commercial space economy," said Sierra Space CEO Tom Vice.

"Sierra Space Ventures is the ideal complement to the pioneering work we do every day that will benefit humanity for decades and centuries to come. Through Ventures, we will help enable the next breakthroughs in human health, computing systems, telecommunications, clean energy, and unlock space as a new destination to explore and learn."

"Sierra Space has a critical role in advancing humanity's presence in space, and we hope to enable broader access to the vast potential space has to offer," said Mejia. "Through Sierra Space Ventures, we can offer prospective innovators access to our space transportation and destination infrastructure to launch their own research in LEO and help position them for success as they mature their capabilities and continue their capital strategies."

Mejia, who joined Sierra Space earlier this year and

oversees strategy, corporate development, and mergers & acquisitions, brings more than 20 years of aerospace and defense experience in finance, management consulting, and investment banking. He previously held the position of Managing Partner and Co-Owner of Renaissance Strategic Advisors, one of the leading consultancies supporting premier firms in aerospace, defense, space, and intelligence. Mejia also served as Chief Financial Officer and Executive Vice President of Strategy and Investor Relations at Aerion Supersonic.

## NASA awards contracts to assess near-space communications capabilities

**NORTH AMERICA:** NASA has selected two companies – Kongsberg Satellite Services (KSAT) USA of Denver and SpaceLink Corporation of McLean, Virginia – to develop capability studies to explore and demonstrate communications and navigation services in support of Artemis missions to the Moon.

The awards, under the Next Space Technologies for Exploration Partnerships-2 (NextSTEP-2) Broad Agency Announcement (BAA) Appendix O, are firm fixed-price milestone-based contracts in the amounts of \$161,638 for KSAT and \$189,881 for SpaceLink Corporation.

The studies will involve direct-to-Earth and lunar space relay communications and navigation services that would



Image of the Moon from low-Earth orbit. Courtesy of NASA ●●●

enhance telemetry, tracking, and commanding services for orbital and sub-orbital missions at the Moon through relay of critical data between spacecraft and ground stations.

"All missions need communications and navigation services to send data back to Earth. These capability studies and demonstrations will highlight networking efficiencies and inform future planning for NASA missions," said Kathy Lueders, associate administrator for NASA's Space Operations Mission Directorate.

NASA's Space Communications and Navigation (SCaN) program oversees the agency's two primary networks: the Deep Space Network and the Near Space Network, the latter of which provides services to missions within 2 million kilometers of Earth through a blend of government and commercial providers. These studies are intended to inform NASA and its stakeholders on industry's capabilities and concepts that would enable a commercial space communications and navigation marketplace where NASA is one of many customers.

"This BAA selection furthers the agency's commitment to commercializing direct-to-Earth space communications and navigation services and integrating a lunar relay to support Artemis missions to the Moon," said Badri Younes, deputy associate administrator and program manager for NASA's SCaN program.

The companies will help NASA and its stakeholders understand advancements in radio frequency compatibility testing that will lead to Near Space Network efficiencies, address industry best practices, tools, and capabilities related to mission planning and scheduling, understand the barriers, challenges, and solutions associated with integrating optical communications ground terminals into the Near Space Network, and understand the

advancements of software-defined radios and cloud computing assets and their integration into the Near Space Network architecture.

NASA's Near Space Network is managed out of the agency's Goddard Space Flight Center in Greenbelt, Maryland, under the direction of the SCaN program. SCaN continues to pursue regular industry engagement to identify matches between commercial capabilities and future NASA needs. ●

## IEC Telecom expands satcom offerings with Intelsat FlexMove

**GLOBAL:** IEC Telecom Group has officially announced a new partnership with Intelsat. With digitalization on the rise, dependency on always-on connectivity is rising. Corporate and private organizations seek to secure continuity of their operations no matter how remote, whether on the pause or the move. IEC Telecom Group through its multiple offices around the world is ready to meet these requirements as a new solution partner for the Intelsat FlexMove High-Throughput Satellite service.

Renowned for dependable Communications-on-the-Move and Communications-on-the-Pause service, Intelsat operates a Ku-band satellite fleet that ensures reliable connectivity for areas with no or limited GSM coverage and powerful backup solution for urban enterprises.

"We're excited by the possibilities of FlexMove connectivity and welcome IEC Telecom as a valued FlexMove solutions partner," says Joel Schroeder, Director for Land Mobile, Intelsat. "IEC Telecom is now offering FlexMove service plans that are sold by the gigabyte (GB) and seamlessly integrate across multiple terminals."

Intelsat has qualified several state-of-the-art satellite terminals that can be paired up with a FlexMove service plan to support recurring, seasonal, occasional, and event-based use. This capability offers unprecedented flexibility to users with large remote operations anywhere. FlexMove is delivered over Starwin and Satcube antennas for stationary use and Kymeta for vehicular use. These compact and portable terminals do not require a complicated set up and can be put into service as soon as required. This makes them especially useful for special missions and humanitarian corps, whose actions depend on the swift response.

"We're thrilled to expand our portfolio with a new service by Intelsat. In combination with IEC Telecom's wide range of optimized applications, FlexMove will help our customers to boost productivity, decrease operational expenses and reap the benefits of digitalization even in the most challenging areas," explained Erwan Emilian, Partner and Group CEO at IEC Telecom.

20x faster than current mobile satellite solutions, Intelsat FlexMove removes the complexity of dealing with bandwidth availability, saving businesses a significant investment. Optimized applications by IEC Telecom, are designed to deliver bespoke digital services with minor traffic consumption, making them a valuable addition to the Satcom users. Such value-adds include IoT,



Photo courtesy IEC Telecom ●●●



telemedicine, remote maintenance, Satcom-adapted surveillance, telemedicine, and more.

Dependable Satcom connectivity is the essence of technological advancement. It offers a solution to digital divide, paving the way to a more inclusive and equal society. Ecotone Analytics reports that every \$1 invested in digital access creates \$2.40 in societal returns, leading to GDP growth and a decrease in social-service spending (Kalmus et al., 2022). The newly established Satcom partnership aims to contribute to this great cause. IEC Telecom's cross-continental operations powered by Intelsat's global coverage would unlock new horizons for public and private sectors across the globe. ●

## Latitude selected within the ambitious French investment program France 2030

**EUROPE:** Latitude (ex-Venture Orbital Systems) has been selected for its projects linked to the category "Micro-launchers" of the French investment program France 2030. The French government shows its support for the French aerospace company again.

One more acknowledgement for Latitude and its microlauncher, Zephyr. The French company is part of the 15 laureates of the "Micro-launchers" France 2030's category. This ambitious investment plan, which includes •65M for microlaunchers, has been designed by the French Government and is operated by BPI and CNES. Supported by DGE, DGRI, DGA, and SGPI on their activities, BPI and the French space agency selected Latitude for "Xanthos". This project supports the development of the second version of Navier, the Zephyr's engine. The first version, which benefited from a CNES R&D contract, will be tested before the end of the year.

This new step enriches this key year for the company. In 2022, Latitude reached several key milestones, including the campaign to test the Navier's igniter, the production of the first Navier engines, the hiring of fifty new employees, the partnership with the Scottish spaceport, Saxavord, a •10M Series A, the choice by the CNES to launch Zephyr from the Centre Spatial Guyanais, and the collaboration with Flying Whales to transit Zephyr by airship to Scotland. Finally, this year will be punctuated by the firing test of Navier.

"This is crucial on our path to developing a reactive and sovereign access to space, and we are honored to have the support of the French government," said Stanislas Maximin, CEO of Latitude. "These two awards, as well as the selection of three other key partners in the Zephyr's development, depict our internal expertise and the expertise derived from our industrial fabric." ●

For further information or to submit information for consideration please contact::

**Executive Editor - Crispin Littlehales**  
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● ● Augustine Ponturiero, TriSept's  
Chief Strategy and Growth Officer

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Q&A

## Staying relevant in today's fast-changing business environment ● ●

TriSept currently provides products, services, and support to the government/military and commercial markets. Because the company is privately held, it can concentrate on delivering innovative solutions to its customers, rather than catering to investors. Augustine Ponturiero, TriSept's Chief Strategy and Growth Officer, explains how the company has managed to thrive for 28 consecutive years.

*Crispin Littlehales, Executive Editor, Satellite Evolution Group*

**Question:** TriSept has been in business for nearly three decades. What kinds of services do you offer to your customers and what are the key ingredients that have contributed to the company's long-standing success?

**Augie Ponturiero:** TriSept is a family-owned business that has never strayed from its founding principles of integrity, expertise, and innovation which were established by Rob Spicer, our founder, and CEO, who is still very much involved in driving the vision and direction of the company. Because we are self-funded, we are not motivated solely by achieving a return for investors. Instead, our mission is to provide high-quality services, products, and support to our customers. This is one of the most important drivers of our long-term success.

Another important factor is the quality, skill, and professionalism of the TriSept team. We have always successfully attracted experienced technical, operational, and security personnel. Much of our success lies in our ability to provide innovative product and service solutions. It may sound strange to say a 28-year-old company is "innovative", but we've not only revolutionized the services that we once pioneered, like the small satellite "rideshare" which we first offered to customers 15 years ago, we've also invented many novel products along the way. For example, our newly minted TriSept Security Enhanced Layer (TSEL) software provides improved cybersecurity protection in an austere and often power and computing capacity-limited small satellite architecture.

Mission support is our largest business area. This encompasses space systems engineering and system integration; cybersecurity and information assurance; space and satellite communications operations/ service management; spacecraft and launch vehicle systems analysis, acquisition, and integration; satellite payload development, integration, and launch.

Our systems engineering and mission support teams work with government and contractor personnel supporting approximately 92 active commercial satellite communications acquisitions that provide direct support to Department of Defense-related teams, warfighters, and programs deployed around the world. Our security business provides security program administration and evaluation services, secure spaces, and construction services to other businesses and we have ongoing projects throughout the continental US.



**Question: You work with both the commercial and the government/military sides of the market; how do these areas differ in terms of their demands?**

**Augie Ponturiero:** From a mission support services perspective, both sides want many of the same things. They are reliable partners that place a high value on the quality of work products and integrity across the workforce. They rely on people with capabilities who can seamlessly integrate into their teams and be effective on day one. From a product perspective, both are looking for innovative, high-quality, reliable, secure, and effective products that are "traceable" so that they can be comfortable knowing where and how the products were developed and built. For example, our TSEL software was developed by our team here in the DC area, so our customers are getting a traceable product with no "offshore" components. To them, this is very important from a risk management perspective.

While there are similarities in demand, the processes and activities involved in doing business are different. Government/military requirements are very structured and somewhat rigid. Timelines for acquiring new products and services are well-established and often lengthy, which can be both a blessing and a challenge. While allowing us time to develop solutions and products without having to use outside support, we risk losing "ideal" candidates for other opportunities. When pursuing government work each Request for Proposal (RFP) has clear-cut requirements and includes information on exactly how the customer expects companies to respond. When you win the work, you perform per the contract, and it's straightforward. There may be options within the contract that allow the government to modify requirements, but for the most part, your team performs to standards.

Commercial work opportunities are more flexible and move at a faster pace. There is more back-and-forth communication, and you get feedback throughout the process. In most cases, you can adjust your proposal to reflect these ongoing conversations. While price and ability are always factors, there are often other subjective elements in play such as corporate reputation in the market and the opinions of potential customers' board members. When you win, you perform to the contract specifications, but there is more communication with the customer allowing for modifications on the fly.


I've found that B2B working relationships are more personal, and we strive to bring some of that to our government/military programs as well. We emphasize developing effective communication and customer service skills so that our teams establish solid customer

working relationships and work immediately to resolve any misunderstanding or potential performance issues.

**Question: What is the most interesting project you've been involved with in the last twelve months?**

**Augie Ponturiero:** We've been positioning TriSept for the future space economy. We have a reputation for being a "government services" company and we have a track record of accomplishment in that market space. However, that is not our only skill set, nor is it our sole focus. We are first and foremost an innovative small business with patents and a highly technical workforce. We believe that puts us in a solid position to expand our commercial business offerings both in the US and internationally. We have been doing research and collaborating across our leadership team to examine different aspects of the blossoming space economy to see where TriSept can have an immediate, positive impact.

I enjoy strategic planning; examining trends in the



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market space; evaluating our internal strengths and opportunities; pairing our skills with trends in the market; and building a path ahead to a stronger, more competitive company. Our leadership team converses with colleagues to get their impressions, attends briefings, and conferences, learns about new technologies, and works with our CEO in crafting our vision.

**Question: You have a new product—TSEL satellite security software; how does it work and has it been road-tested?**

**Augie Ponturiero:** TSEL was developed to meet the rising demand for a managed cybersecurity solution that secures an embedded device much like a terrestrial server is protected. TSEL offers a series of automated mechanisms and updates that deliver detailed audit data, near real-time security analysis, and patch updates along with “zero trust” verification layers to protect against hackers and to provide an accurate account of what’s happening aboard the satellite.

A growing number of attacks on critical infrastructure have shown just how vulnerable spacecraft can be, especially as most small satellites are ill-prepared to protect themselves from focused cybersecurity threats. The software starts with locking down the satellite’s operating system at the board level in accordance with the latest information assurance and vulnerability standards, thus allowing satellite developers to build their satellite capabilities with a secure digital foundation. We

work with our customers to ensure their satellites and networks are as protected as they can be by providing several tiers of updates and support throughout the system lifecycle.

We have successfully tested TSEL in an operational lab environment and a vacuum chamber. We are in the process of testing the software as part of a sub-orbital flight evaluation and anticipate having an orbital test of it within the next 3-6 months.

**Question: TriSept’s Sensitive Compartmented Information Facility (SCIF) development and management business is soaring right now, to what do you attribute that success?**

**Augie Ponturiero:** Two primary factors have increased the demand for secure facilities. First, several government organizations are expanding their search for solutions to include “non-traditional contractors”. These businesses have great capabilities but often don’t have the facilities needed to be effective in working on government programs. As a result, they are looking to either lease secure space or build out secure space within their own facilities. TriSept assists those companies by providing consulting services and security-focused administrative help as they ramp up their security. We can also assist with construction should they decide to create their own secure rooms.

The second factor is the change in work habits since the pandemic. When government buildings were closed



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Photo courtesy Toria/Shutterstock ●●●

or restricted, TriSept was fortunate to have ready access to secure spaces in our corporate offices, so we were able to continue to provide a workspace to our team members who were impacted by government closures. Many government and commercial organizations aren't fully opening their facilities for work so many contractors are required to work remotely. This can be challenging without access to an appropriately cleared facility. As a result, many companies are seeking to acquire or build secure facilities to meet their contract requirements.

**Question: The satcom market is rapidly changing with more attention focused on near-Earth, lunar, cislunar, and beyond. How is TriSept evolving to meet new market demands?**

**Augie Ponturiero:** We're doing two things today to optimize new satcom architectures and services. First, for our current customers, our team members are helping our customers understand how new technology and satcom service offerings will impact their business and mission operations. We also ask tough questions: does the new service require a complete update to existing ground equipment and network; does the service model align with internal processes that are already in place; are changes in policy, doctrine, and operational processes required to derive maximum impact and value out of new services?

Second, we look at ways we can help improve the integrity and availability of satcom systems for all users. Our TSEL product is a good example of this. By providing foundational cybersecurity protection for satellites, we reduce the risk of intrusion and compromise. Additionally, we can provide satcom companies with rapid launch and on-orbit services to help them maintain their satellite constellations and systems regardless of their operational orbit.

**Question: Where do you see the company going in the next five to ten years?**

**Augie Ponturiero:** In addition to expanding our mission support work, our security-focused services, and construction projects, we are designing a second software product that will help both the range and launch communities. We are also expanding our security-as-a-service footprint beyond Northern Virginia with both

strategic partnerships and new construction opportunities. Finally, TriSept has maintained a small Innovative Technology Solutions group for a few years now and we are poised to become a true innovation engine for the NewSpace economy.

You'll see changes in our organizational structure as well. Recently, our founder relinquished his role as president, allowing him more time to focus on TriSept's future vision and role within the NewSpace economy. Our new president, Dean Blom, will concentrate on improving our internal corporate strength.

We are committed to being more scalable, agile, and responsive in the commercial market while maintaining our solid government/military support workforce. We have also established solid working relationships with international companies and are in the process of planning a more permanent presence in the UK. Our roadmap calls for TriSept to remain a family-owned business and to stay true to our core values. ●

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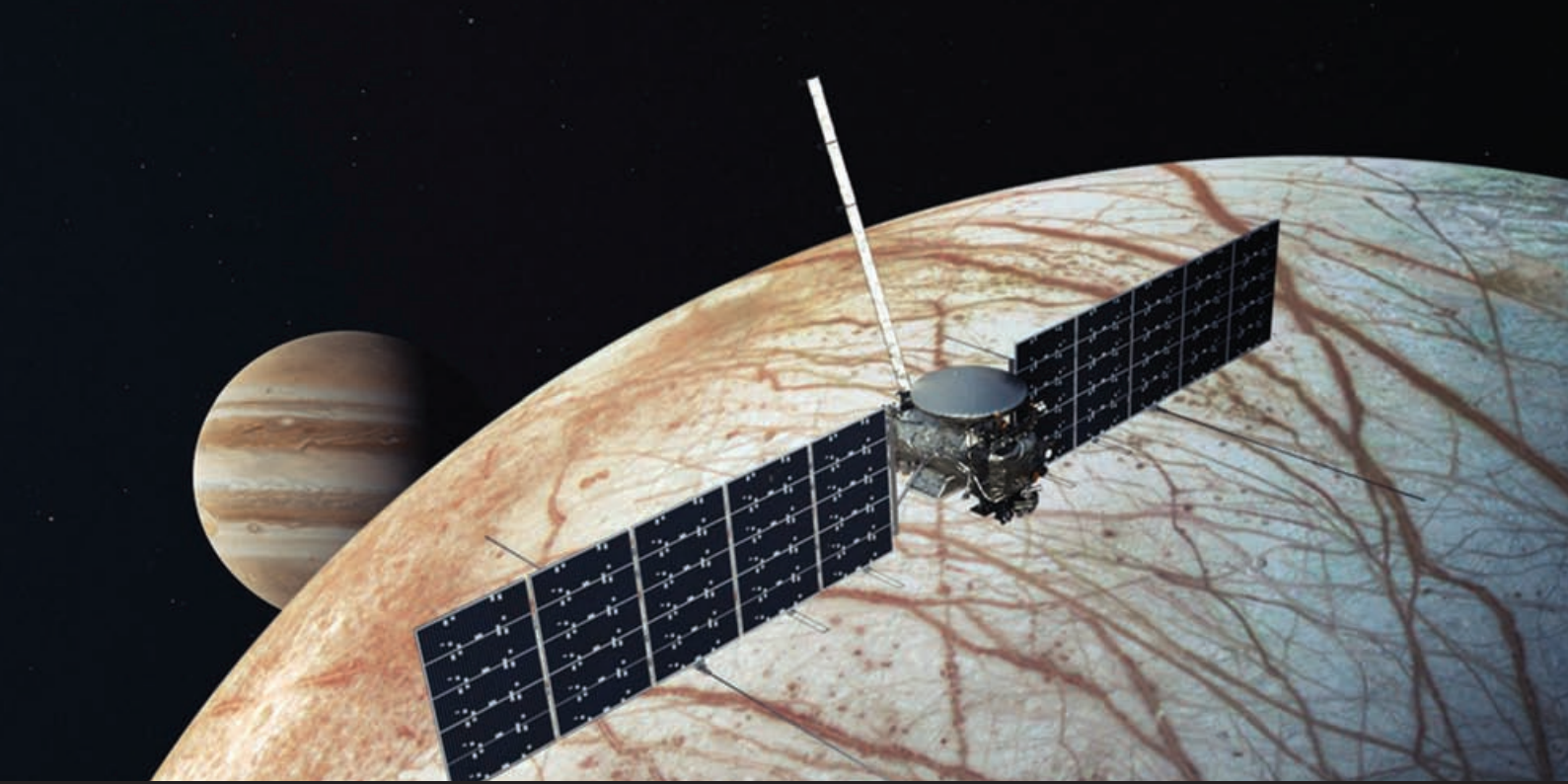
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Artist's rendering of NASA's Europa Clipper spacecraft. Photo courtesy NASA ●●●

## Space agencies galvanize projects to unlock the mysteries of Jupiter's moons ●●

Beyond the expected fascination with the Moon and Mars, Earth's nearest gas giant, Jupiter, encapsulates a wealth of promising moons that scientists have long been eager to study, although the incredible distances involved, and challenging environments have made experimentation difficult. With new ESA and NASA technologies and expertise, the secrets of the biggest planet in our solar system could be set to unravel.

*Laurence Russell, Associate Editor, Satellite Evolution Group*

The excitement of the progress of NASA's Artemis program has reignited interest in how the world's leading national space agencies are approaching space exploration in the NewSpace era. For decades, astrophysicists have studied the solar system with scientific spacecraft, but with Artemis marking another key milestone, space science has turned a corner.

ESA is planning a new leap forward in the Jovian System (the system of Jupiter's moons and their surrounding cosmic environment) with their JUICE (Jupiter Icy Moons Explorer) mission, which intends to survey the Galilean moons: Io, Europa, Ganymede, and Callisto. The mission is expected to launch in April 2023 and arrive eight years later in 2031.

The work will be complemented by NASA's follow-up,

the Europa Clipper mission, which will pay special attention to Europa in a series of flybys. This mission plans to launch in 2024 and arrive in 2030. The two missions' objectives will then coincide.

### THE WORLDS OF JUPITER

To hear about the opportunities of the Jovian System, we went to the experts at ESA and NASA. Dr Curt Niebur, NASA Lead Scientist for Flight Programs tells us "NASA's primary goal is to assess the habitability of Europa. We have evidence to suggest that Europa possesses some of the four ingredients to life; liquid water, energy sources, the right chemicals to support the development of nutrient matter, and a stable environment. We simply don't know for certain whether Europa has any of these until we find out for ourselves."

With some of the ingredients for life present out in space, the incredible work of space colonization can become a little easier, as we begin to answer vital questions about food, power, and shelter on alien surfaces. "We're going to find out if Europa's habitable today, not billions of years ago," Dr Niebur clarifies.

His rhetoric is likely informed by the mounting interest in establishing the foundations of space industries over the course of the 21<sup>st</sup> century, which has long fascinated the tech startup sector and brought no end of excitement to investors.

Human survival in space will be one of the most challenging scientific hurdles that our species faces, with myriad issues to consider. At present, even the technical challenge of keeping high-spec autonomous machines



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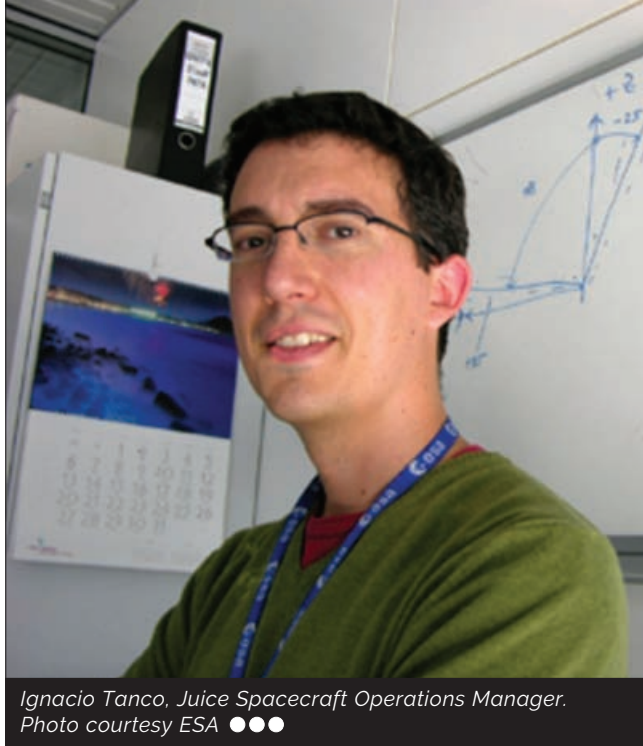
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Ignacio Tanco, Juice Spacecraft Operations Manager.  
Photo courtesy ESA ●●●

safe in the cosmos of Jupiter is one that has taken years of work to facilitate.

#### HAZARDS OF THE JOVIAN SYSTEM

Dr. Niebur explains, "The Jupiter system is darker and colder than most of us can imagine. Both Jupiter-bound spacecraft are solar-powered, but sunlight is only 1/25th as intense out there as it is around the Earth, so the solar arrays must be large and very efficient. Arrays that large and complex are difficult to deploy and make piloting the spacecraft more cumbersome."

Ignacio Tanco, ESA JUICE Spacecraft Operations Manager agrees. "In order to power the spacecraft with one-kilowatt peak power, we need just over 85 square metres of solar panels, which is massive," he notes. "These panels must be as light as possible to be mass-efficient, meaning they can be quite flimsy if strained. JUICE needs to make two orbit insertions during its mission, making it the first spacecraft to do so around Jupiter."

But limited light for power is the least of their worries. Jupiter is a highly radioactive planet. Specialized shielding beyond the measures taken to mitigate ambient solar radiation found outside of the Earth's atmosphere is required.

"For the spacecraft to survive the mission," Mr. Tanco explains, "we have had to engineer lead shielded vaults for the craft's sensitive electronics, especially for the environment around Europa."

"Clipper gets much closer to Jupiter than JUICE," Dr. Niebur adds. "At Europa, the radiation is very severe, which has led to an extensive course of testing and development on radiation-hardened components in our vaults."

"We've mitigated the risks we can prepare for to all extents possible," Mr. Tanco concludes. "But in the highly unpredictable environment of space, we'll just have to cross our fingers and see how our precautions face up to the Jovian frontier."

#### THE FUTURE OF THE SPACE INDUSTRY

Space is becoming an increasingly commercial frontier as industrialists and financiers continue to see opportunity. As such, the role of national space agencies and the

scientific missions with which they've become associated has been increasingly connected with the aims of private industry.

"Every one of our missions has parts or subsystems or entire spacecraft built by commercial entities," Dr. Niebur says. "NASA excels at creating a single team with a diverse set of team members to accomplish the impossible."

"The arrangement in JUICE, and the wider tradition across ESA and NASA projects," Mr. Tanco corroborates, "is that the developer (in JUICE's case, Airbus) has the contract to develop the platform, and ESA prioritizes the project's scientific instrumentation, before executing the mission with their expertise. ESA has a long tradition of collaborating with commercial developers. In fact, we often see our work as complementary to them."

These arrangements have resulted in manufacturing expertise becoming concentrated with commercial developers. "Airbus has extensive experience in developing scientific platforms across similar arrangements on previous missions such as GAIA, the solar orbiter, and Rosetta—all of them very successful missions," notes Mr. Tanco.

Developments like this have sometimes spawned anxieties regarding an over-commercialization of space. For example, the heavy costs involved in mitigating the space debris problem and the climate crisis are daunting for a profit-motivated economy to address, but Mr. Tanco sees the conversation differently. "I don't view space as some pristine, abstract world that cannot be commercialized," he says. "I am convinced that our future in space must be commercial because that's the material motivator that will empower our progress."



Dr Curt Niebur at a NASA press conference. Photo courtesy NASA ●●●



"The debris crisis is a true issue that requires concerted attention and swift address, but I view it as more than a challenge. It's a milestone of our achievement," he continues. "Every field of human progress creates similar consequences, which we can count as by-products of the scale of their accomplishment. There are necessary steps in these cases to stabilize our success with rational, long-term thinking, which is just as much proof of our success as a species as our scientific accomplishments themselves."

"I am a firm believer that there is a role for state regulation in this space. Even in Europe, we should have

stronger regulations for mitigating the creation of debris, and the capture of existing debris, and we should better support the development of the technologies that address this. But I don't think over-commercialization is to blame for this, nor does it frustrate our capacity to find solutions."

Of course, we see economic challenges beyond debris on Earth and in the stars beyond, but Mr. Tanco's forward-looking logic applies just as soundly to them. As the NewSpace economy grows, mankind's capacity to balance ambition with wisdom will be once again tested, but it's one we've never been better prepared for. ●



Artist's rendering of ESA's Jupiter Icy Moons Explorer (JUICE). Photo courtesy ESA ●●●



● ● Sethu Saveda Suvanam, Founder & CEO of ReOrbit

Satellite Evolution Global

Q&A

## What ReOrbit says we can do today to make our satellites reusable ● ●

A particularly onerous complaint of the new era of LEO satellite networks across industry debates has been their longevity. As developers struggle to find the lowest possible cost for their platforms, quality, flexibility, and longevity are all sacrificed. With an effective servicing market still far on the horizon, measures must be taken as soon as possible to make space industries as reusable as possible. Sethu Saveda Suvanam, Founder & CEO of ReOrbit offers his plan for what can be done today.

*Laurence Russell, Associate Editor, Satellite Evolution Group*

**Question: ReOrbit specializes in reusing space technology to disrupt the market of single-use small satellite platforms. What are the economic benefits of reusable, modular satellites?**

**Sethu Saveda Suvanam:** A lot of the satellites built in the last 3-4 years have been designed cheaply with singular functions. The moment those kinds of platforms break, be it a small radio, or a part of a single processor, the entire unit becomes tantamount to scrap, because it can't do that one job properly anymore.

Back on Earth, computers aren't all that different from satellites compositionally. When something breaks, you have a wealth of options to diagnose it, do repairs, offload data, and even upgrade it. These options have made these devices some of the most valuable examples of consumer electronics in existence, and the design ideology behind their flexibility is absolutely something we can extend to satellites.

If we could ensure satellites could at least connect to one another to exchange data, with some degree of autonomy, you would solve a big persistent problem and open up a big new market. We estimate that around 30-40 percent of derelict craft are partially functional, sometimes a hair away from full functionality, which is a massive error in efficiency. By addressing this, you'd be multiplying the productivity of satellites without having to build anything new or establishing any new orbits.

**Question: In the face of an increasingly congested orbital environment, what will it take to keep orbits orderly and effective?**

**Sethu Saveda Suvanam:** Of course, there needs to be strong global regulation and standardization around how these things work. We can't force the world to adopt NASA or ESA standards, but we need to agree on a fair playing field in this highly global environment and commit to it. It'll save us all time and energy later.

Today, it's very challenging to enforce any existing piece of regulation or make a company play fair if there's no monetary incentive. If we can devise positive directions for the economy to follow and prove its profitability and longevity, we'll have a solution that everyone can agree on. Ultimately, sustainability is profitability.



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**Question: How do you see GEO satellites contending with the market disruption of LEO?**

**Sethu Saveda Suvanam:** This is a kind of paradox. Everyone talks about LEO being a big disruptor, especially in communications, where the critical competition gap rears its head. But, if you look at the numbers, every player going into LEO is launching progressively higher and higher, with OneWeb now targeting MEO ranges for their next generation of platforms, and all sorts of hybrid LEO satellites that interface with higher orbits.

The truth is these dramatic arguments about LEO being a perfect solution were exaggerated. Beyond the hype, the costs of building thousands of satellites for LEO aren't going to pay off as wildly as spokespeople have inferred. The real market is flexible with how it observes these orbits.

**Question: How do you anticipate societal demand for connectivity evolving, and how can orbital capacity prepare for that?**

**Sethu Saveda Suvanam:** We're far more connected now than we were ten years ago, and ten years from now we'll be even more connected. The first generation of this newfound connectivity has come from mobile networks. I

would see the next generation supported by non-terrestrial networks where space plays a vital role.

There's certainly an increasing use here, and the key parameter that will grow it further will come from bringing the dollar per gigabit as low as possible. In the terrestrial world, reusability and renovation have saved a lot of money which has brought costs down and created a highly competitive market offering, alongside good protocols, and standards. If those methodologies could come to our orbits, we'll see non-terrestrial's competitiveness evolve.

It's all about how smartly you use – and reuse these technologies, which is what ReOrbit is championing and working hard to bring to more people. Why reinvent when you can just reuse?

**Question: What's the future of satellite reliability? How do we make orbits safe from debris, and is the orbital servicing market a path to perpetual satellite service?**

**Sethu Saveda Suvanam:** We can't just launch for the sake of launching. Starlink is planning to launch thousands of new devices to replace their constantly breaking machinery and keep up with rapidly increasing demand by flooding the market with quantity over quality. It's not a very future-minded strategy. Besides new technologies and innovations, we have to address raw reusability to unlock the real results of our satellite networks.



*Gluon Satellite Bus, a software-defined platform optimized for communication payloads in MEO and GEO. Photo courtesy ReOrbit ●●●*



Today, satellite servicing isn't economically viable, because of all the steps that need to occur in order for successful refurbishment to occur. In economic terms, it's just cheaper to launch a new one, and I imagine that'll remain the case for many years as the servicing market finds its feet. I assume that'll start maturing in the next 15 years or so.

The good news is that we can do things today to connect satellites to exchange data in the case of redundancies. It's just common sense.

**Question: As software-defined satellites become increasingly popular, how do you see that trend developing?**

**Sethu Saveda Suvanam:** Today, the term software-defined satellite has been very much abused. You hear it absolutely everywhere to the point that the definition has become nebulous. To me, a software-defined satellite is one that can be sold with almost zero non-reoccurring costs and is able to accommodate all kinds of systems and business cases.

The irony is that every satellite player that's been working toward this goal can't simply plug and play on top of your software architectures. We see added costs and complications everywhere. The industry will grow and evolve of course, and hopefully, over that time we'll see true software-defined satellites rolling out.

**Question: What can we expect from ReOrbit in the next five years?**

**Sethu Saveda Suvanam:** ReOrbit's ultimate aim is to build the quintessential satellite operating system. The same situation you see with computers and phones today, where



*Small SatCom: a flexible and cost-efficient SatCom solution. Photo courtesy ReOrbit ●●●*

Windows, Linux, Android, and IOS can all install and run on diverse hardware. This would be a fully flexible system with all imaginable applications, unburdened by any proprietary complications in its hardware.

In the current economy, the moment the hardware changes – as it often does in this rapidly evolving space, you then need to rebuild the software from scratch. That's simply not intuitive, and the faster we can grow beyond that annoying contrivance the better.

The area that we're hoping to enter, and capture is beyond LEO, which we see as quite crowded, focusing instead on primarily GEO satcoms and data-related applications. Five years from now, we intend to be the established go-to player for software operating systems for space. ●

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## Making space accessible to everyone

It is difficult to imagine an environment more foreboding or forbidding to human life than space. It lacks oxygen, has an average temperature of negative 455 degrees Fahrenheit, and is pulsing with radiation that experts warn can cause cancer and other degenerative diseases. In short, space is not a place where any human should feel comfortable. Yet, despite all the arguments for avoiding space, we continue to explore it. Those at the forefront of the most recent wave of exploration are a new breed of private companies referred to collectively as NewSpace. Their vision is to make space accessible to everyone.

*Tim Chrisman, Founder and Executive Director of Foundation for the Future*

Historically, space travel has been accessible to an elite few. There have been approximately 600 astronauts since Yuri Gagarin became the first person to orbit the earth in 1961, the vast majority of whom qualified for space flight by completing years of rigorous



*Tim Chrisman, Founder and Executive Director of Foundation for the Future* ●●●

educational and physical training. And for every applicant who was selected to be an astronaut, more than 1,000 others were rejected.

In the early 2000s, space tourism became a reality, allowing anyone to travel to space without meeting the qualifications imposed by state-run programs like NASA. Starting in 2001, a company called Space Adventures brokered trips on Russian Soyuz rockets to the International Space Station and back. Between 2001 and 2009, seven wealthy tourists bought tickets from Space Adventures.

During the past two years, space tourism has taken a big step forward. A number of private companies, including Blue Origin, SpaceX, and Virgin Galactic, have made headlines for hosting the type of space flights that only state-run agencies had accomplished in the past. In 2021, Blue Origin launched missions that carried 14 people to space, twice as many as those traveling with Space Adventures in the first decade of space tourism.

### SPACE TRAVEL

There are two key changes that should be noted in the recent commercialization of space travel. First, the ticket price for space tourism has come down. When Dennis Tito became the first space tourist in April 2001, he reportedly paid \$20 million for his ticket. The price tag for a suborbital trip on a Virgin Galactic today is \$450,000.

The second change to note is that buying a ticket from Blue Origin, SpaceX, or Virgin Galactic lands one a seat on a spacecraft that those companies have developed, built, and are operating. Private companies engaged in space tourism now are developing the technology, not simply acting as space travel agents. They have a vision that goes beyond tourism to encompass exploration and — in some cases — migration.

Visit the SpaceX website and you will find information about their vision for "returning humans to our lunar neighbor" and "making humanity multi-planetary" by going to Mars and beyond. Visit the Blue Origin website and you



*Night lights of the United States. Photo courtesy NASA* ●●●



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Spacecraft looms high above Earth. Photo courtesy of NASA ●●●

will find information on their vision of “millions of people living and working in space for the benefit of Earth.”

These changes signal not only increased accessibility but also a dramatic shift that indicates the future of space access can be driven in large part by private companies.

#### CREATING AN INFRASTRUCTURE TO SUPPORT MIGRATION

The technology that is empowering a new age of space tourism could be the same technology that is used to launch an era of space migration. At this point, the missing component is the infrastructure that would support those living off planet.

On Earth, we rely on agriculture, industry, communication, and transportation. To succeed in space, we will need the same infrastructure. The task may seem daunting, but I believe there are two factors at work that can contribute to success. The first is our proven record of overcoming hostile environments. Human history is full of success stories that show how creativity and courage were leveraged to conquer new frontiers.

The second factor is the trend toward commercialization in the space economy. When you look at the industrial revolution as a model, you see commercial interests driving the development of infrastructures such as roads, railroads, and canals. The same model needs to be applied to the development of the infrastructure that will support space migration.

Commercial gain will drive the innovations that will allow for space migration. It will also allow for developments to gain and maintain momentum. State-run programs such as NASA and others made considerable strides but eventually lost their funding as other more pressing national needs arose. A more sustainable and cost-effective way to push the limits in space is necessary. Unlocking long-term private capital is the solution to financing the infrastructure.

#### USING SPACE TRAVEL TO IGNITE THE JOB MARKET

Ultimately, advancing the space economy will require developing the infrastructure to enable it, the investment tools to finance it, and the workforce to empower it. In the same way that the industrial revolution required a new workforce to establish and maintain its infrastructure, gearing up for space migration will present the same type of opportunities for workers.

The work that must be done to solidify the market for those workers would benefit greatly from the establishment of a public-private sector federally chartered corporation for space infrastructure and enhancement of space-related projects. One of our initiatives at Foundation for the Future involves the promotion of a bill known as the Space Public-Private Advanced Commercialization Enterprise (SPACE) Corporation Act that proposes such an entity.

The bill, which sought early support in the halls of Congress in 2021, seeks to provide an avenue for commercial space investment, financing, and project development that does not currently exist. As interest in space travel and related industries continues to grow, the space economy needs a backbone to support the excitement and deliver on the increasing expectations. The SPACE Corporation Act would accomplish that by establishing a program for creating more than 2.6 million new jobs, generating nearly \$160 billion in new economic activity, and increasing state and local tax revenue by more than \$10 billion, all in its first decade.

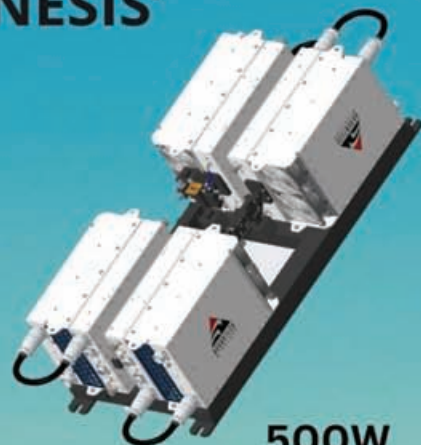
The foundation for space travel is already in place. The next step is opening the door to a vibrant space economy that will empower people to live and thrive in space. The more mainstream the idea becomes, the more momentum there will be to fuel it. The sooner it can be seen as not only possible but also essential, the sooner space will be accessible to everyone. ●





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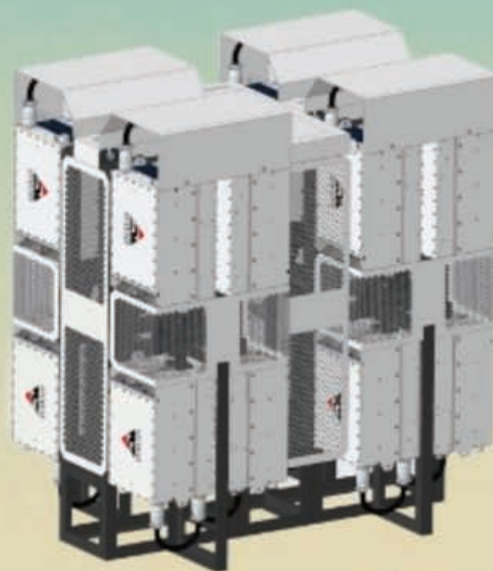
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## The critical role of environmental assessments in the licensing of UK space flight activities ●●

The accelerated growth of the space sector in the UK demands an ever greater need to assess and quantify the impacts of this new and burgeoning industry, particularly when it comes to the safety and environmental consequences of such operations. In this article Ruth Fain, from leading environmental consultancy ITPEnergised, shares her experience preparing assessments of environmental effects (AEEs).

*Ruth Fain, Environmental Consultant, ITPEnergised*

**T**he UK is seeing a step change in space sector activity and capability, with both horizontal and vertical satellite launches from British soil scheduled within months. Aiming to become an international hub for commercial spaceflight and related technologies, and with one eye on the fact that only 10 countries currently have their own launch capabilities, the UK government is committed to building one of the most innovative and attractive space economies in the world, supporting the growth of a robust and competitive commercial space sector.

The Space Industry Act 2018, along with the associated Space Industry Regulations 2021, provide the legal framework for the licensing of space, sub-orbital and associated terrestrial activities and sets out the requirements of the regulator, the Civil Aviation Authority (CAA). Any organization looking to operate a spaceport or launch vehicles from the UK is required to apply for the relevant license, which includes undertaking an assessment of environmental effects (AEE). AEEs must

consider the effects of space operations on population and human health, biodiversity, air quality, water, noise and vibration, the marine environment, climate, land, soils and peat, landscape, and visual impact as well as material assets (cultural heritage). With the regulations only just a year old, the first AEEs are only now being considered for approval by the CAA.

Ruth Fain and her team have submitted two AEEs to date; one for the SaxaVord Spaceport in Shetland, and the other for Skyrora Limited, a launch operator looking to launch the Skyrora XL launch vehicle in 2023. ITPEnergised is also assisting several other launch operators with the preparation of their AEEs.

### WHAT THE APPROVAL PROCESS FOR AN AEE INVOLVES

AEE is just one facet of the license application for a spaceport or space launch operation. However, due to the nature of the assessment, it can become a consuming factor in terms of both time and resources. Though the process may feel familiar given similarities to the environmental impact assessment process required under UK planning regulations, there are key differences in





Ruth Fain, Environmental Consultant,  
ITPEnergised ●●●

geographical and temporal scope as well as the assessment methods needed. There is also a unique interplay between the spaceport and the launch operators which requires focus and cooperation.

The AEE process is split into four main stages – preparation and content of the AEE, conducting of the AEE, regulator review (and licensing), and post-license continuous review. The regulator review stage is also split into stages with Block A comprising the initial screening and feedback and Block B comprising full assessment and public consultation prior to the determination of whether a license can be issued.

The CAA has now issued guidance for AEE and in July 2022 followed this up with additional notes on Block A expectations. As we progress through the license application process working with both operators and the CAA it is clear that the UK, through the CAA, is setting and maintaining a high bar for environmental protection.

#### KEY CONSIDERATIONS FOR AEEs

Understanding and making clear the geographical and temporal scope of proposed space operations is paramount to a successful AEE. The environmental zone of Influence will likely differ over the environmental topics considered. What it means in terms of receptor experience is key. Equally important is understanding how effects vary with time. Whilst a single launch is a discrete and short-lived event, cumulative effects through time must be considered and reported to ensure the environment and identified human and ecological receptors are protected.

The physical mechanics of a rocket launch also adds a level of complexity to both air quality and noise modeling. Depending on the location and trajectory of the launch there may be a need for additional modeling to appraise the effects of sonic booms and marine chemistry interactions. With no previous assessments to work from, ITP Energised has developed a team of specialists using partners from across the UK and USA to identify and apply best practices to the process throughout.

As with any novel industry, the lack of UK datasets to support AEE also poses a constraint. For the SaxaVord Spaceport AEE, it was necessary to draw on surveys and datasets from other countries—particularly regarding noise and ecological effects—and to undertake the assessment using a precautionary approach where data was scarce. Even though no significant effects are predicted within the AEE, SaxaVord is looking to undertake noise and ecological monitoring during a range of launches involving launch vehicles of different sizes and scales, to develop a working database in which they, the regulator, and other interested parties may interrogate in the future.

Finally, the consideration of effects along the path of the launch trajectory is another potentially complex area of assessment. Not only do the physical, chemical, and biological interactions of return to earth debris need to be identified and assessed, but also the socio-economic and geo-political factors of launching through multiple marine and airspace zones.

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SaxaVord Spaceport in Shetland. Photo courtesy SaxaVord ●●●

#### THE INTER-RELATIONSHIP AND DIFFERENCES BETWEEN AEEs FOR SPACEPORTS AND LAUNCH OPERATORS

There is an obvious and highly necessary inter-relationship between the AEE for a spaceport and all associated AEEs for launch operators based at the same location. In cases where a spaceport has only one launch operator engaged, such as Spaceport Cornwall and Virgin Orbit, the AEEs can mirror one another exactly in terms of launch number and launch vehicle specifics. As a result, it may be possible to develop a joint AEE. However, this is not possible when the spaceport is looking to develop as a multi-operator launch as there will be multiple AEEs for launch operators covering a range of different launch vehicles and operating situations.

In this case, the two AEEs may develop in parallel dependent on timing but will always be separate documents. Depending on the business case for each operation, and the progress along research and development pathways, critical elements of interplaying data may be missing at the time of AEE preparation.

Whilst under the regulations it is possible to apply for a spaceport license without knowing the full details of launch vehicles, the CAA guidance states that, "the applicant must [determine and] base their AEE on a reasonable worst-case scenario, based on the representative launch vehicle(s) they are aiming to attract." This requires a detailed analysis of the likely scale, fuel type, and physical formats of the proposed (or envisaged) launch vehicles and their anticipated trajectories, as well as the maximum number of launches to take place over one year. Even then, the CAA notes that should the anticipated launch vehicles

change before the license is granted, a revised AEE may be required.

This level of complexity requires close collaboration with partners that may or may not yet have signed contracts from the outset of the spaceport AEE process. As a result of their early engagement, the spaceport may then allow the launch operator to access the original assessments thus reducing duplication of effort and enabling refinement and focus of the existing assessments to meet the exact specification and flight path of the specific launch vehicles being assessed.

Inter-reliance and cooperation between the spaceport and launch operator are exactly in line with the ethos of the regulations which aim for all parties to work collectively towards the safest and most environmentally secure operation.

At such an early stage in the development and determination of AEEs, transparency of approach and seeking insight and guidance from the CAA has been a huge benefit. As the AEEs submitted to date progress and feedback from the regulator and the public is received, we continue to work with the spaceports and launch operators to refine our assessments and ensure the efficiency of the process for future applicants.

It is clear that, with UK sights set on being the pre-eminent European location for satellite launches, the CAA as regulator is demanding thorough and robust environmental assessment and development of steadfast, practicable management plans to ensure that the UK can become a beacon for sub-orbital and orbital launches in this decade and beyond. ●





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● ● Dr. Kevin Petty, Vice President of Weather and Earth Intelligence, Spire Global Inc

Satellite Evolution Global

Q&A

## Spire tells Congress they're ready to collaborate with competitors and academia to protect America from ecological catastrophe ● ●

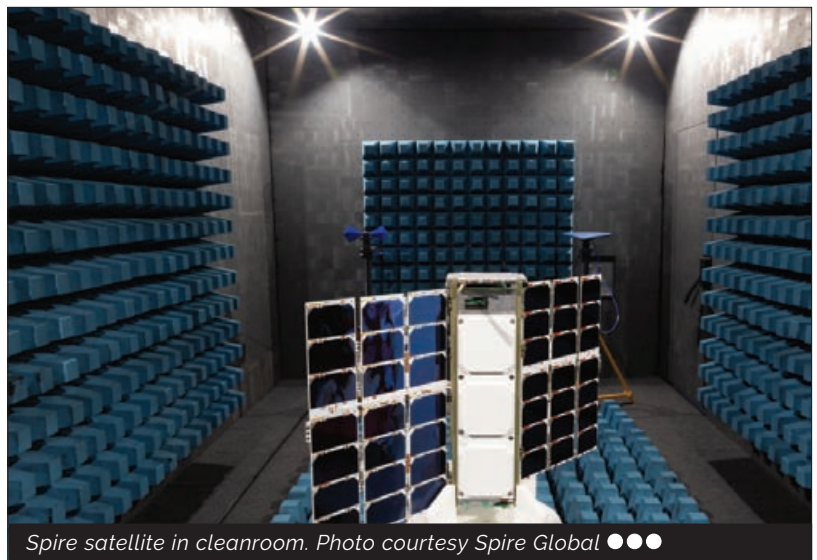
In mid-2022, Spire Global was called to Congress along with other academic and corporate representatives to discuss the state of weather prediction technology, and the private sector and academic power available for the United States Government to galvanize. Dr. Kevin Petty, Vice President of Weather and Earth Intelligence, Spire Global Inc, discussed the proceedings with us, and what they mean for the future of atmospheric sensing in a world facing ecological calamity.

*Laurence Russell, Associate Editor, Satellite Evolution Group*

**Question:** In June, you testified at a hearing in congress discussing priorities for weather R&D over the next decade. What does Spire see as the best-case outcome of public forums with policymakers like this?

**Kevin Petty:** Public forums, such as the hearing, are a great way to showcase how the private, public, and academic sectors can work together to better predict and understand weather events.

The best-case outcome of these public forums, for Spire and the industry at large, is for policymakers to remain invested in learning more about the weather enterprise and creating opportunities to work with all



Spire satellite in cleanroom. Photo courtesy Spire Global ● ● ●





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sectors towards the shared goals of improving weather and climate research and forecasting for increased safety, economic security, and operational efficiency.

**Question: With both acute weather disasters like hurricanes and obtuse ones like long-term water shortages becoming far more common, accurate weather tracking has never been more important. Do you feel policymakers understand the extent of this accelerating problem, and are serious about addressing it before the situation becomes critical?**

**Kevin Petty:** The problems that the weather enterprise is equipped to address are front of mind for many policymakers — for example, hurricane prediction for Congresswoman Sherrill's constituents in New Jersey and tornado tracking for Congressman Lucas's constituents in Oklahoma. Government leaders engaging in discussions with the academic community and private sector is a positive step towards ensuring they are prepared with the latest technology and innovations to address the effects of extreme weather events and long-term climate trends.

Remote sensing techniques, such as Spire's satellite constellation that collects global weather data, will be a cornerstone to researching extreme weather and climate change and developing solutions to mitigate their effects. Coupled with conventional, ground-based observing systems, advanced computational platforms, improved numerical models, and the integration of the social sciences, we will see significant advancements in the coming years.

If policymakers are serious about addressing these issues, they must continue the conversation in Washington, D.C. and across all sectors to best prepare and protect their home states.

**Question: Congresswoman Stephanie Bice (and others) suggested that increased communication is needed between public and private spheres to solve this problem, with an interest in collaboration over competition. Do you agree with that strategy?**

**Kevin Petty:** A collaborative approach, such as that sparked by the 2017 Weather Research and Forecasting Innovation Act, aids in stimulating innovative solutions, reducing risks, and meeting end users' needs. The National Oceanic and Atmospheric Administration (NOAA) has identified many priorities for research and development, and it will be difficult to make material investments in all of them. Where it makes sense, NOAA should partner with the academic and private sectors to make use of the competencies and resources that already exist.

As the private sector has grown, so has its ability to carry out rigorous high-quality research and development. For example, Spire made significant investments that led to the successful deployment of the world's largest multipurpose satellite constellation with over 100 satellites operational in orbit today. This constellation delivers a rich and unique set of data about the atmosphere and the Earth.

NOAA is and will remain a cornerstone of the weather enterprise. It serves as a catalyst in driving research and forecast investments to mitigate the impacts of weather,

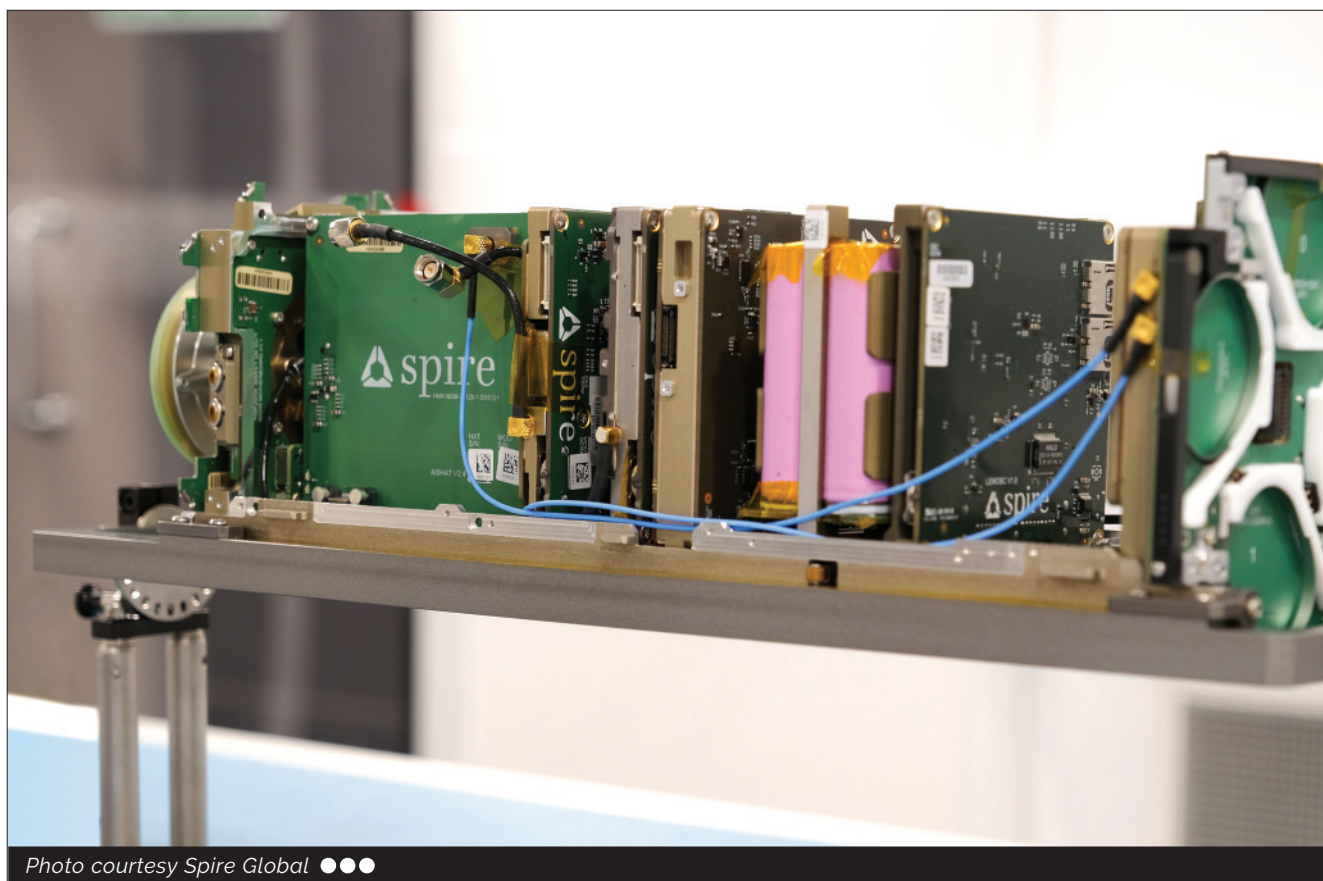


Photo courtesy Spire Global ●●●





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water, and climate extremes. However, NOAA's investments must be strategic—mainly from the perspective of ensuring that our nation is a global leader in weather prediction.

Fundamentally, forecast accuracy and reliability drive the effectiveness of downstream weather products, services, and solutions, including many offerings in the private sector. Therefore, NOAA should formulate an R&D investment strategy that carefully considers and accounts for the investments being made by others in the weather enterprise.

**Question: Prompted by Congressman Lucas, you highlighted a recommendation to strengthen observation of the boundary layer, which you understand to be a missing link in the existing weather prediction ecosystem. Could you expand on that?**

**Kevin Petty:** The boundary layer is the lowest part of the atmosphere that is influenced by the Earth's surface through processes such as moisture and heat exchange between the atmosphere/surface interface. Such processes have a significant impact on weather and understanding and predicting the physical processes in this portion of the atmosphere is central to improving weather forecasting.

Note that the depth of the boundary layer can vary from tens of meters to multiple kilometers, depending on the location. Researchers and operational meteorologists have traditionally relied on ground-based observing systems to sample the boundary layer; however, these systems are

limited in terms of the spatial coverage (horizontal and vertical) they can provide.

To address this gap, there needs to be additional investment that would facilitate the deployment and operation of supplemental ground-based observing systems, airborne observing platforms, and space-based sensors capable of delivering enhanced spatial and temporal coverage throughout the boundary layer.

**Question: Agriculture and renewable energy generators both stand to benefit from more accurate weather predictions. What kind of results can these sectors expect in a world where Spire and NOAA achieve their goals?**

**Kevin Petty:** If Spire and NOAA achieved their objectives, sectors like agriculture and renewable energy generators can expect increased efficiency, reduced operational costs, and less disruption to the regular course of business.

With the ultimate vantage point of space, Spire is able to collect global weather data, reaching remote areas that have traditionally been difficult to gain insight into using terrestrial or ground-based weather instruments.

While we can't alter the weather, we can make sure that commercial organizations have the data and insights needed to best prepare for and mitigate the impacts of extreme weather events on their business. For example, better weather forecasts can help agriculturists boost crop yields and make important cost-saving decisions, such as protecting crops from frost when temperatures are expected to drop.

**Question: What are the advantages and disadvantages of utilizing private R&D power over those of national institutions? How do these sourcing decisions affect the taxpayer?**

**Kevin Petty:** I don't believe it is an either-or scenario. Instead of attempting to invest in each of its many priority areas for R&D, NOAA should develop and invest in strategic partnerships with the private sector to utilize and build upon the research that's already been completed. Due to market demands, private sector companies have incorporated agile and lean strategies and practices to foster faster, flexible, iterative, efficient R&D environments, with a focus on end-user value.

Some companies in the weather enterprise have extensive expertise in specific parts of the value chain (e.g., observations, computing, and information delivery and translation).

Accordingly, the private sector is well-positioned to contribute to improvements spanning research to operations, including support of NOAA's mission. This has been demonstrated by multiple private sector companies including Spire, Vaisala, IBM, Amazon, Ball, Campbell Scientific, and Advanced Environmental Monitoring, to name just a few.

In the case of Spire, significant company R&D investments were made, which led to the successful development and deployment of our Low Earth Orbiting (LEO) satellite constellation. In addition, these investments included signal processing research, which has advanced Spire's understanding as it relates to measuring and deriving Earth observations from space.

Ultimately, Spire has been able to operationalize the collection of reliable, high-quality GNSS-Radio Occultation

(GNSS-RO) and GNSS-Reflectometry (GNSS-R) data to support its customers across all sectors. In fact, Spire is proud to be a Weather-Ready Nation (WRN) Ambassador and honored to be a supplier of GNSS-RO data to NOAA through the Commercial Data Program (CDP). This would not have been possible without Spire's investment in science and technology research, which is at the core of the company's success.

**Question: Following the hearing, how will Spire move forward over the next decade?**

**Kevin Petty:** It's an exciting time in history to be an atmospheric scientist and to be at a company like Spire, which is harnessing space technology to power global weather forecasts for the world's key industries. Spire is uniquely positioned to empower governments and organizations worldwide with space-based, AI-powered weather insights to strengthen global weather awareness, and in turn, optimize costs, increase safety, and boost decarbonization.

Over the next decade, we will continue to build out the capabilities of our fully deployed satellite constellation to gather new weather and atmospheric data. For example, we recently announced our plan to launch satellites carrying hyperspectral microwave sounders to gather atmospheric moisture and temperature measurements, which will further enhance the value and accuracy of our global weather forecasts when coupled with the weather data we currently collect.

Spire will also work to foster public-private-academic partnerships aimed at promoting and delivering innovative solutions capable of addressing the growing challenges associated with extreme weather and a changing climate. ●



Spire satellite constellation. Photo courtesy Spire Global ●●●



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## Ken Venner, former SpaceX Executive, joins Sierra Space

Sierra Space, a leading commercial space company at the forefront of creating and building the future of space transportation and infrastructure for low-Earth orbit (LEO) commercialization, has announced former SpaceX executive, Ken Venner, as Senior Vice President (SVP) and Chief Information Officer (CIO).

With nearly 40 years of experience, Venner has been delivering innovative technologies for some of the world's leading companies. He will work at Sierra Space's Louisville, Colo., facilities and report directly to Chief Operating Officer Jeff Babione.

Prior to Sierra Space, Venner was SpaceX's CIO for nearly seven years where he helped transform and grow the organization into a strategic, results-oriented, service delivery engine. Most recently, Venner was President and Chief Product Officer of e-Share, a global external collaboration software company, where he built and operated SAAS solutions to enable simple and secure collaboration in cloud technology.

"Sierra Space is thrilled that Ken is joining the senior leadership team. We are confident that he will play a significant role in helping the company continue to expand and build platforms in space to help benefit life on Earth," said Babione. "Ken is an industry leader with a long and successful background in bringing companies forward into their next stages of growth.

"As Sierra Space continues to rapidly expand, Ken will ensure that our Integrated Digital Environment provides a strong foundation as we seek to identify and seize upon



*Ken Venner, Sierra Space Senior Vice President (SVP) and Chief Information Officer (CIO) ●●●*

opportunities for the further development of space."

"I am honoured to join Sierra Space and take up this new position of Chief Information Officer," added Venner. "Sierra Space stands at the forefront of the emerging space economy and is in the unique position to build a vibrant, growing and accessible commercial space economy through Dream Chaser, Orbital Reef and more. I look forward to helping grow Sierra Space and cement its position as an industry leader in the commercial space economy."

Venner has a Master's degree in Business Administration from New Hampshire College, a Master's degree in Engineering from Carnegie-Mellon University, and a Bachelor's degree in Engineering from Stevens Institute of Technology. ●

## Northrop Grumman elects Roshan Roeder Corporate Vice President and President, Defense Systems; Mary Petryszyn to retire

Northrop Grumman Corporation announced that its board of directors elected Roshan Roeder Corporate Vice President and President, Defense Systems sector, effective October 17, 2022. Roeder will succeed Mary Petryszyn, who has announced her intent to retire effective January 13, 2023.

"Roshan is a seasoned executive with extensive experience leading a broad spectrum of businesses," said Kathy Warden, Chair, Chief Executive Officer and President, Northrop Grumman. "With her leadership, our Defense Systems businesses will continue to thrive as they deliver mission-critical capabilities for our customers."

"On behalf of our company and the board of directors, I want to thank Mary for her contributions over her decade-long career with Northrop Grumman," said Warden. "Mary's unwavering commitment to our people, our customers and our culture is core to who she is and what she stands for."

Petryszyn will continue as Corporate Vice President, reporting to Warden to support this transition until her retirement.

Roeder is currently Vice President and General Manager of the Airborne Multifunction Sensors Division in the Mission Systems sector, which delivers large-scale, mission-critical C4ISR systems and complex hardware and software products for airborne platforms.

In her 20-plus-year career with Northrop Grumman, she has led many different businesses for the company. She holds a bachelor's degree in computer engineering from Virginia Tech. ●



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## Camilla Taylor appointed CFO for Satellite Vu ahead of satellite launch

Satellite Vu, the UK climate tech satellite company aiming to become the world's thermometer from space, has hired industry veteran Camilla Taylor, as Chief Financial Officer (CFO) ahead of their upcoming satellite launch.

Camilla has devoted her career to climate tech and finance, and spent the last decade in CFO roles, most recently as a portfolio CFO. Previously she served as CFO at what3words, where she helped scale the company from 20 people to post Series C, and at electric mobility business Saitta Group PLC, where she led the company through its first funding rounds and a strategic acquisition. She began her career in commercial roles in two climate start-ups, and then joined a specialist climate / clean tech fund as an investor. She graduated with a degree in Biological Sciences from Oxford University, holds a master's in Environmental Economics, and an MBA from Columbia and London Business Schools.

Satellite Vu has seen significant business growth over the past 18 months, raising over £20 million in venture funding led by Seraphim Space Investment Trust, with A/O Proptech and Lockheed Martin Ventures, and grants from the UK Space Agency and European Space Agency.

This has allowed Satellite Vu to commence construction of their first two Mid Wave Infra-Red (MWIR) thermal monitoring satellites with Surrey Satellite Technology Limited (SSTL) ahead of the launch of the first of their planned constellation of eight satellites aboard a SpaceX Falcon-9 rocket in May 2023.

Once in orbit, the satellites will collect high-resolution climate data, in near real time, of the natural and built environment anywhere on the planet, both day and night. This data will enable governments and businesses to identify and monitor infrastructure and buildings that are



Camilla Taylor, CFO, Satellite Vu ●●●

non-compliant with Net Zero targets, and enable prioritized action to be taken with regards to carbon emissions management. The technology will also measure the urban heat island effect, assist with fire spread prediction, monitor water pollution, and hold organizations accountable to their Environmental, Social and Governance (ESG) credentials, ensuring that greenwashing is a thing of the past.

Camilla Taylor, Chief Financial Officer for Satellite Vu said: "Climate change mitigation is the defining issue of our time, and it's never felt as mainstream as it does today. It's a privilege to be joining Anthony, Toby, and the exceptional team at Satellite Vu, and to be working on a project with such great disruptive potential, in a sector that I love."

Anthony Baker, Founder and CEO of Satellite Vu said: "With the launch of our first satellite fast approaching, we are delighted to welcome Camilla to the team at such an exciting stage of our journey. Camilla brings invaluable climate and financial experience with her proven track record of scaling impact-driven companies, and we look forward to working with her to deliver our first of its kind satellite technology."

## NASA announces pending departure of Science Associate Administrator

Dr. Thomas Zurbuchen, Associate Administrator of NASA's Science Mission Directorate, will leave the agency at the end of 2022, after six years of dedicated service.

"NASA explores to better understand our place in the universe, and to use what we learn to support life on Earth. Thomas has made an indelible mark at NASA – indeed, he has held this job continuously longer than any other person – and I am thankful for his dedication to our agency," said NASA Administrator Bill Nelson.

As the head of science, Zurbuchen oversees nearly 100 science missions. He helped select 36 new missions during his tenure, including Dragonfly, SPHEREx, and the Mars Sample Return mission. He has worked tirelessly to ensure NASA's science missions build partnerships across disciplines and with industry and other nations to generate new questions and help advance the frontiers of knowledge and exploration.

Zurbuchen brought a wealth of scientific research, engineering experience, and hands-on knowledge to NASA's world-class team of scientists and engineers. He led the mission directorate during some of the agency's most inspirational moments, such as sending the first spacecraft to touch the Sun, launching and sharing the first images from the James Webb Space Telescope, and landing the Perseverance rover on Mars along with the first powered, controlled flight on another planet with the Ingenuity helicopter, to name a few.





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