AAC CLYDE SPACE

SPAACE TALK

Issue #3

MESSAGE FROM THE CEO

What do you think when you hear the words 'space technology'?

Most people's minds turn outwards to images of faraway galaxies, robots scouring Mars for signs of life, or Kirk and Spock boldly going where no one had gone before.

But most money invested in space technology actually goes into developing infrastructure that monitors the Earth, supports businesses, and provides services to people like you and me. For example, there are close to 5,000 satellites orbiting Earth right now – with tens of thousands more to be launched over the next decade. These satellites, particularly the small ones sent into low earth orbit, are crucial to monitoring the crops that produce our food, the health of the forests that produce our oxygen – and measuring the atmosphere that produces our weather. They also provide all manner of tracking and communication services.

In effect, the advent of the small satellite era has created a network of sensors on orbit that now can provide continuous and ubiquitous monitoring of Earth, opening the door to a much more widespread use of data and services from space. But the focus so far has been very much on the land mass. After all, that's where most of us – the consumers of data – live, work and play. By comparison, the other two thirds of the surface of our planet, the oceans and seas, are poorly monitored and serviced from space.

Why is that a problem? For starters, 90% of everything we consume is moved by sea. But the oceans are not just the main artery for our trade. They are the lifeblood of our whole planet, regulating our weather, producing our oxygen, feeding and watering billions of organisms (including us), creating jobs – not to mention bringing a sense of wonder and enjoyment, whether we're watching the waves lap the shore, swimming at the beach, or cruising on a ship.

Recognition of our oceans as an essential global resource that must be managed sustainably, coupled with increasing concern over climate change, has renewed interest in space-based monitoring. This in turn is now driving dedicated small satellite solutions. The first – and very successful – of these was the implementation of SAT-AIS, the tracking technology that allows us to keep an eye on the world's shipping traffic and monitor both legal and illegal shipping.

AAC Clyde Space's own constellation is already providing AIS data, and it will double in size over the coming year. At the same time, the next generation of the system, known by the catchy name of VHF Data Exchange System (VDES), is already in the works. In fact, one of the first operational VDES satellites, Njord-1, is taking shape right now in our facility in Uppsala. This will be the first satellite in a constellation that will not only replace AIS, but add a whole new range of services and capabilities, making travelling the oceans safer, greener, and more efficient.

New technologies are also now being deployed. Synthetic Aperture Radar (SAR) is a well-known example, but super-spectral and hyperspectral imaging are now becoming increasingly common in small satellite ocean monitoring missions. Take the AAC Clyde Space-built SeaHawk, a mission dedicated to determining the colour of the water in order to assess its quality. This early identification of changes in water quality is critical to quickly addressing the causes of pollution.

The bottom line is our ability to manage and mitigate climate change and the threats that come with it depends very much on our ability to monitor the oceans. For a long time, this has been a challenge, but small satellites are now offering more and more solutions. It's up to us at AAC Clyde Space to keep innovating and delivering those solutions – and data they capture – to the scientists, policymakers and businesses who need them.

It's time to remember the forgotten two-thirds. Our planet's future depends on it.

Luis

'In effect, the advent of the small satellite era has created a network of sensors on orbit that now can provide continuous and ubiquitous monitoring of Earth, opening the door to a much more widespread use of data and services from space. '

THE BIG IDEA

PUSHING BOUNDARIES

Our new space-powered, global maritime communications system will help to address climate change – especially when combined with other developments across the Group. President of Data and Services Dr. Andrew Carrel explains more...

What's driving the need for innovation in maritime?
The oceans play a vital role in supporting all life on earth. They are also a crucial part of the global economy, with 90% of trade moving by sea.

But the marine environment is changing rapidly, both in terms of the demands being placed on it by stretched supply chains and the pervasive impact of climate change. The shipping industry is itself responsible for nearly 3% of global greenhouse gas emissions.

The blue economy needs to adapt to this changing context, and quickly – we need to use our marine resources more efficiently. In fact, conservation and sustainable use of the oceans, seas and marine resources is Goal 14 of the UN Sustainable Development Goals.

The good news is that emerging small satellite technologies can help to accelerate this process – by providing new insights into weather patterns, vessel movements and the ocean environment.

What kind of change are we talking about?
For example, the melting Arctic ice cap is opening previously unusable sea routes – we can see this by using the AIS data captured by our satellites to analyse vessel traffic. There's a clear correlation between increasing traffic within the region and retreating sea ice.

In addition, geopolitical tensions over trade, conflict zones and the recent Covid-19 pandemic have disrupted supply chains at sea.

While the shift away from fossil fuels is creating new demands on the marine environment, as offshore wind plays a growing role in the green energy transition.

So, what are we doing about it?
At AAC Clyde Space we are developing Earth observation and communication technologies which, when combined, will help the shipping industry to do two critical things: one, adapt to climate change, and two, mitigate the damage it causes to the environment.

For example, we successfully delivered the satellite for the SeaHawk mission – a project with NASA and other partners to capture data on ocean health. The satellite carries NASA's Hawkeye instrument, which monitors the changing biology of the ocean's surface through ocean colour imaging. This space-based remote sensing provides global coverage of our oceans, which would be impossible using planes and ships alone.

What are you most excited about in terms of maritime innovation?
Together with Saab and ORBCOMM, we are developing the next generation of maritime communications, based on a new standard – VDES (Very High Frequency Data Exchange System). This is built on the long-used VHF communications employed in terrestrial AIS – which is already mandated by the International Maritime Organisation – but now with added space capability. We are developing the first satellite of a future constellation that will use this new technology to provide robust, two-way communications at sea over a wider spectrum.

VDES can be integrated with e-navigation systems, enabling savings in fuel and emissions of up to 25 percent, aiding navigation, and increasing safety.

That sounds great. But how is AAC pushing boundaries here?
Where things get really interesting is when we combine the different technologies we are developing across the Group to maximum effect.

For example, new spaceborne microwave sounders being developed by AAC Omnisys will allow us to capture space-based measurements of the atmosphere, with global coverage. The first of these will launch on ESA's Arctic Weather Satellite. When integrated into Numerical Weather Prediction (NWP) models, this data will provide a more accurate view of maritime weather.

Now remember, VDES is a two-way communications system. So it can be used to harvest meteorological data from vessels and buoys across the ocean to 'truth' those NWP models. Conversely, the same connectivity can be used to alert crews at sea to approaching storms through updated weather forecasts and ice charts – all while enabling them to maintain constant contact with fleet operators.

This kind of combined capability creates the opportunity for us to provide new data services with high-quality insights and forecasts that improve efficiency within the maritime sector. The result will not only be reduced operating costs but also a more sustainable shipping industry.

Where are we and what are the next steps?
The satellite constellations that will make this vision a reality are being formed today. We will soon be launching more AIS satellites and our first VDES mission is already in build. The microwave sounding instrument for Arctic Weather Satellite is in development as the mission takes shape.

Meanwhile, we're working with partners to bring new value-added data services to the market that bring our satellite data to new user groups. We will continue to innovate as we work to play our part in protecting the marine environment and supporting a safe and sustainable blue economy.

COMPANY HIGHLIGHTS

ONE STEP CLOSER TO SAFER ARCTIC SEAFARING

Completion of preliminary designs for the European Space Agency's Arctic Weather Satellite programme take us one step closer to improving observation of Earth's northernmost latitudes.

The Northern Sea route posted its busiest season ever in 2021 and is set to get busier, with the maritime sector planning to use such routes more often as climate change alters Arctic sea conditions. Still, it's an unpredictable route. Having accurate weather predictions in this harsh and remote environment is essential to ensure safe and efficient transportation.

We're helping a consortium, led by OHB Sweden AB, to provide just that. Under a European Space Agency contract awarded last year, the Arctic Weather Satellite is an initial prototype mission for what will ultimately be a constellation of 16 small satellites. This constellation will provide an almost constant stream of temperature and humidity from every location on Earth, markedly improving observation of higher latitudes.

To date, forecasting weather at these higher latitudes has meant waiting for polar-orbiting satellites to circle the globe and relay their observations.

The Arctic Weather Satellite constellation will change that. Scheduled to launch in 2024, the mission will provide better coverage and latency than current systems, resulting in better weather predictions. AAC Clyde Space is supplying the core avionics and weather sensors for the initial prototype mission. We're excited to being part of the team that provides safer, more efficient, travel through the Northern Sea routes.

HISTORIC MOMENT FOR UK SPACE SECTOR

AAC Clyde Space prepares to take part in the first ever orbital launch from a UK spaceport.

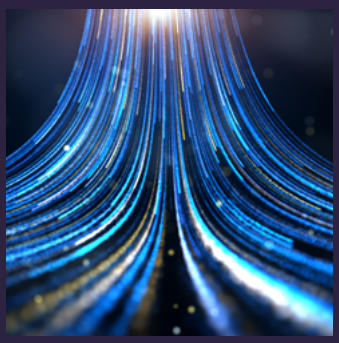
This year, Cornwall will become famous for more than its sandy beaches, rugged coastlines and pasties. The English county is set to make British spaceflight history as the UK's first operational spaceport.

The mission is a historic moment for the UK space sector, demonstrating how UK launches can benefit the country's rapidly growing space sector and enable companies to quickly get new technologies into orbit. It will serve as an example of how the country's space sector can work together to grow and thrive. The entire project has been funded, developed, and managed by UK companies.

The satellite itself, Amber-1, was built by AAC Clyde Space for Horizon Technologies and Catapult and will be launched by Virgin Orbit's LauncherOne. It is the first in a planned constellation of 20 satellites, intended to provide Maritime Domain Awareness data to organisations like the United Kingdom's Joint Maritime Security Centre. They'll use it to keep seafarers safer and combat illegal maritime activity, including piracy and terrorism.

Amber-1 is scheduled to launch in Q4 2022.

AI AI, CAPTAIN



Working alongside the Royal Netherlands Aerospace Centre, AAC Hyperion is developing artificial intelligence that will improve our small satellite capabilities.

When you hear the words artificial intelligence (AI), you might imagine Arnold Schwarzenegger chasing Sarah Connors across L.A. or Agent Smith dodging bullets. Today's AI may be less cinematic, but it's still exciting and certainly has more positive applications.

In fact, AAC Hyperion is developing onboard AI that will significantly improve our earth observation capabilities – as well as weather and climate monitoring.

Currently, the data volume of high-resolution images collected by earth observation (small) satellites is so large that, given their limited download capacity, not all of it can be transmitted back down to earth. Our AI hardware and algorithms will process and sort the data from the satellite, lowering the volume of data that has to be transmitted.

It will also optimise data links and upgrade constellation control and navigation, resulting in faster response times. And that means better decisions.

We'll be able to plot better routes for ships; to better monitor production sites, crops, and infrastructure; and to better track and predict potential natural disasters. Our AI will be helping to speed up travel times, lower emissions, improve agriculture, and avert catastrophes.

"NLR is pleased to support AAC Hyperion in its ambition to improve small satellite capabilities introducing AI onboard satellites as a tool to improve satellite efficiency for Earth observation to the benefit of society," — NLR's CEO Michel Peters.

NEW GROUND STATION FOR AFRICA

AAC Space Africa prepares to deliver a new ground station on the continent.

Back in 1964, Zambian science teacher Edward Makuka Nkoloso believed his country could win the race to the moon. Sadly, he was unable to secure the grants he needed to make his dream a reality. But now, Africa's space industry is expanding at pace.

Between now and 2025, over 100 satellites are set to be launched from African nations. AAC is proud to be part of this story – in fact our subsidiary, AAC Space Africa, has been selected to deliver a ground station to the region. It will be essential to the operation of existing satellites and new missions.

The station will be constructed, assembled, and tested in South Africa, before being dismantled, packed and shipped for delivery. The design is based on a converted shipping container, meaning all the parts can be packed inside and loaded into a standard container trailer.

Our engineers will be on hand to provide extensive training along with the delivery. They'll teach our client how to operate the station from the control room, from a remote location, or in automated mode.

"We are delighted to participate in the digitalization of Africa. The ground station will be a stepping stone to leverage space based data and services to improve the quality of life, safety and economic prosperity in the region." — AAC Clyde Space CEO Luis Gomes

MAURITIAN SATELLITE OPENS SPACE FOR GROWTH

A year after Mauritius launched its first satellite into space, what does it mean for the country?

Our first issue of SP**AAC**E TALK profiled the launch of the first Mauritian satellite, MIR-SAT 1 – an important step in the country's development as a spacefaring nation.

Following its deployment from the International Space Station, and after 300 days in orbit, the satellite re-entered and fully disintegrated into the Earth's atmosphere in the early morning hours of 19 April this year.

MIR-SAT 1 has allowed Mauritius to take a huge leap forward into space and satellite technology. It's a great example of collaboration: the team involved was not only multi-institutional, but multinational. They had to deal with significant uncertainties, including Covid-19, and have learnt much in terms of satellite design, integration, testing, launch and operation in space, which they will no doubt take into their next project.

The satellite has also given the Mauritius Research and Innovation Council an opportunity to get the nation's students and teachers excited about the space industry. Over 100 students and teachers have been introduced to the basic concepts and practical aspects of capturing data from space.

This has been incredibly exciting for the Mauritian team, and with good reason. It has opened a range of exciting avenues for exploration, for example, the use of satellite data to manage the country's surrounding seas; hosting innovative start-ups in the space field; and opportunities for further collaboration with friendly nations to develop their space capabilities. Watch this space...

5 MINUTES WITH...

STEFANIA MANDIROLA

AAC Clyde Space's Chief Operating Officer talks about her priorities for the coming year – and the change she'd like to see in the space industry.

Why did you join AAC Clyde Space?
I decided to join AAC Clyde Space last October to be part of an innovative and dynamic team. I want to help realise our full potential. And after nearly two decades in a long-established industry, I also want to explore a different phase of the lifecycle and the challenges of scaling up a global business. Plus, space is such an exciting sector right now!

What are you most excited about by working here?
Without a doubt, the potential. The sector is buoyant as everyone realises how much space can help us on earth. Smaller, cheaper technology and infrastructure make the market more accessible, and the competition is fierce. Our group is extremely well positioned to provide access to space data with competitive technology across the whole value stream. We have global reach through a footprint that spans six sites and three continents, and our growth potential is huge.

What has surprised you most about AAC since you joined?
How much passion there is for space, not only amongst the sector but in anyone and everyone. I travel a lot and when I mention space people's eyes go wide with wonder. Space remains one of the most fascinating subjects there is.

What are your top three priorities as COO for the coming year?
Firstly, to deliver on our commitments to customers. Secondly, to continue to build and develop an empowered, high performing team across the Group. Finally, I want to accelerate the journey towards arming the organisation with improved efficient processes and tools to make decisions, drive quality and improve business performance.

What do you love about working in space?
The passion of everyone involved. That sense of community, striving to use technology to benefit our planet and its people.

What are the biggest challenges the industry is facing?
Apart from the obvious – the geopolitical instabilities that can put a spanner in the works, and some global supply chain issues the whole electronic industry has been facing of late – there's the talent pipeline. Having and retaining a robust pipeline is a challenge. The industry is rapidly expanding and some of the skills are not widely available in the market. They need to be created or adapted from declining markets. This means true heritage and expertise is hard to find. That's why we're working with local governments, institutions, academia, schools, and industry partners to prepare for the next decade and beyond.

What would you like to see change in the industry?
I'd like us to be more open to non-space industry practices and approaches. The strong sense of community can sometimes prevent us seeing what there is to learn elsewhere.

What's the most important lesson you've learnt in your career to date?
Be humble, work hard and learn from anyone or anything. Oh, and enjoy what you do. We spend far too many hours at work for that not to be the case!

What advice do you have for women working in the space industry?
Keep it up! There are many women in the industry and many at AAC Clyde Space too. Continue to be role models for others to follow and be true to yourselves. Diversity is what makes us a stronger team. We learn more from all the challenges each of us has faced.

Is there anything we've missed that you really want to mention?
Keep your eyes on the prize and never give up! The future is bright.