



AAC
CLYDE
SPACE

SPACE TALK

Issue #1

MESSAGE FROM THE CEO

THE BIG IDEA

COMPANY HIGHLIGHTS

5 MINUTES WITH... DINO LORENZINI



MESSAGE FROM THE CEO

WELCOME TO THE FIRST EVER ISSUE OF SPAAACE TALK.



This is where we take a closer look at what's going on across the Group and hear from colleagues and industry experts on the most exciting themes in New Space.

Our vision at AAC is to deliver high-quality, timely data from space for a better life on Earth. To that end, in the last year we have welcomed three fascinating businesses to the Group and expanded our talented team to over 150 people across the world – from Washington to Uppsala. As we continue to grow and accomplish great things together, I hope that SPAAACE TALK will help us to stay connected and focused, by sharing stories from all corners of our global business and putting them into a broader context: how do they help to make our vision a reality?

In this issue, we are shining a light on Space Data as a Service. This will be AAC's top growth engine over the coming years and it's an area I'm hugely excited to develop. We've already made great progress: our acquisition of SpaceQuest in 2020 was a gamechanger and we'll be speaking to SpaceQuest founder Dino Lorenzini in this issue. We've also got an exciting round-up of news from across the business, including a very special guest visit to our Glasgow facility – so read on, I hope you enjoy it.

Luis

THE BIG IDEA

SERVING UP SUCCESS

The world needs more data, better data and more timely data.

Whether to detect extreme weather patterns, manage crop irrigation, monitor ocean health – or make driverless cars a reality, the demand for real-time, high-quality data is insatiable. And terrestrial solutions alone cannot fulfil it.

That's where we come in.

Technological advances and falling costs within the small satellite industry are fuelling the creation of a new, global market for data from space. In the same way that smartphones put significant computing power in the palm of your hand, small satellites can now perform many of the same tasks as larger spacecraft at a fraction of the cost – and with a higher service quality. Not to mention, new smart payloads and sensors are making a much wider range of commercial applications possible.

Crucially, small satellites are enabling operators like us to engage constellations. Over the next decade the number of small satellites launches will explode into the thousands, driven by the deployment of constellations. These swarms of satellites not only deliver close to real-time data; they also allow us to bring the benefits of space data to a much broader, commercial client base through a new model: Space Data as a Service (SDaaS).

The fact is that most businesses are unable to take on the added complexity of owning a satellite to pursue space-based activities. Now, through SDaaS, they no longer have to. Instead, they simply tell us what data they need, and we deliver it straight to them. We own and manage all of the space part – from building and launching the satellites to operating the constellation, so clients can focus on their core business. This model is a game changer for us because it means we can serve multiple clients from the same constellation.

We are currently working with leading organisations, such as Orbcomm, to provide SDaaS to various industries but, over time, our plan is to deliver proprietary data services that can serve multiple clients. In fact, SDaaS will be our primary growth engine over the coming years, and we are acting fast to position ourselves to be a world leader in this market.

We're aiming to reach one fifth of our revenue from SDaaS by 2024 – one fifth of our Group revenue target – and over the last year, we've made great strides in achieving this.

Firstly, through our acquisition of SpaceQuest, which already operates its own constellation and ground station network to deliver a highly successful satellite data service. Through our global reach, this will now be marketed to a global audience in need of data from space, allowing us to rapidly grow our SDaaS business line. The acquisition also brings a valuable North American client base, including NASA, US Navy, US Air Force, and corporates such as LeoStella, Orbcomm, Northrop Grumman.

We also secured the xSPANCION contract with the European Space Agency to design and develop an innovative constellation of 10 satellites. xSPANCION will revolutionize our SDaaS offering by giving us a blueprint for building and deploying constellations. This will allow us to shrink the cost of every message collected and every image captured – and support those business cases that to date have not been able to justify the expense of having hundreds of sensors in orbit.

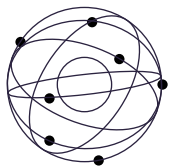
Another important step in accelerating SDaaS is the grant from the Swedish Transport Administration to develop the next generation of maritime communications. Together with Saab and ORBCOMM, we are developing the first satellite of a future constellation that will provide a space-based VDES (Very High Frequency Data Exchange System) for two-way communication between satellite and ground. The added space capability will increase VDES' range from the shoreline to anywhere in the ocean, converting what is currently a predominantly coastal system into a global maritime system, and helping to make our oceans safer and healthier.

We're also able to collect new types of data, thanks to our acquisition of Omnisys, which brings well over 20 years of experience developing profitable high-performance electronics hardware, including world-class sensors. This will be critical in extending our SDaaS offering to new areas. For example, Omnisys microwave sounding sensors give us a leading position in space-based weather data, a field set to grow strongly as new technology enables huge improvements in forecasting and climate research.

Last but not least, our acquisition of Hyperion gives us access to key technologies, including propulsion and laser communications, that add substantial capabilities to our constellations and will help us to overcome two major challenges faced by the industry: increasing congestion and radio frequency bandwidth limits.

Our new combined capabilities are already helping us to strengthen our SDaaS pipeline. We recently finalised our largest SDaaS contract to date: a four-year agreement with Canadian Earth observation company Wyvern Inc. Under the agreement, AAC Clyde Space will design, manufacture and own three satellites, providing Wyvern Inc. with hyperspectral images of Earth.

The bottom line is that SDaaS presents a huge opportunity for AAC to change the way we all use and benefit from space technology. From weather forecasting to maritime communications, I hope you are as proud as I am that the work we are doing across the Group is helping to build a safer, healthier, more efficient planet and improve our quality of life on Earth.



WHY ARE CONSTELLATIONS IMPORTANT?

Constellations provide a much higher sampling frequency than previously possible – in other words, they can deliver close to real-time data. This timeliness of data has great value and creates opportunities for optimization and prediction across a vast range of applications, such as: fighting wildfires, cargo monitoring (for example, vaccines, which must be kept at precise temperatures in transit) and tackling illegal fishing, to name just a few.

Emerging data needs can also be satisfied at a totally new pace since the lead-time for small satellites, such as CubeSats, from concept to data delivery, is a fraction of what it is for large geostationary satellites. This means that constellations can effectively be launched on demand, for example, to collect information in response to a catastrophe or to monitor a conflict zone.

COMPANY HIGHLIGHTS

AAC CLYDE SPACE SECURES ITS LARGEST SPACE-DATA-AS-A-SERVICE CONTRACT



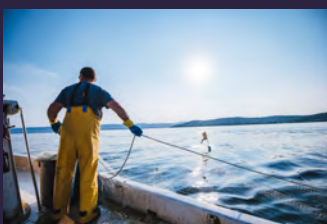
In July, we finalised our largest SDaaS contract to date: a SEK 100m contract with Canadian Earth observation company Wyvern Inc. Under the agreement, AAC Clyde Space will design, manufacture and own three satellites, providing Wyvern Inc. with hyperspectral images of Earth.

These images capture far more information than the human eye is able to detect and will be used across various sectors including agriculture, where they will help to optimize yield and detect changes in soil makeup, invasive plants and pests.

After the first four years, the contract can be extended on an annual basis. The first satellite is planned for launch during first half year 2022, followed by two satellites planned for launch during the second half year 2022.

"This contract is our largest Space Data as a Service contract to date. I foresee many more to come, both larger and smaller, as businesses discover this cost efficient and convenient way to access data from space-based assets," said AAC Clyde Space CEO Luis Gomes.

PARTNERSHIP WITH HORIZON TECHNOLOGIES MOVES FROM STRENGTH TO STRENGTH



We have secured a SEK 55m follow-on order from Horizon Technologies to expand its Amber constellation, dedicated to delivering Maritime Domain Awareness (MDA) intelligence data.

The order includes two new CubeSat launches – scheduled for 2022 – operations and data delivery. It may eventually be extended to include more than 10 additional CubeSats.

The EPIC-6U satellites will be able to locate and track vessels worldwide by geolocating and demodulating RF signals in a system that can be used to fight piracy, illegal trans-shipments, illegal fishing, and refugee smuggling, but can also be used for other purposes such as detecting and tracking a variety of RF emitters. The order is a follow-on order from the Satellite Applications Catapult IOD programme (IOD-3 AMBER), for which AAC will also deliver a 6U CubeSat to the International Space Station (ISS) in 2021, from where it will be deployed into orbit.

"We are looking forward to expanding our current partnership with AAC Clyde Space as we move forward with more launches and advanced versions of our mission payload. They are a key part of the Amber™ team," said Horizon Technologies CEO John Beckner.

AAC CLYDE SPACE SOLUTIONS ROCKET TO THE MOON



Our lunar missions continue to grow with a SEK 8m follow-on subsystems order from Intuitive Machines for an ice-drilling mission (IM-2) to the Moon. This follows the recent delivery of flight models for Intuitive Machine’s IM-1 mission, the first lander in NASA’s Commercial Lunar Payload Services initiative, focused on the exploration and use of natural resources of the moon.

AAC Clyde Space will deliver its most powerful and efficient power system, Starbuck, to the IM-2 mission, expected to be launched in late 2022. The mission will drill after ice on the Moon and after harvesting it, use a mass spectrometer to measure how much is lost as the ice turns from solid into vapor. The data will help scientists understand how to search for water at the Moon’s pole, and how much water may be available to use as NASA plans to establish a sustainable human presence on the Moon by the end of the decade.

“We are delighted to continue to collaborate with Intuitive Machines in this new era of lunar exploration aiming to pave the way for a sustainable human presence on the Moon by the end of the decade. The use of systems developed for small spacecrafts in this type of mission shows that our part of the space sector has come of age,” says AAC Clyde Space CEO Luis Gomes.

We have also been selected by UAE’s Mohammed Bin Rashid Space Centre to deliver a SEK 2m computer system for the Rashid lunar rover. This is the fourth lunar mission in which AAC Clyde Space will take part.

MAURITIUS SUCCESSFULLY LAUNCHES ITS FIRST SATELLITE



Mauritius has launched its first satellite, MIR-SAT-1, into space – an critical milestone in the development of the country’s national space infrastructure.

MIR-SAT-1 was built in AAC Clyde Space’s Glasgow facilities, launched onboard a SpaceX Falcon 9 rocket to the International Space Station, and deployed from there into space in June. AAC Clyde Space has also supported the client, the Mauritius Research & Innovation Council (MRIC), in supplying and establishing their first ground station.

MRIC intend to use MIR-Sat-1 to build knowledge on satellite technology and on how to efficiently collect and process land and ocean data from space. This will help the country to tackle issues of national priority identified by its government, from fish depletion in the Mauritian Exclusive Economic Zone to natural disaster mitigation.

“Satellites are one of the most vital tools to better understand our planet. This is a milestone mission for Mauritius and serves as a model for other small island states. This pioneering mission is the start of great things to come, and we look forward to seeing the country’s space-based capabilities and infrastructure develop in the coming years,” says AAC Clyde Space CEO Luis Gomes.

MRIC have also been focusing on STEM (science, technology, engineering and mathematics) outreach to inspire young Mauritians to consider careers in satellite and space technology and support the country’s vision of being a spacefaring nation. “It’s an exciting time for our country and for our team, the first of its kind here in Mauritius...We are hopeful that this first step in Space and Satellite technology could be a platform fostering STEM in the Republic of Mauritius,” said Dr Vickram Bissonauth, Research Coordinator from the Mauritius Research and Innovation Council.

This mission is part of a UNOOSA initiative (United Nations Office for Outer Space Affairs) in partnership with JAXA. UNOOSA works to help countries access and leverage the benefits of space to accelerate sustainable development.

AAC CLYDE SPACE HONOURED WITH ROYAL VISIT



In June, we were honoured to host Her Majesty The Queen and Her Royal Highness The Princess Royal at our Glasgow facility, in celebration of our contribution to the UK space sector.

Guests also included Head of the UK Space Agency, Dr Graham Turnock, and the Lord Provost of Glasgow, Philip Braat.

During the visit Her Majesty The Queen, Her Royal Highness The Princess Royal, and AAC Clyde Space CEO, Luis Gomes, toured the building and met with key members of the team for an overview on the company's latest services, missions, and next generation satellites.

"We're honoured to have welcomed our royal guests here at AAC Clyde Space today, to celebrate Scotland's contribution to the thriving UK Space sector. Over the last two decades, Scotland has built a world leading industry in satellite manufacturing, engineering, data, and ground-breaking research. As we look forward to the next chapters in this successful journey, including the UK's first orbital spaceport, this is a great time to not only celebrate but to promote Scotland's growing space industry to future generations." said AAC Clyde Space CEO, Luis Gomes.

AAC Clyde Space designed and manufactured Scotland's original satellite, UKube-1, in 2014 in partnership with the UK Space Agency, and has since launched 10 satellites built in Glasgow, with a further seven in production. The visit highlighted the UK's commitment to become a global leader in the space industry, STEM promotion and the development of sovereign capabilities, such as the quickly approaching vertical launches from Scotland, which will enable the UK to offer full end-to-end small satellite supply chain capabilities.

UK Space Agency Chief Executive Dr Graham Turnock said: "From space-based earth observation and data analysis to world-class satellite design and manufacture, Scotland is pivotal to the UK's ambitions in space. Thanks to its science and engineering strengths and geographical position, Scotland is at the heart of our plans to launch satellites into orbit from home soil in 2022, and we're proud that the Scottish space sector is growing fast and creating the high-skilled jobs that will power economic growth."

ANDREW CARREL JOINS AS VP OF FUTURE PROGRAMMES



Dr. Andrew Carrel has joined the Group as VP of Future Programmes. His arrival marks the start of the next phase in our plan to strengthen Space Data as a Service and he will be responsible for the xSPANCION programme and for leading the development of new Space Data as a Service offerings.

Dr. Carrel has worked in the space industry for over 20 years and, until recently, was the CTO of Rezatec, a specialist company in geospatial analytics, where he developed a technical team and delivery engine for space data analytics. He holds a physics degree from Cambridge, a MSc from Cranfield and a PhD from Surrey. His past experience includes the design of AOCS systems for advanced Earth imaging missions, project management of satellite missions and various management roles in the satellite industry.

"It is great to have Andrew join the team. His experience and technical know-how will strengthen AAC Clyde Space and help us to deliver new solutions for users of data and services from space to accelerate sustainable development" said Luis Gomes, AAC Clyde Space CEO.

5 MINUTES WITH...

DINO LORENZINI

The founder of SpaceQuest reveals what drew him to space and why future value lies in data

**What first drew you to space?**

I was commissioned by the U.S. Air Force Academy in the 1960s at the height of the space race with the former Soviet Union. After earning a master's degree and PhD in Astronautical Engineering at MIT, space became part of my permanent future.

While in the Air Force I tested the Apollo Lunar Module Navigation System, worked on the development of the NAVSTAR GPS satellite system, managed the High Energy Space-Based Chemical Laser at DARPA (US Defense Advanced Research Projects Agency) – and went on to direct the pilot architecture study for the U.S. Strategic Defense Initiative.

After retiring as a Colonel, I directed a team of engineers providing technical support for Strategic Defense. I realised that the future of satellite development was moving from military to commercial space activity, and I founded SpaceQuest in 1994 to commercialize the microsatellite technologies that were being developed by the Amateur Radio Satellite Organization.

What was your ambition when you founded Space Quest? How has that changed?

My initial goal was to create a constellation of commercial microsatellites to track mobile vehicles and monitor remote assets worldwide. Given the lack of commercial, low-cost satellite components at the time, we had to develop them all at our own expense. Our US launch capability was also limited, so we began launching our small satellites as piggyback payloads on the Russian Dnepr rocket, a converted intercontinental ballistic missile dating back to the Soviet Union.

'In combination with AAC, SpaceQuest has access to new components, capital and intellectual property to advance its strategic objectives without having to respond to short-term investor goals..'

Lacking any outside investment funds to deploy a full constellation of IoT satellites, we shifted our emphasis to monitoring messages transmitted by vessels at sea. The IMO (International Maritime Organization) had mandated the Automatic Identification System (AIS) to avoid vessel collisions by having ships constantly transmit their GPS position, velocity, heading, turn rate, and other parameters of interest. SpaceQuest was a pioneer in the development of a satellite AIS system, making it possible for the first time to monitor the movement of ships on a global scale.

Why is AAC x SpaceQuest a powerful combination from your perspective?

The nature of the commercial space community has changed significantly during the 26 years since SpaceQuest was founded. Although our satellite components are still sought by small satellite developers, the company was too small and undercapitalized to compete for the large-scale space programs being funded by governments and private equity investors.

In combination with AAC, SpaceQuest has access to new components, capital and intellectual property to advance its strategic objectives without having to respond to short-term investor goals. As AAC transitions from the construction and sale of spacecraft buses to the delivery of space data, SpaceQuest can contribute its infrastructure and operational experience in delivering satellite data to clients.

What are the biggest changes since joining the AAC Clyde Space Group?

There were no big surprises, but the requirements for being in a public company are certainly new to me. As a private small business, we only needed to be concerned with cash flow and remaining profitable. So, the most immediate change was the requirement to track labour hours and provide detailed sales and cost information to the Group. We're also now interacting regularly with a larger family of space entrepreneurs and we're starting to participate in joint space projects with other members of the Group.

Why is Space Data as a Service so important?

The development of satellite components, systems and launch services is now a cottage industry. Other than the challenge of obtaining satellite licensing, the evolution of the CubeSat standard has made it much easier to access space. Increased competition is driving down prices and profit margins, leaving little room for growth without the addition of new revenue streams.

Investors in New Space enterprises want their portfolio companies to focus on customer needs, sales and revenue generation, and not be distracted by the development and operation of space infrastructure that can be better managed by a dedicated team. That's why the future value lies in the data obtained from space and the analytics associated with extracting valuable and timely information for decision-makers.

What kind of data are you collecting at the moment?

SpaceQuest is currently collecting AIS data from four of its current satellite fleet and capturing global radio frequency spectrum data in the two to seven GHz range. We are also providing IoT services for a hosted payload customer.

How do you see that changing over the next 5 years?

Over the next five years, we expect to be operating a fleet of AIS and IoT satellites, providing data services to several key customers. On a broader scale, we plan to construct, launch and operate several weather satellites, and to get more involved in the data analytics associated with asset tracking and weather prediction.

'The future value lies in the data obtained from space and the analytics associated with extracting valuable and timely information for decision-makers.'

'We need to work with reliable business partners and draw upon the capabilities and experiences of our sister companies in the AAC Group.'

Are you focused on particular industries?

Given the proliferation of optical and radar imaging satellites, we are focused on the collection of weather data that can be processed to improve weather prediction. There is a growing need for better long range weather forecasting by both government and commercial users – and AAC's acquisition of Omnisys provides the company with advanced atmospheric sensor capabilities.

What do you see as the biggest challenges for the space industry?

The last big challenge was the availability of piggyback launch opportunities, which has been largely addressed by the entrance of the SpaceX Transporter and other small satellite launch providers. Current challenges include space station licensing, orbital debris mitigation and ground station infrastructure to download imaging data. On the business side, the real test will be whether we can sell sufficient satellite data at a reasonable price in the face of stiff competition and cover the cost of replacement satellites.

How are you dealing with these?

We need to work with reliable business partners and draw upon the capabilities and experiences of our sister companies in the AAC Group. It's also important to identify an anchor customer and have a compelling business case before committing to the construction and launch of new satellite infrastructure.

What technologies or projects are you most excited about at the moment?

One of our near-term objectives is to develop and flight test a novel satellite AIS antenna technology to demonstrate high performance using a small, low-cost spacecraft. But most interestingly of all, we are working on developing and flight testing a Doppler Winds and Temperature Sensor. This has the potential to significantly improve long range weather forecasting that is driven by winds in the upper atmosphere.