Member of the NASDAQ GlobeNewswire Distribution Network
ISSN 2755-1326

SATELLITE EVOLUTION GLOBAL

Front cover photo courtesy Trevor Mahlmann/Rocket Lab

your connection to the industry...

February 2023

Linked in YouTube

Plus:
Green propulsion: The key to space accessibility and sustainability

Rocket Lab: A remarkable trajectory

Q&A Satellogic
- page 12...

Green propulsion
- page 16...

Q&A Slingshot Aerospace
- page 20...

Sign-up for your FREE copy at satellite-evolution.com...

Crispin Littlehales, Executive Editor

Risky business

Henry Ford once said, "The world was built to develop character, and we must learn that the setbacks and grieves which we endure help us in our marching forward." What an apt sentiment to remember as we consider the launch side of our industry. Before any mission can succeed, it must first leave Earth and that, as we all know, is a risky business.

The failure of Virgin Orbit's "Start Me Up" mission, still fresh in our minds, was one of a number of high-profile disappointments in the last 12 months. Blue Origin's New Shepherd suffered a problem with a booster on an all-science mission. Astra lost four tiny cubesats when its upper stage blasted two nose cone halves asunder. The fourth Hyperbola1 self-destructed after an issue with the attitude control system. India's Small Satellite Launch Vehicle could not deliver its two satellite payloads to their intended orbit because of a sensor issue occurring on the final stage of the launch. Skyrora's first attempt never reached its orbital goal and fell into the Norwegian Sea. Japan's Epsilon rocket was terminated when the third stage didn't kick in as planned. Europe's Vega C rocket encountered an anomaly less than three minutes after leaving the launch pad.

The good news is that 2022 saw 178 successful launches. US carriers took first place with 87 orbital launches and China came in second with 64. NASA debuted its Space Launch System for the Artemis program which was created to take humans back to the Moon. Rocket Lab launched the pathfinder to the Moon, CAPSTONE, on the Electron. Space X conducted 60 launches of its Falcon 9 rocket with 58 of those flights accompanied by the return of the first stage. The Atlas V 511 launched for the first time, as did the Angara 1.2 rocket, the Vega-C, CAS Space's ZK 1A, Long March 6A, and Jielong-3.

Giza, Egypt. Photo courtesy Satellogic

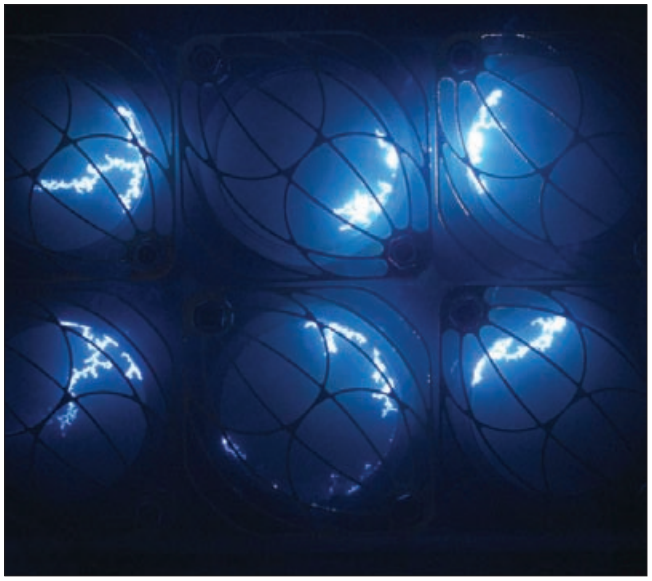
2023 looks to be another exciting year. Viasat's high-capacity GEO satellite, ViaSat-3, is set to launch on a SpaceX Falcon Heavy rocket that will also be deploying Astranis' Arcturus, the first of the company's MicroGEO satellites. Also anticipated to be launched on the Falcon Heavy is Hughes Network Systems' Jupiter3, the world's heaviest GEO satellite. Maxar plans to launch its first two WorldView Legion satellites and Amazon hopes to launch its Project Kuiper prototypes on ULA's first Vulcan Centaur. We have our fingers crossed.

In this issue of Satellite Evolution Global, we sit down with Peter Beck, founder and CEO of Rocket Lab who talks about his favorite missions, his gameplan for keeping investors satisfied, and how seriously he takes every launch. Benchmark's Chris Carella explains where propulsion technologies are headed and how green fuels are key to sustainability. Luisa Buinhas, co-founder of Vyoma, addresses the problem of space debris and how on-demand tracking can help to prevent collisions.

Laurence Russell talks to Erin Defossé, COO of Slingshot Aerospace to delve into the company's rationale for providing free access to its Beacon product for mitigating collisions by coordinating orbital access. He also interviews Caitlin Kontgis, VP of Go-to-Market for Satellogic about monitoring all subnational protected areas of the planet.

Regulars

Features & Market Reports



Executive Q&As

Satellite Evolution Global - February 2023 - Volume 2 No. 1... ISSN: 2755-1326

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
production@dsairpublications.com

OPTIMIZE YOUR SATCOM TERMINAL

C-Band
From 5W
to 800W

X-Band
From 5W
to 400W

Ku-Band
From 4W
to 400W

Ka-Band
From 5W
to 80W

NOT A SIMPLE BUC
CHOOSE INTELLIGENCE
GET AN IBUC

Reliable high-performance Intelligent Block Upconverters backed by test data guaranteed by key performance indicators such as low phase noise, high linearity, & rated output power over temperature.

Explore all **IBUC** models at Terrasatinc.com

IBUC **2**

IBUC **3**

SATELLITE 2023
MARCH 13-16 | WASHINGTON, DC
VISIT TERRASAT AT STAND #1529

TERRASAT
Communications, Inc.
Engineered to Endure

SES, ThinKom and Hughes enable multi-orbit resilient connectivity

SES, ThinKom and Hughes have demonstrated revolutionary high-performance multi-orbit service capable of supporting multiple solutions for government airborne missions. The open architecture ThinKom ThinAir Ka2517 airborne satcom terminal was successfully demonstrated over SES's Medium Earth Orbit (MEO) and Geostationary (GEO) satellite networks during testing at ThinKom's Hawthorne, CA, facilities and on an aircraft in Mojave, CA. To enable roaming across the satellites, the architecture included the Hughes Network Systems software-defined ruggedized HM400 airborne modem. The testing validated the formal release of the latest ThinAir Ka2517 software, interfacing with the Hughes HM400 modem for MEO and GEO operations.

The latest generation Ka2517 antenna is designed for full commercial Ka-band and mil-Ka band satellites operating over 17.7 – 21.2 GHz (forward link) and 27.5 - 31 GHz (return link), providing governments and the military with broad airborne communications capabilities.

The Ka2517 is based on ThinKom's field-proven patented VICTS (Variable Inclination Continuous Transverse Stub) phased-array technology, that has proven its unparalleled spectral efficiency and reliability with installations on over 1,600 commercial aircraft or more than 33 million operating hours, over eight years of service. The Ka2517 is operational on SES's GEO satellite services and the innovative high-throughput SES-17 satellite. The antennas have also been providing continuous service on US Government aircraft for five years, and boast a very low profile, minimizing drag and increasing time on station.

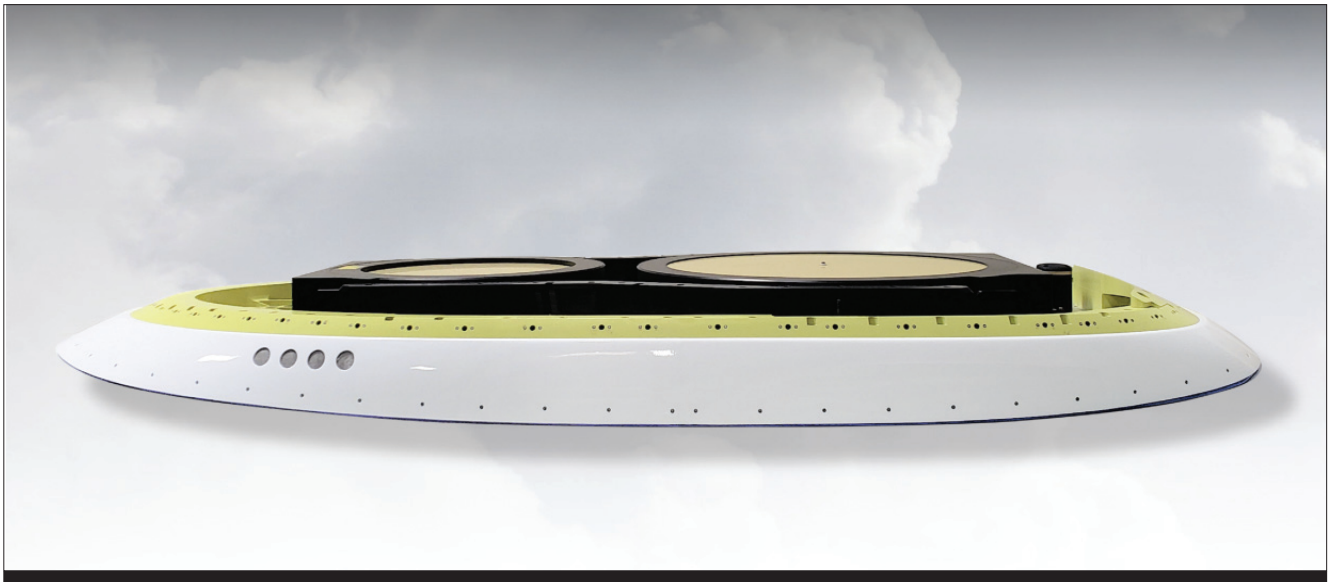
The new demonstrated MEO and GEO capability enables industry-leading performance and multi-orbit resiliency for critical mission success, especially in contested environments.

"As the industry shifts towards a multi-orbit model to boost performance and resiliency, ThinKom is leading the way with a flexible open architecture platform to support connectivity from every orbit to every mission," said Bill Milroy, ThinKom's co-founder and Chief Technical Officer. "We are proud to be flying in continuous service on US Government aircraft since 2018 and look forward to extending that partnership with the next generation of ThinAir solutions."

"The demonstrated architecture leveraging the phased-array antenna and open-standards modem has the versatility to interoperate with satellites in GEO and non-geostationary (NGSO) orbits, ensuring global connectivity that meets the governments' Joint All Domain Command and Control (JADC2) requirements for multi-orbit operations," said Will Tong, Vice President of Strategic Government Initiatives and head of the Aero ISR market at SES. "This demo showcases that through our partners' and SES's innovative satellite technology, such as the O3b mPOWER system, we can address the rapidly growing sensor needs and future-proof tomorrow's fleets of C2/ISR aircraft programs, enabling manned and unmanned ISR and C2 high-workload missions."

"The success of the Joint All Domain Command and Control mission depends on secure, resilient and reliable high-bandwidth satellite communications," said Rick Lober, vice president and general manager of Hughes Defense and Government Systems Division. "In cooperation with SES, ThinKom and others, Hughes continues to deliver innovative software defined modem technology for missions around the globe, ensuring comprehensive, efficient service delivery for our warfighters."

At the start of operation, SES's O3b mPOWER MEO system featuring thousands of high-performance, low-latency steerable spot beams, will provide truly



The open architecture ThinKom ThinAir Ka2517 airborne satcom terminal

uncontended seamless connectivity service for sending and receiving high-volume data and unlock full access to real-time information, high-resolution images and video for government airborne missions.

Anuvu selects Telesat for antennas and ground station infrastructure

Anuvu will lease new antennas and ground-station infrastructure from Telesat, one of the world's largest and most innovative satellite operators, to support the development of the Anuvu Constellation.

The facilities will support Tracking, Telemetry and Control (TT&C) of Anuvu's first two MicroGEO satellites built by Astranis Space Technologies Corp. Anuvu and Astranis remain on track to launch the first two satellites for the Constellation in mid-2023, with entry into commercial service by year-end.

The new Telesat-managed antennas and ground-station infrastructure will enable Anuvu's satellite operations from Telesat's flagship Allan Park, Ontario teleport, with fully redundant operations at its Calgary, Alberta teleport. Telesat will equip each site with new 9-meter Ku-band and 9.2-meter Ka-band antennas as a gateway for inflight connectivity and maritime services, connecting to Anuvu's co-located Dedicated Space™? hub infrastructure in a 24/7 managed carrier-class environment, with redundant fiber connectivity to internet Points of Presence.

"The newly-built, state-of-the-art antennas at diverse locations within Canada allow us to maximize the capacity available to our US and Caribbean customers, reducing latency with shorter paths to the Internet and offering increased network resiliency. Our new software-defined radio architecture provides unmatched flexibility in allocating satellite capacity and power to meet the rapidly evolving demands of our mobility customers," said Tim Southard, Anuvu VP of Networks. "Anuvu's partnership with Telesat will allow us to continue a superior connectivity experience."

This new agreement further strengthens Anuvu and Telesat's long-standing relationship for geostationary orbit satellite capacity. Additionally, Anuvu's new tracking antennas in Allan Park will be adjacent to the Telesat Lightspeed low-earth orbit landing station, providing additional synergies as Anuvu implements its multi-orbit, multi-frequency service strategy.

"Telesat's proven 54 years of regulatory expertise and teleport operations brings unmatched reach, flexibility and resiliency to the Anuvu Constellation and ensures travelers' access to the smoothest, highest-capacity connectivity experience available," said Philippe Schleret, Vice President of Aviation for Telesat. "We are proud to continue to build on our longtime partnership with Anuvu to enable the seamless transition to LEO for the global mobility market."

For further information or to submit information for consideration please contact::
Executive Editor - Crispin Littlehales
crispin@dsairpublications.com

Peter Beck, Rocket Lab's Founder and CEO

Satellite Evolution Global

Q&A

Rocket Lab: A remarkable trajectory

Rocket Lab's first Electron mission to launch from US soil, dubbed "Virginia is for Launch Lovers", made its ascent on January 24. Beneath the light-hearted nomenclature the company uses for all its missions lies a commitment to safety and success that is dead serious. In 2022, the company had 9 flawless launches including the pathfinder to the Moon, CAPSTONE. According to Peter Beck, Rocket Lab's Founder and CEO, 2023 is setting up to be even more exciting.

Crispin Littlehales, Executive Editor, Satellite Evolution Group

Question: What prompted you to found Rocket Lab?

Peter Beck: I had always had two passions in my life. One was engineering and the other was space. You must appreciate that I come from New Zealand which had zero space industry when I was a kid. When I'd talk about wanting to work in the space industry it was a source of comedy, not a source of aspiration. My intention was always to come to the States and work for one of the big aerospace primes or for NASA. But it came to a point where the things that I thought were important and the things that I wanted to do weren't really being done in those places. I figured that if things aren't happening the way you think they should be or could be, you either moan about it, or do it yourself. So that's the genesis for Rocket Lab.

New Zealand may not have been the natural place to start the

CAPSTONE spacecraft integration. Photo courtesy Rocket Lab

company, but it was a good place to start. The ability to get things accomplished very easily, quickly, and affordably was great. But we became a US company by the end of 2013 when I went to Silicon Valley to raise capital.

Question: What has surprised you most about the company's evolution over the last 17 years?
Peter Beck: I think "never say never" has been a lesson for me. It's very easy to be resolute about certain views but things can change quickly. That's probably the biggest takeaway. In some respects, the evolution feels painfully slow and in other respects it has happened way faster than we thought it would in some areas. A good example of that is our Space Systems Division. We started that in 2019 and we hoped that it would generate two thirds of our revenue by maybe 2025. However, we reached that goal last year.

We always challenge people to think about Rocket Lab as more than just a launch company. Launch steals the show for sure but we're an end-to-end space company. Customers can come to us with ideas about hardware and we use them to build entire satellites. We are able not only to launch those satellites, we can also operate them.

Question: You had a very eventful 2022. Which three missions do you consider the most noteworthy and why?
Peter Beck: At the top of the list has to be the CAPSTONE mission, baby Artemis, if you will. It was an insanely complicated mission. We built the entire spacecraft. After Electron launched CAPSTONE into an initial low Earth orbit, over a period of eight days the Photon bus performed orbit raising manoeuvres, every one of them in the blind. Then came the translunar injection to send it to the Moon. Prior to that, most people would have written off the ability to go the Moon on such a small launch vehicle and for such an affordable price. So, I think that mission is a headline, and I think it fundamentally changed people's perception of what you can achieve.

The other two missions would have to be grouped together. They were the "Antipodean Adventure" and the

CAPSTONE wet dress rehearsal. Photo courtesy Rocket Lab ●●●

Rutherford engines on Electron. Photo courtesy Rocket Lab ●●●

"Wise One Looks Ahead" missions for the National Reconnaissance Office (NRO). We turned two rockets around in 15 days and launched them back-to-back. These are really important national security missions and as such are far more complicated than a commercial mission. We were actually on schedule to perform the task even more quickly than the NRO required so that was a great proof point for the company. Not only can we produce rockets swiftly, but we can also integrate them in parallel. We had two different launch sites with a rocket on each pad and we were able to launch them in that tight timeframe.

Question: Rocket Lab is making considerable inroads not only with the NRO, but also the US Space Force and the Defense Advanced Research Projects Agency (DARPA). What makes Rocket Lab such a desirable partner?
Peter Beck: We are second behind SpaceX in terms of frequency when it comes to launches. We do as we say we're going to do and we execute. We provide great value for the government, and I think that's always at the top of the list. At the end of the day, you can have as many PowerPoints and hold as many press conferences as you want, but you must actually put payloads into orbit and that's what we've been able to demonstrate time and time again. Also, we are a mature company. We are easy to work with and we have a great relationship with all our customers. I think that helps as well. But ultimately, it's our capabilities and competence.

The government has been opening up to new partners and new launch providers with the caveat that they need to have some level of demonstrated performance. But working with the government takes more than just execution, it requires a tremendous amount of relationship and trust building over time.

Question: You went public in 2021 and your financial picture is now very strong. To what do you attribute your success?
Peter Beck: I used to joke that I'm the only non-billionaire running a space company. It can be difficult to compete with people who have no cost of capital but that's kind of the strength of the company because every decision we

make has to be a financial one as well as an engineering one. I would say that a fair portion of our success Is that we must make sound commercial *and* engineering decisions. This is not somebody's hobby, it's a publicly traded entity and we have real shareholders that expect results so we run the company accordingly.

It's funny, I'm often asked a similar sort of question about the way I think about building the rocket part of the company. To me, it's like running through a maze at night. At every dead end, there's someone with a shotgun. This is because if you make the wrong decision, if you go down the wrong pathway, it can be terminal for your company. You consume so much capital and time that wrong decisions or wrong technical avenues can be the end. The maze is dark because you're in R&D and you're never sure of the result that you're going to get. You can't waste time. You have to run.

So that's been the best analogy I can think of. It's running through a maze in the dark and making all the right decisions along the way, poking your head around the corner enough to know that there's a dead end, but not running so quickly down that dead end that it becomes terminal.

We've had our fair share of failures along the way. Our first flight didn't quite make it at all, but the vehicle was proven to be very reliable. Now we're at 30 launches.

Putting one rocket on the pad is immensely difficult. By the time you get to the twentieth rocket, I reckon it's twenty times harder. Why? Because by then it's all done by technicians reading work instructions. You're relying completely on your quality control systems. It's all supply chain and ERP systems and finance systems that all have to work seamlessly. That's a totally different scenario than the first rocket when all your best engineers were pouring over every action in excruciating detail. To make the machine that makes the machine is just way, way harder.

Question: You make several kinds of rocket engines. Could you give me a brief rundown on what is unique about these rockets and what kinds of missions they are best used for?

Peter Beck: We were the first to put a 3D printed rocket engine in orbit. When we first started on the development of the Rutherford rocket engine, 3D printing an entire engine was seen as a fairly fringe thing to do. People had been experimenting with it but nobody had actually built a whole engine that way. There were several pioneering technology steps that we took to deliver the engines and the entire launch vehicle. Ironically, everybody pretty much uses 3D printing for their engines today so that technique has come a long way.

As we go forward, we have the Rutherford rocket engine which powers the Electron launch vehicle and the Curie which is a little engine on top of the Electron. We also have the HyperCurie which is the engine we used to go to the Moon and we have the Archimedes which is a very large engine for our Neutron launch vehicle.

Question: What's ahead for Rocket Lab in 2023 and is Neutron still on track to launch in 2024?

Peter Beck: 2023 is going to be a big year for us. The Neutron project will be very significant this year. We have lots of spacecraft to build. You can expect to see some Neutron tanks roll out of the factory and hot-fire tests for the Archimedes engine. We also have a lot going on in our Long Beach Complex Satellite Division. All our business units, all the separation system software, reaction wheels and so forth have pretty much doubled year-on-year so it's been a steep growth trajectory in that respect. Then, too, we are continuing to scale Electron and we are ready to start making reusable Electrons as standard items. If you go down to the production floor now, you'll see any number of reusable Electrons running down the line.

All these activities are setting us up for 2024 which will probably be the biggest year in our company's history. We hope to roll a Neutron launch vehicle out to the pad and there are a number of other large programs that will all come to fruition in that time frame.

Question: Do you have any plans to send humans up into space?

Peter Beck: Combining both the ability to launch and build spacecraft is something that puts Rocket Lab in a strong position to do some meaningful, impactful things in the future. Neutron was designed with human spaceflight in mind—but not right out of the chute. While it is part of the master plan there is only one customer for human spaceflight right now and that is NASA. They are well served by Boeing and SpaceX. Until there is an impetus or another customer, we'll probably hold off on human spaceflight until it makes commercial sense. ●

Lift-off of the 30th Electron launch. Photo courtesy Rocket Lab ●●●

AvL TECHNOLOGIES
avltech.com

HARSH WEATHER?

Communicate through extremes

1.6m Manual Point Tri-Band Terminal
Operational winds to 60 mph
MIL-STD-810G tested
MIL-STD-188-164C & Skynet compliant

Let's talk harsh weather comms @ SATELLITE ✦ Booth 2325

Caitlin Kontgis, Satellogic VP of Go-to-Market

Satellite Evolution Global

Q&A

Earth observation is preservation

Last year, Satellogic signed an agreement with the GREEN+ Jurisdictional Programme on monitoring all subnational protected areas of the planet. Now in 2023, with their multiple launch agreement with SpaceX coming into force, covering its next 68 satellites, Satellogic aspires to capture every square meter of the Earth's surface daily in high-resolution to support environmental protection. We spoke to Caitlin Kontgis, Satellogic VP of Go-to-Market about the green opportunities in space, and how they ripple across various industries.

Laurence Russell, Associate Editor, Satellite Evolution Group

Question: The space segment has sometimes been thought of as problematic because of the emission release associated with launch, but many are quick to point out its environmental potential too. What can we do from space to protect the natural equilibrium of the Earth below?

Caitlin Kontgis: Satellite data today has a positive daily impact on protecting our planet from irreversible damage – from the management of wildfires to oil spills. The need is growing as fast as capabilities, and increased access to updated and modern satellite data is a powerful weapon in humanity's fight to save our planet.

Photo courtesy Satellogic

Our entire company, beginning with top management, takes account of how our actions, from what we've done in the past through what we decide to do tomorrow — will impact the future of our planet and people. We're driven to deliver global solutions to global environmental problems, and our greatest contribution today is increasing global access to satellite data.

While there are emissions associated with the initial launch of a satellite, the long-term benefits for the complete lifecycle of a satellite are significant. Those include real-time planetary health monitoring covering areas such as global temperatures, ocean levels and natural disasters. Satellites also provide intelligence for resource efficiencies like invasive pest populations and humidity monitoring for irrigation, among others. Increasingly, our customers are engaging us for solutions to enable early detection of illegal deforestation, oil spills, and other activities that cause irreversible damage and loss. Earth observation data helps us:

- Analyze change over time and spot emerging conditions to inform more effective solutions by enabling detection and analysis of environmental impacts caused by natural disasters, human activity, or climate change such as coral reef degradation, droughts, or landslides.
- Monitor land use and detect illegal activity to expedite response by enabling customers to identify and track deforestation, illegal harvesting, and land use over large areas of interest in detail.
- Assess and more accurately predict the impact of wildfires to reduce risks and loss of life by perfecting near-real time imagery to help scientists, first responders, and researchers examine active wildfires as well as affected areas to mobilize rescue and recovery resources more effectively.

Question: In September 2022, Satellogic announced a contract to monitor all subnational protected areas of Earth through the GREEN+ Jurisdictional Programme. Could you summarise the initiative and your work with it?

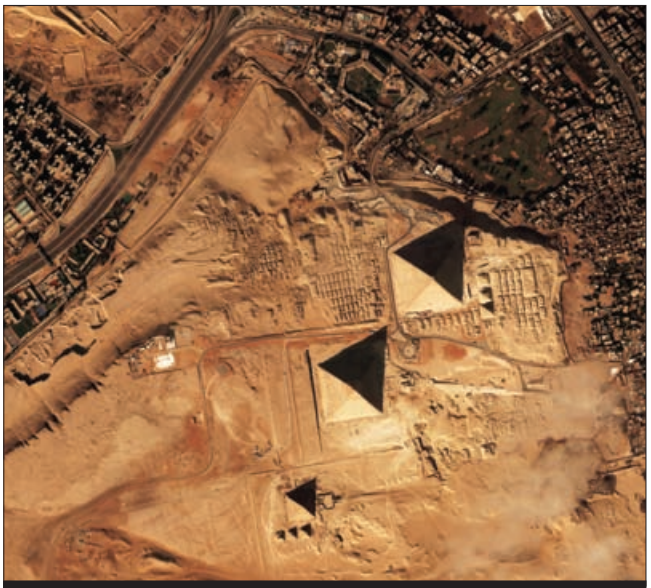
Caitlin Kontgis: Leaders of small and emerging economies have issues accessing and processing the data that enables their participation in the NewSpace economy – including environmental protection. In September 2022, we signed the agreement that outlines monitoring of all subnational protected areas on the planet through the new GREEN+ Jurisdictional Programme.

This provision of reliable and consistent high-quality satellite data will be governed by the CC35 Capital Cities Secretariat with the goal of enabling individuals, organizations, and global markets to accurately monitor the compliance of signatory jurisdictions to avoid deforestation.

This is a great example of how critical information on the loss of our planet's biodiversity can be widely accessible to foster a sustainable future.

Question: Conventional Earth observation and geospatial tools can aid all sorts of industries, but they often boast sustainability benefits too. How can having a big-picture view of things help us decarbonise?

Caitlin Kontgis: The best view of what is happening down here, is from up there. Satellites are great tools to fight climate change at local and global scale. Satellite imagery can enable users to quantify health and damage across ecosystems worldwide regardless of borders and time zones. Frequency and range are the key to revealing opportunities for conservation even in the most hard-to-



Pyramids of Giza, Egypt. Photo courtesy Satellogic ●●●

reach places. In the domain of space, satellites also possess the potential to expose hidden sources of greenhouse gas emissions and give international coalitions as well as individual governments the power to monitor compliance and illegal activity by providing visibility and accountability for sustainable transformations.

Question: More directly, satellites can keep watch of vital wild areas of the planet to properly protect them. With these swathes of wilderness being so consummately remote, space is one of the best places to observe them. Why is this more critical now than ever?

Caitlin Kontgis: There has always been a need for this, probably as far back as the first industrial revolution. What's critical today is ensuring there is broad, low-cost access to the information that is available through advancements in technology. We are uniquely positioned to provide transparency at scale, a critical capability that is vital to protecting remote wilderness areas that are currently under threat.

Question: The GREEN+ Jurisdictional Programme compliments carbon credit investing. Could you explain the concept for us, and how it can drive a greener economy in step with net-zero regulation?

Caitlin Kontgis: Some critical activities that contribute to emissions are unavoidable but investing in and supporting an equal or greater reduction in emissions surrounding separate initiatives balances and reduces the total emissions that all together impact the planet. That's why working with Green+ was important for us, and we jumped at the chance this year when it formed as an alliance of

Olympic Dam mine, Australia. Photo courtesy Satellogic ●●●

Ortigueira, Brazil. Photo courtesy Satellogic

institutions across regions and cities to combine biodiversity protection, energy transition, artificial intelligence, biocapacity, risk, finance, carbon and more. Together, we have the potential to transparently protect the planet and ensure conservation to accelerate decarbonization towards net zero commitments.

Question: There's a lot of potential for greenwashing in this new eco-conscious economy. To what extent do you believe the space industry is susceptible to that?
Caitlin Kontgis: While we can't speak on behalf of the entire space industry, Satellogic works closely with commercial, government, and NGOs with full transparency into activities.

Question: What should the space economy be prioritizing in order to create a powerful green reputation so as to get away from its lingering reputation as a polluter?
Caitlin Kontgis: We believe the single greatest priority needs to be increased accessibility to lower-cost earth observation data. Access means more users can monitor climate change and irreversible loss of biodiversity. Two major problems, however, are preventing the ability to make this data actionable and universal.

Satellite data becomes more valuable with people trained to understand and interpret the information, so it's imperative that public and private agencies can learn from experts how to derive meaningful insights from geospatial data. Access and intelligence in emerging and developing economies enable public and private organizations to monitor and report changes with precision and frequency. Increased access to information and training for people to interpret it provide a roadmap for where leaders can start to have the most impact.

A growing sense of urgency and new regs around space debris fuel demand for propulsion. Photo courtesy Benchmark

Green propulsion: The key to space accessibility and sustainability

Innovations in propulsion technologies are aimed at keeping space clear, safe, and sustainable. Payloads capable of reaching ideal orbits on their own eliminate the burden on launch vehicles to get there. The next few years of propulsion development and deployment will play a huge part in enabling and unlocking the exciting possibilities and opportunities around just about every type of mission you can imagine.

Chris Carella, EVP of Business Development and Strategy, Benchmark Space Systems

There's a portion of each rocket that stays in space after every launch. If we can keep that launch debris below 500 kilometers, it will be below most of the planned LEO constellations. Propulsive capabilities in satellites and orbital transfer vehicles (OTVs) can help with last-mile insertion to complement these lower 'drop-off' altitudes.

Remnants from launch vehicles discarded in destination orbits at one-thousand kilometers or higher, on the other hand, will clutter up those increasingly busy travel lanes in space for decades. That's no longer sustainable, given major increases in the number of satellites launched into space and new FCC regulations mandating deorbits within five years of a completed mission. Launch vehicle systems that have active de-orbit or re-use capabilities, however, can help keep rocket debris safely away from a growing layer of satellites at increasingly popular altitudes in space.

Rideshares are a fraction of the cost of a dedicated mission to access space and have quickly become the go-to solution for LEO operators. Once deployed from the launch vehicle, propulsive satellites or OTVs carrying multiple payloads can fire up their thrusters to maneuver the rest of the way effectively and precisely to their planned orbital slots in space. They can also leverage propulsion to deorbit with more certainty and speed.

Not only will rideshares and propulsion equipped OTVs, and satellites make things safer for launch vehicles by reducing the need for rockets to go through crowded space to higher orbits, but they can also help reduce the demand for harsh LV propellants. A launch vehicle can burn thousands of gallons of dangerous chemical fuel in space to go the extra lift from 500 to 1,000 kilometers. Compare that to Benchmark Space Systems thrusters, for example, which have delivered satellites and spacecraft the last mile using a couple of liters of non-toxic High-Test Peroxide (HTP)-based propellant.

GREEN FUELS ENABLING EXTENDED MISSIONS

Safe, abundant, and affordable propellants are an essential enabler and building block for the in-orbit ecosystem, which includes everything from the maneuverability, servicing, and refueling of a broad range of satellites, spacecraft, and in-space operations.

HTP is truly green and opens the door to more space

Chris Carella, EVP of Business Development and Strategy, Benchmark Space Systems

accessibility and sustainability. In fact, HTP-fueled propulsion systems can be refueled through the utilization and processing of water and ice found in space. Hydrogen peroxide-powered thrusters provide the speed, precision, and control required for a broad range of large impulsive maneuvers as well as rendezvous and proximity operations (RPO).

Our flight-proven Halcyon propulsion systems run on HTP and have become our workhorse solution for a growing number of commercial and government missions, even defense initiatives in space. High concentrations of HTP are used in the semiconductor market and other industries, making it extremely affordable on every continent with launch capability.

Non-toxic and green propellants enable launch-vehicle agnostic systems that combine safety and high thrust capabilities (last mile/insertion). The result is unprecedented flexibility in launch logistics due to the significant reduction in safety protocol and infrastructure required for propellant loading and launch vehicle integration. Being decoupled from a specific launch vehicle or deployment orbit has a material effect on spacecraft versatility, mission cost, and revenue generation for operators and end-users.

BREAKTHROUGHS IN GAME-CHANGING HYBRID PROPULSION

Non-toxic chemical propulsion (CP) and electric propulsion (EP) are powerful enablers in their own right – offering the ability to go fast and maneuver with precision. Working in tandem across the entire spectrum of satellites, from cubesats to mircrosats and larger ESPA class birds and OTVs, CP and EP will offer unprecedented flexibility.

Using pre-integrated turnkey hybrid systems that deliver the best of both worlds at a cost close to that of a chemical or electric propulsion systems means that satellite operators will no longer have to make operational compromises between speed and endurance. Indeed, hybrid propulsion systems offer the most versatility in meeting high impulse and high thrust operation sets and it's a bonus if they can be fueled with safe and affordable propellants.

For example, Benchmark's hybrid propulsion solution combines the flight-proven Halcyon chemical propulsion system with Xantus electric metal plasma thrusters (MPTs) that light up like fireflies riding bursts of propulsive energy through space. Our hybrid offering also leverages an advanced propulsion controller with Guidance, Navigation and Control (GNC) software that serves as the common bus interface across all Benchmark flight systems, providing both reduction in integration and operational costs. They will be an enabler of vital applications, including In-space Servicing, Assembly and Manufacturing (ISAM)

Non-toxic CP and EP working in tandem offer versatility for critical operations. Photo courtesy Benchmark Space Systems

Propellant and system design is critical in meet varying launch vehicle and range safety requirements ●●●

operations, with platforms engineered for docking capabilities and In-space Resource Utilization (ISRU), such as rocket stages recycled in space as equipment warehouses to help enable a sustainable space ecosystem.

What's more, the hybrid offering can increase the ROI on virtually any mission where the status quo for 90 percent of the market is to design their mission around either chemical or electric propulsion. That's a choice that is no longer necessary or prudent, and operators with a hybrid system will have a competitive advantage.

We're getting reports from experienced operators of monthly collision avoidance maneuvers, with only 10 percent of the anticipated operational assets in LEO thus far. Having the ability to reach orbits fast and respond to late-notice maneuver commands will be increasingly important, as space no longer seems as big as it has historically. The speed and controllability of chemical propulsion will be a critical sustainability tool as orbits get crowded, spacecraft trajectories become less predictable, and required response times are drastically reduced.

LAUNCH VEHICLE AGNOSTIC PROPULSION

Rapid reconfiguration is trending fast as a way to help ensure operators are ready for just about anything in a space industry that is always shifting with little notice. Launch and mission plans are always shifting and changing, and propulsion systems must be flexible enough to empower operators to successfully manage logistics.

The ability to spin a new engine configuration to adapt from mission plan A on rocket X to mission plan B on rocket Y is central to the future of the propulsion and space

OTVs will play an instrumental role in space payload transport and delivery. Photo courtesy Benchmark Space Systems ●●●

industry. Lead time provides a critical edge, and the ability to reduce cost and time between delivery and launch. To that end, we've developed a standardized plug-and-play interface to enable rapid integration, the cost and safety benefits of loading propellants, and an embedded GNC loop that can ease and assist operational efforts.

Using this approach, operators know they can have a mission-optimized propulsion solution in time to meet planned and evolving mission timelines and specs. If an operator must change launch logistics last minute, they can add a single-asset kick stage to the satellite to get the payload into the right orbital position.

ON THE HORIZON

A perfect storm is driving demand for green propulsion systems. A record number of satellites are launching into space – fueling the transition from demo to exciting operational missions and with that a growing sense of urgency along with new regulations aimed at addressing space traffic and debris.

As we enter the operational phase of commercial space, there's also added pressure on the economic health of a company in any given market segment focused on increasing ROI with shorter time to revenue generation. Extended missions and fewer constellation assets also feed into the demand for improved space mobility.

We are even seeing an increase in propulsion demand in the cubesat segment, where propulsion adoption has been modest until now. We expect pressure from the FCC and other de-orbit regulations to boost propulsion adoption by four to five times over the next two years, despite the perception that cubesats are short-lived and disposable assets.

A near 100 percent adoption of spacecraft propulsion is anticipated within the next five years, as the commercial space economy proliferates. Propulsion providers are in a position to enable and unleash the full potential of virtually every type of space mission you can think of or dream up.

We find this to be extremely exciting and the missions that excite us the most are the in-space initiatives that improve life for all humankind. Life here on Earth may depend on space-based sensing, services, and data networks one day, and we are thrilled to be doing our part in the sustainability of space.

Erin Defossé, COO of Slingshot Aerospace

Satellite Evolution Global

Q&A

Providing free tracking data to a costly industry

Slingshot Aerospace wants space to be a safer place for all. That's why the company is providing the increasingly crowded and potentially hazardous environment with free access to its Slingshot Beacon product which can help mitigate collisions by coordinating orbital access. We spoke to Erin Defossé, COO of Slingshot Aerospace about the offering.

Laurence Russell, Associate Editor, Satellite Evolution Group

Question: The costs and risks of space enterprise tend to be the primary obstacles to investment in the NewSpace economy. To what extent do these barriers affect sustainability?

Erin Defossé: The precipitous drop in launch costs and satellite development in recent years has accelerated the democratization and commercialization of space, opening the market up to hundreds of satellite operators all over the world. While this is great news for the innovators that are developing new and creative ways of using satellites to drive commerce and improve our way of life on Earth, there remains a significant cost to all of this new space activity. Even with these recent changes, space is still an expensive and unforgiving environment in which to do business.

This continued increase in activity on orbit has resulted in a substantial proliferation of satellites and debris, making space operations riskier than ever. This problem will only increase as more and more satellites are deployed. Space sustainability is about ensuring safe and successful operations in space through responsible flight and deorbiting of debris and defunct equipment. Slingshot Aerospace exists to help operators mitigate risks by leveraging our Digital Space Twin™ platform to simulate and analyze the space environment in real time so every satellite operator across the civil, defence, and commercial sectors can fly safer on orbit even as orbits become more and more crowded.

Slingshot Aerospace sensor network

Question: Slingshot Aerospace recently acquired Numerica Corporation's Space Domain Awareness (SDA) division to make use of its optical sensor network for satellite tracking. We've seen heated demand for more accurate and comprehensive SDA in recent years. How do you plan to press this new advantage?

Erin Defossé: Numerica spent more than a decade building proprietary hardware and software technologies for space situational awareness (SSA) including a network of sensors around the globe that tracks satellites and debris and produces calibrated astrometric and photometric observations. These capabilities give Slingshot's Digital Space Twin™ platform an unparalleled level of fidelity to help operators make mission-critical decisions with confidence. Slingshot is now able to provide world-class SSA data and inform these mission-critical decisions through our platform and services to commercial, civil, and defence customers across all orbital regimes: from LEO to GEO to Cis-Lunar.

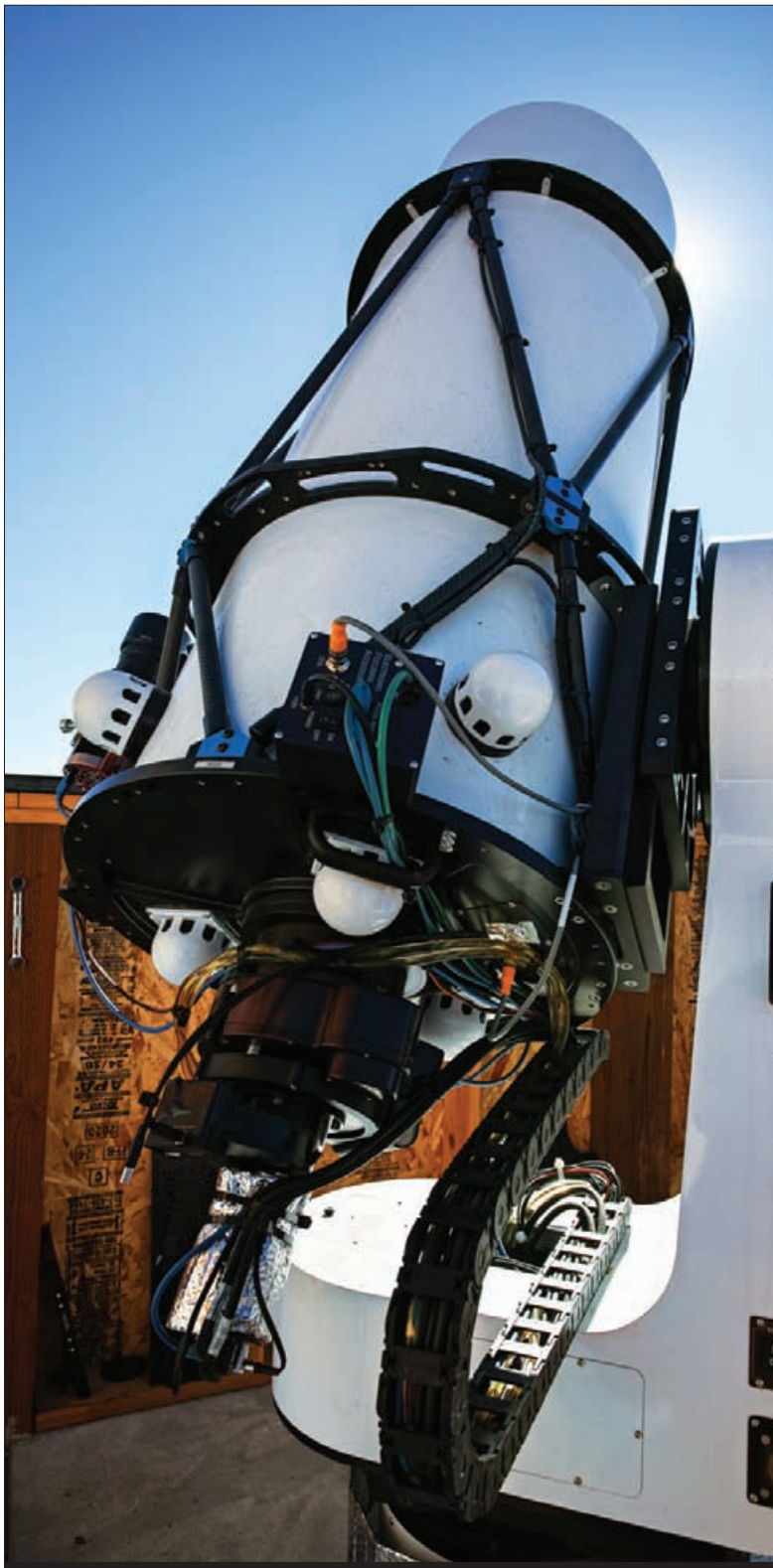
Question: You've also acquired the UK/European Seradata, integrating their SpaceTrak satellite and launch database into your portfolio. Given the globalised nature of space, what's your philosophy for approaching markets overseas?

Erin Defossé: There is no jurisdiction in space, so effective space operations require participation from all space operators, not just the ones in a specific country or region. All safe space operations require the same level of care and coordination, so our philosophical approach is the same regardless of who is using our products to mitigate risk. It's our responsibility to ensure that our products are as reliable and high fidelity as possible, so the world's space operators place a high level of trust in them. Because SpaceTrak is the most authoritative database of historical and planned satellite launches in the industry, incorporating this information into our Digital Space Twin™ platform allows us to offer incredibly robust and trusted solutions for space situational awareness and space traffic coordination.

Question: You've said these acquisitions move you closer to rolling out your Slingshot Digital Space Twin™, a virtualization program that visualises and predicts risks for space missions. Could you outline the project?

Erin Defossé: With the Digital Space Twin™ platform, Slingshot Aerospace is the first company to virtualize the entire space operating environment. Specifically, the technology is a cutting-edge virtual space environment that reflects the current state of objects in Earth's orbit at any given moment. The Digital Space Twin™ platform fuses a rich set of astrometric, contextual, and environmental data to create a real-time mapping of objects in orbit with high-fidelity physics to simulate how actual or planned missions will behave in the real space environment.

Slingshot's Digital Space Twin™ platform will help organizations reduce costs, accelerate product development, optimize decision making and enhance operations. Organisations are making mission-critical decisions in this high-risk environment, and they need the right information at the right time. Our customers will use our Digital Space Twin™ to gain insights that help to mitigate potential risks, facilitate safer satellite operations, and optimize for their unique operational parameters as the domain becomes more congested. Customers will be able to leverage our packaged SaaS applications and data-



Slingshot Aerospace Sensor Telescope

as-service offerings built on the Digital Space Twin™ platform or leverage the platform itself as a service to build their own applications or integrate our capabilities directly into their existing tools.

Question: You've put a lot of resources into addressing this problem, but not all space businesses do, and aren't inclined to take on extra costs to address sustainability when so many other players are rolling the dice. What's your solution for bringing tracking data to those who want to dip their toe first?

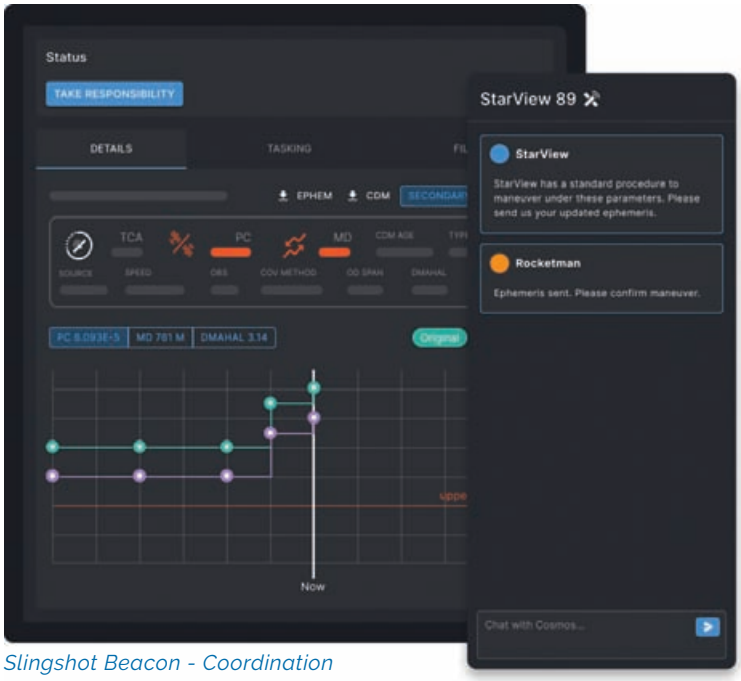
Erin Defossé: There is an urgency to mitigate the risks associated with orbital operations. This was the motivating factor in our decision to offer space operators free access to Slingshot Beacon, our first commercial product built on top of our Digital Space Twin™ platform. With Beacon, customers can coordinate, communicate and deconflict potential space collisions. It also allows our customers to invite other companies to coordinate via Beacon even if they don't have an existing account with us so everyone can benefit from safer operations.

It's incumbent on all space operators to consider the potentially devastating outcomes that become more and more likely with each new launch, and to act accordingly.

There are more than 10,000 satellites in orbit today according to Slingshot's space object database, Seradata SpaceTrak, with potentially more than 115,000 planned to be in space by 2030. Slingshot's data shows that more than 30 percent of proximity alerts are with other active satellites. This means space operators need to avoid more than just debris when manoeuvring in space and underscores the need for active coordination amongst the global space community to avoid incidents. Beacon aligns with the needs of the space community at all levels, so we decided to bring its core capabilities to market for free as a way to create a globally connected space community.

Question: Tracking is one piece of the space sustainability ecosystem. Space vehicle future-proofing, debris regulation, and on-orbit servicing make up the rest. What will it take for the industry to rally behind these solutions?

Photo courtesy Shutterstock



Slingshot Beacon - Coordination

Erin Defossé: Tracking and space traffic coordination are not just components of the space sustainability ecosystem. What we've been hearing from operators is that they are necessary to the foundation of other space sustainability solutions. Take on-orbit servicing for instance. That requires not only highly detailed tracking capabilities to ensure that rendezvous and proximity operations (RPO) go smoothly, but also coordination tools that allow operators to share data and coordinate on how to best conduct any approach.

For the industry to rally behind space sustainability, it will first take the data/coordination infrastructure to exist. The next phase of that is further validation of the business case for using these services, which is the main key to adoption at scale.

Encouragingly, we've already seen operators start to adopt other pieces of the sustainability ecosystem like future-proofing for a few years now, so while there's much work to be done, the transformation of the industry is underway in all of these areas. Ultimately, our role at Slingshot is about removing as much friction as possible for space operators to execute their missions sustainably.

Question: After its bold string of acquisitions, what can we expect from Slingshot Aerospace over the next five years as the NewSpace market takes off?

Erin Defossé: As a company, we will continue to develop our platform, products, and services that the industry needs in order to make space operations as safe and successful as possible. It's difficult to anticipate what that looks like years from now, but I can assure you that every move we make will be driven by our customers' needs and will enable safe space operations that help protect and improve our way of life for generations to come.

SPACE SYMPOSIUM

SPACE FOUNDATION

April 17 - 20, 2023

Colorado Springs, CO, USA

JOIN US IN OUR SPACE OR YOUR SPACE
In-person or Virtual registrations available

www.spacesymposium.org

Register now

On-demand tracking: Ground vs Space

It is clear that space debris is a huge and growing, problem. While there are a number of solutions out there to track objects in space and warn of close approaches, no system is as yet perfect in terms of object trajectory accuracy.

Luisa Buinhas, Co-founder, Vyoma

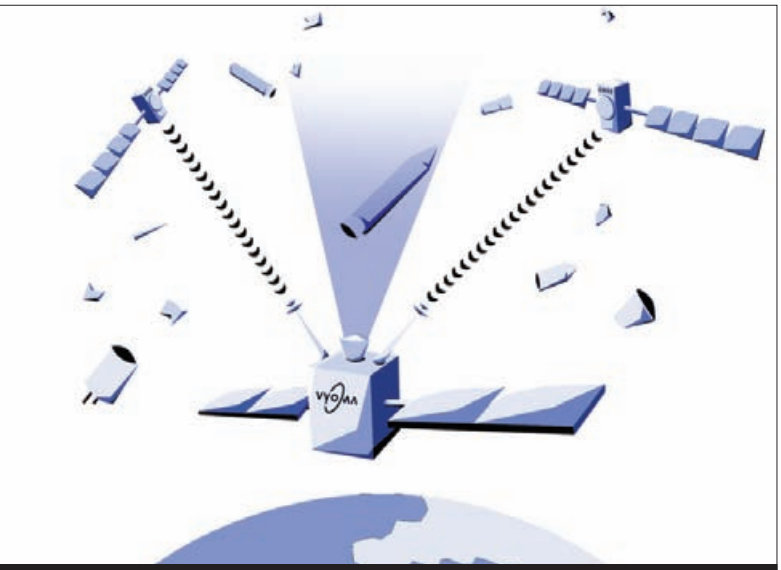
Luisa Buinhas, Co-founder, Vyoma ●●●

According to the ESA, there are only around 32,500 debris objects regularly tracked by Space Surveillance Networks, out of an estimated one million pieces of debris ranging from the size of a paper clip to a city bus. The agency estimates that more than 640 break-ups, explosions, collisions, or anomalous events resulting in a fragmentation event have occurred.

With so many small objects currently undetected, there is a high chance of a collision involving one or more of those pieces. Small as they may be, it is certain that even these fragments could cause catastrophic damage to a satellite due to the high relative velocities between objects in space. So how can we evolve tracking systems to ensure a better space environment? Are ground-based systems sufficient to tracking these small objects effectively?

WHAT IF WE DON'T TRACK?

Seems like an obvious question as we know the importance of having visibility of objects in space and being able to detect potential collisions. However, there are certain developments making this more important than it has ever been before. The growing number of objects in space is only serving to increase the probability of collision. Having accurate information is therefore important for a couple of main reasons.



Vyoma will track objects in space. Photo courtesy Vyoma ●●●

THE CHANGING ENVIRONMENT MEANS RISING COMPLEXITY

No universal regulation of action in space exists. We are entering an era in which access to space is becoming widespread and thus bringing to orbit a diverse set of stakeholders, with often competing interests and sets of practices where bilateral channels of direct and fast communication do not always exist if conflicts (for instance, a possible close approach) are detected. This multitude of actors and lack of dialogue brings an unprecedented level of complexity to space operations.

Add to that the fact that many small CubeSats are launching without the ability to maneuver. As a result, managing space traffic becomes relegated to players who can actively steer their satellites. In the face of a lack of communication and ability to act upon a threat, at least being able to adequately detect conjunctions early and form a plan of action (even unilaterally) is of extreme importance to mitigate risks of future collisions.

AVOIDING UNNECESSARY MANEUVERS

Inaccurate and insufficient data means operators are more or less working on a hunch. If the data being received is not actionable, they have to determine whether or not to maneuver based on very little real information. This becomes challenging as the cost of maneuvers is significant. Operators are having to balance the time, resources, and costs involved with the probable risk of sustaining damage. Sometimes this means they will make the decision not to maneuver but more often than not, they will perform the maneuver if collision risk thresholds rise above 1 in 10 000 – a value motivated by the large investment that is at stake.

Currently, operators average two collision avoidance maneuvers per year per satellite. However, this is likely to increase for two main reasons. Firstly, there are more objects in space than ever before, and predictions estimate 100,000 are satellites due to launch in the coming years. Secondly, as we begin to track smaller objects, there will be even more warnings. We can see a situation where we

Space-based tracking can increase statistical confidence. Photo courtesy Vyoma

will witness weekly avoidance maneuvers which is simply not sustainable – there is not enough fuel onboard and satellites need to be functioning without being subjected to downtimes due to avoidance maneuvers.

THE LIMITATIONS OF GROUND-BASED TRACKING

Ground-based tracking is crucial and will continue to be so over the coming years. That said, it is challenged with a number of limitations. For example, optical technology in particular is limited to nighttime or even dawn/dusk depending on the altitude of the target satellite. Bad weather conditions can also make it difficult to locate and track objects from the ground. In the case of radar ground sensors, the strength of the signal of an observed object is inversely proportional to the square of the distance (between the radar transmitter and the object). Given that the signal needs to travel two times (once up to hit the object and back down to hit the sensor), the strength of the signal will have a 10^(-4) relation to the distance. This makes radars very power hungry and only suited to observe small objects at low altitudes.

Another major shortcoming of ground-based systems is the fact that these are stationary and thus rely on observing debris as it passes overhead. Depending on the geometry, days can pass until the next observation update. Smaller pieces of debris have not only reduced orbital stability but also can behave quite erratically. This can increase its position uncertainty of any object to several hundreds of kilometers and significantly affect the probability of close approaches with active satellites.

As well as observing what is happening now, we need to be able to predict what will happen next in order to plan maneuvers. Predicting the way in which objects, whether that be satellites or debris, move relative to each other in space is a complex process. Various factors including the initial estimate of the location of a satellite in combination with difficult-to-model perturbations to its orbit (such as accelerations due to atmospheric drag) make it complicated to predict where a satellite will precisely be, even in the near future.

While it is already hard to observe small objects, the most challenging part is being able to associate different observations of the same objects. For that, we need accurate modelling of the environment. This means a periodic calibration of the models and perturbations.

IS SPACE-BASED TRACKING THE ANSWER?

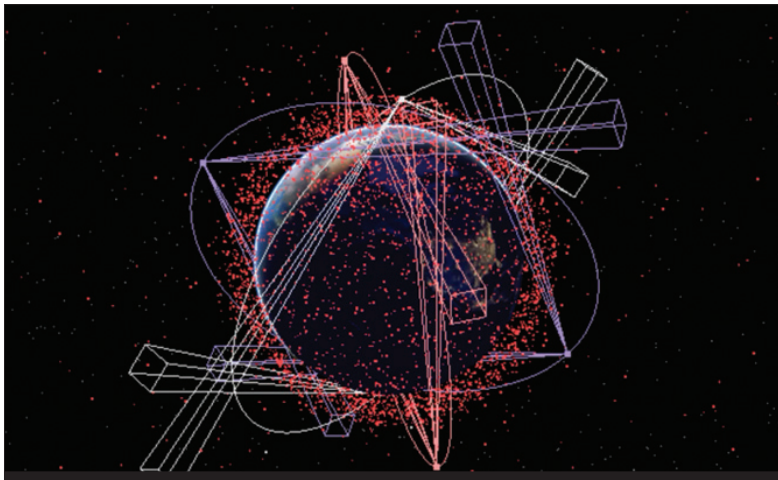
Tracking from space using optical systems suddenly does away with the limitations caused by weather events or lighting conditions which is already a massive improvement in terms of maximizing observation opportunities. It enables a more complete mapping of the space environment as it is possible to track smaller and darker objects which are hard to observe from the ground due to atmospheric distortion and light pollution. Being able to continually track from space will make for much more timely alerts, meaning they will be actionable, even for the smaller pieces of debris, whilst minimizing the rate of collision false alarms overall.

This concept is not new, having first been proposed back in the 1980s. However, only now is technology both powerful and miniaturized enough to make it cost-effective to launch into orbit. It will not be enough to simply launch satellites to track debris, we need to combine this with automation and advanced modelling capabilities to be able to process the large amount of data that is generated. Advanced modelling can better predict the near future of the resident space object population, enabling the provision of actionable insights.

Human-in-the-loop processes are both expensive and inefficient. As the amount of conjunction events increases, it will become even more challenging to action these manually. AI can train the systems to spot possible collisions and deliver the right data at the right time with the required accuracy.

WHAT IS THE FUTURE OF SSA?

Space-based tracking has the potential to massively increase statistical confidence, raising the level of knowledge of the whereabouts of space objects to the point where operators can be confident enough to avoid unnecessary maneuvers, even when they get close. The space-based observers will be able to perform much more frequent observations, keeping those alerts timely. That said, space situational awareness is all about having as much data as possible and the future of space safety lies in collecting better and more data, coupled with the ability to effectively fuse data from multiple sources.



Advanced modelling can better predict the near future of objects. Photo courtesy Vyoma

Don Claussen appointed CEO of ST Engineering iDirect

ST Engineering iDirect has named Don Claussen as its new CEO, effective January 2, 2023. Claussen will lead the company in expanding its global leadership and technology vision against a backdrop of rapid satcom industry transformation. Based in the US, Claussen brings with him over 15 years of industry experience, and has transformed solutions development and delivery for global satcom companies.

"A respected innovator and leader in the satcom industry, Don's impressive experience and track record will help to accelerate ST Engineering iDirect's growth during this pivotal period of change in the industry," said Low Ka Hoe, President of the Satellite Communications business group at ST Engineering. "Don has led major growth initiatives for satcom leaders, driving significant gains in customer impact. We welcome Don as he joins a strong leadership team in place at ST Engineering iDirect and will play a key role in creating new growth opportunities for ST Engineering's satcom business unit."

Tim McBride, President of ST Engineering's US headquarters, said, "We are delighted to have Don join the ST Engineering leadership team and contribute to the Group's business growth in the US and globally. Don's strong credentials and experience will be instrumental in steering ST Engineering iDirect to its next phase of growth."

"It is a distinct honor to join ST Engineering iDirect at this critical moment in the company's growth as the satcom industry pivots to standards-based solutions that will deliver unprecedented access and flexibility to end users," said Claussen. "Innovation has been the focus of my career, and I am excited to collaborate with a renowned technology team that continues to deliver an innovative agenda for the satellite ground segment. There is a great deal of opportunity to deliver industry leading solutions to our partners and customers, supported by our passionate global team, into the rapidly expanding new space and 5G era."

Claussen joins ST Engineering iDirect from Intelsat General Corporation where he served as Vice President responsible for Strategy, Business Development, Product Management and Service Delivery. During his time at Intelsat General Corporation, Claussen aligned the product development and service delivery teams to launch a multi-orbit capability, providing end users seamless access to GEO and LEO satcom services from a single user interface.

Prior to joining Intelsat General Corporation, Claussen was Vice President and General Manager of a portfolio division at L3Harris focused on satcom products and solutions for the US and international markets. Claussen also served as a Business Unit Director at Viasat, with responsibilities for its broadband and narrowband satcom product lines.

Don Claussen, CEO, ST Engineering iDirect

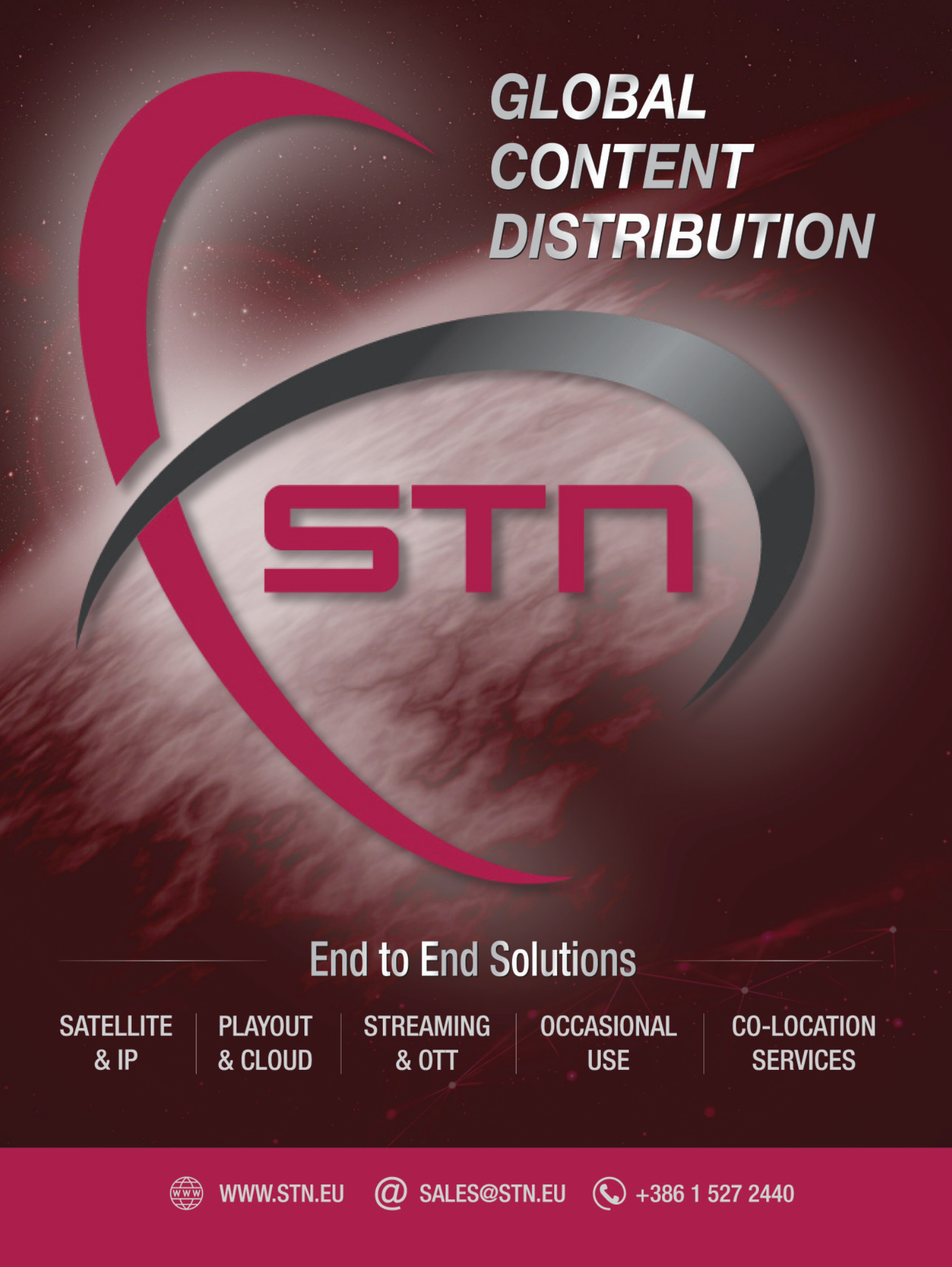
Claussen is a veteran of the US Army with eight years of service. He earned an MBA from Northeastern University and holds a Bachelor of Science degree in Business Administration & Management from Colorado Technical University.

Samir (Sam) Mehta named President of L3Harris' Communication Systems Segment

L3Harris Technologies has announced Samir (Sam) Mehta as the new president for its Communication Systems segment, reporting to Chair and Chief Executive Officer, Christopher E. Kubasik, effectively immediately. Mehta brings a breadth of diversified aerospace and defense experience to L3Harris, most recently serving as President, Advanced Structures with Collins Aerospace, a Raytheon Technologies subsidiary. In that role Mehta led a multi-billion dollar global business focused on next-generation flight and aviation components for commercial and military customers. Prior to Raytheon, Mehta spent over 17 years with Sikorsky Aircraft, notably serving as President, Defense Systems and Services.

"Sam is a tremendous leader with a passion for driving business results and mission-critical solutions that serve our nation and our allies," said Kubasik. "His customer-first approach, operational discipline and experience leading global organizations uniquely positions him to deliver on our strategic priorities as a Trusted Disruptor within the defense industry."

Mehta succeeds Dana Mehnert, who is retiring after 38 years of distinguished service with L3Harris.


GLOBAL
CONTENT
DISTRIBUTION
STN
End to End Solutions
SATELLITE & IP
PLAYOUT & CLOUD
STREAMING & OTT
OCCASIONAL USE
CO-LOCATION SERVICES
WWW.STN.EU
SALES@STN.EU
+386 1 527 2440

ND SAT COM

INSTALLING RELIABILITY

SKYWAN – THE NEW DIMENSION IN AIRBORNE SATELLITE COMMUNICATION

© AIRBUS HELICOPTERS, BART ROSSELLE

www.ndsatcom.com

SATELLITE 2023

ND SATCOM BOOTH #1122

www.ndsatcom.com