THE RACE TO SPACE

Aireon's ADS-B system, which is set to transform oceanic control, is being trialed by NATS

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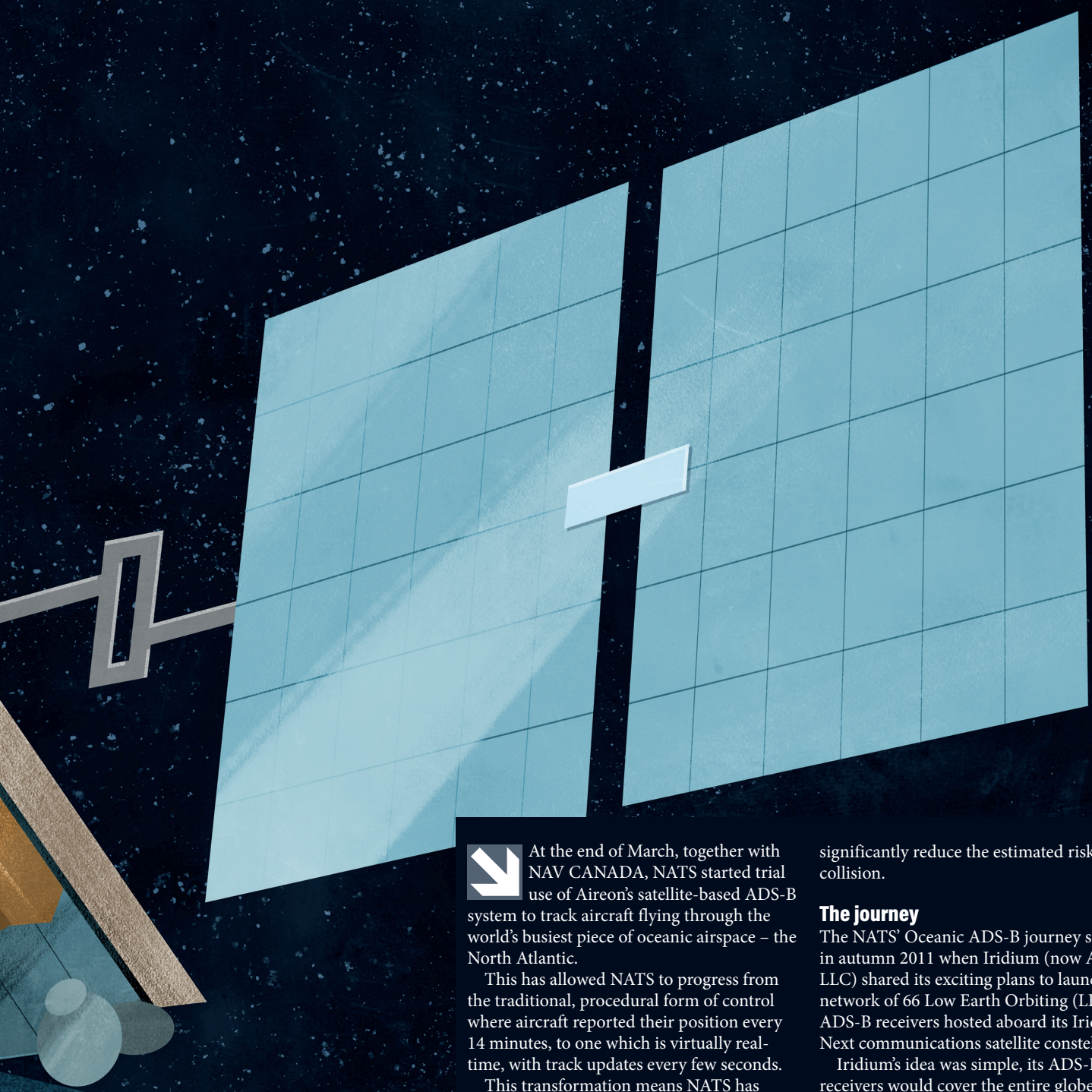
IridiumNEXT satellite



At the end of March, together with NAV CANADA, NATS started trial use of Aireon's satellite-based ADS-B system to track aircraft flying through the world's busiest piece of oceanic airspace – the North Atlantic.

This has allowed NATS to progress from the traditional, procedural form of control where aircraft reported their position every 14 minutes, to one which is virtually real-time, with track updates every few seconds.

This transformation means NATS has been able to begin reducing aircraft separations and for airlines to begin flying at the speed that best suits them. That's in addition to the clear safety benefit of having real-time surveillance and conformance monitoring (i.e. knowing that an aircraft is complying with the clearance they've been issued), something we believe will significantly reduce the estimated risk of a collision.

The journey

The NATS' Oceanic ADS-B journey started in autumn 2011 when Iridium (now Aireon LLC) shared its exciting plans to launch a network of 66 Low Earth Orbiting (LEO) ADS-B receivers hosted aboard its Iridium Next communications satellite constellation.

Iridium's idea was simple, its ADS-B receivers would cover the entire globe (including the poles) enabling ATS Surveillance of all equipped traffic, regardless of today's terrestrial line-of-sight constraints. Commercially, Iridium believed that the cost of this service would, for every US$1USD spent on the signal fees, generate returns to airspace users of about three times that figure in reduced fuel costs.

The concept sounded great, the benefits attractive, though with the traditional role of ANSPs being to deliver this kind of change, the threat of a disruptive technology company entering the ATM market prompted some focussed work by NATS to lead the operationalisation and deployment of this new technology within the ICAO regulatory arena to assure that ADS-B deployment within the critical North Atlantic (NAT) Airspace artery was supported by the ICAO North Atlantic Systems Planning Group (NAT SPG).

By early 2012 NATS and NAV CANADA led the development of a vision for 2025 that saw the planned deployment of LEO surveillance within NAT airspace. At a detailed level, substantial work was necessary to create a strategy and concept of operations; new longitudinal and lateral separation standards and to develop the benefits and business case to gain industry, customer and regulatory support.

NATS delivered this change via a project named TELSTAR, the name being a nod to the transformational role that one of the first satellites played in enabling such transformational change in so many aspects of our modern day lives.

A simple concept

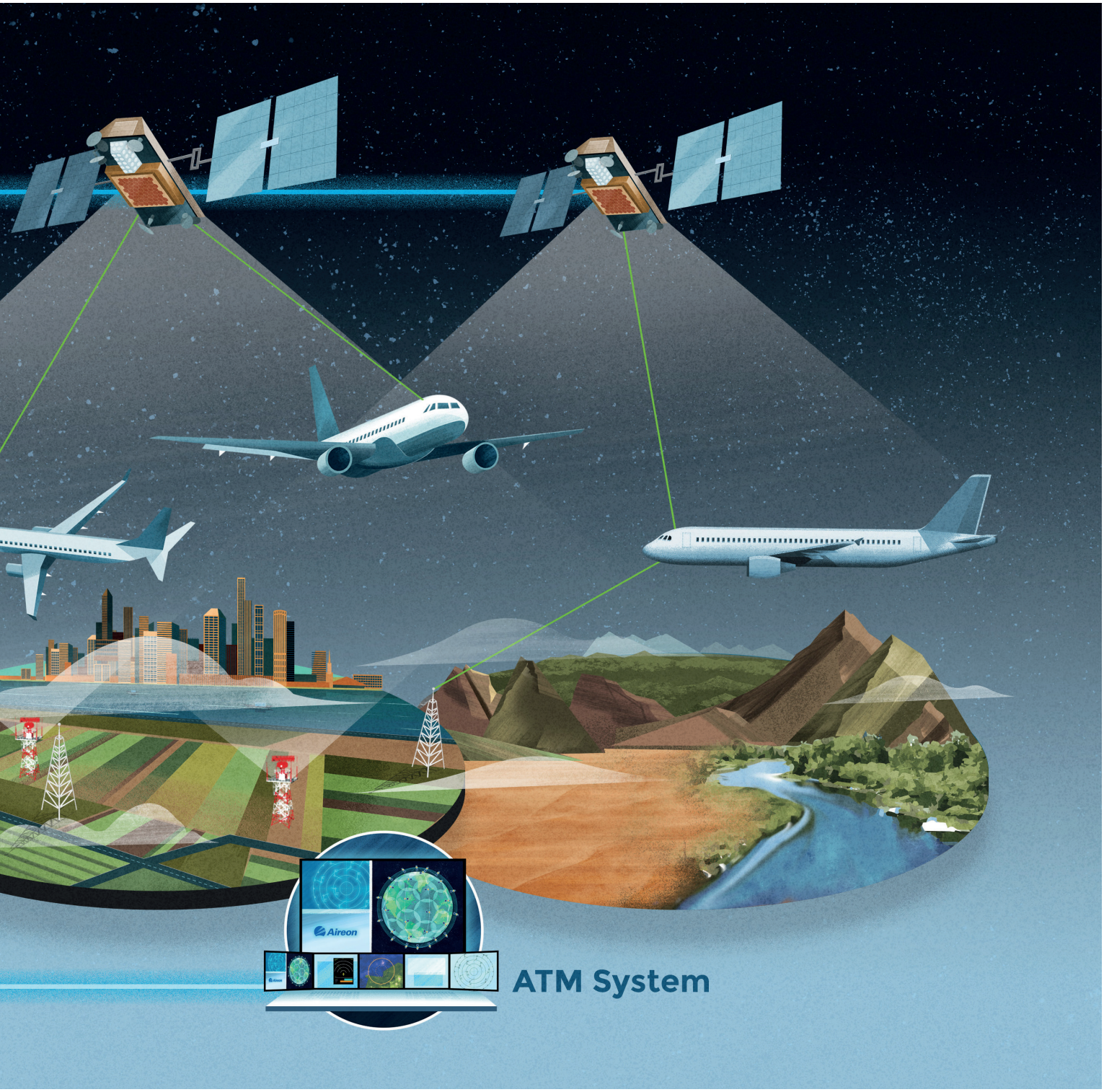
NATS' Concept of Operations, strengthened through close cooperation with NAV CANADA and in turn the ICAO NAT groups to form the NAT Concept of Operations, was simple and followed a similar path to that led by NATS previously to deliver Reduced Longitudinal and Lateral Separation minima (RLongSM and RLatSM). This involved the acquisition and presentation of aircraft position information from Aireon's ATS Surveillance System alongside Controller-Pilot DataLink Communications/ADS-C messages provided by FANS Datalink. ATC procedural clearances, and hence safe separation, continue to be safeguarded from entry to exit within oceanic airspace.

New flight monitoring tools, underpinned by ADS-B data, were developed to manage new separation standards that are now distance, not time, based. ATM system tools now assist the controller to determine and maintain minimum separation between flight trajectories, providing warnings and alerts when minima are approached or breached.

Whilst most tools echo what FANS DataLink has done for many years on the NAT, the real breakthrough is the underlying Aireon ADS-B data. Aireon's North Atlantic

ADS-B performance is outstanding, updating aircraft position data as frequently as every four to five seconds with signal latency of less than one second, frequently better than many terrestrial surveillance sources.

NATS' oceanic controllers are very efficient today, frequently handling around 70 simultaneous Air Traffic Movements (ATMs), so introducing ADS-B wasn't targeted at driving operational efficiencies, that was considered unrealistic given the



unpredicted and inexorable rise in transatlantic traffic throughout RP2, something forecast to continue through RP3, indeed controller numbers are being supplemented to cope with this new level of demand. NATS' focus was on making its controller's tasks easier, to deliver essential safety, fuel efficiency and controller workload benefits, and to deliver the transformational benefits of the new ADS-B surveillance system, separation standards and ATM system tools, whilst retaining the efficiency of its existing service. The final piece of NATS' CONOPs was to use this new capacity to enable a speed trial that permitted flights to fly econ speed (aka cost index, Variable Mach etc.), providing fuel efficiency and flight time flexibility choices

There can be almost 1800 flights handled within the North Atlantic on a busy day, making it the world's busiest oceanic airspace

back in the hands of its customers.NATS' CONOPs is comprehensive, with comparable separation standards to those frequently observed within en-route airspace served by traditional radar and VHF services, but using an all satellite-based communications, navigation and, now, surveillance service instead.

Benefits

As the TELSTAR benefit delivery manager my role was to identify and quantify compelling performance benefits our airline customers would support; to build and secure agreement for an attractive investment / business case; and ultimately to assure benefit delivery when TELSTAR transitioned into service. Typically, these benefits quantify how much safer, more fuel efficient or more cost-effective our services will be for our customers, or how much easier it makes our controllers' tasks to deliver improved capacity day to day. TELSTAR is the catalyst to enable all of these benefits to be delivered and has commenced a NAT trial implementation of NATS' new CONOPs to demonstrate its delivery, ahead of its planned permanent introduction in 2020.

Safety benefits, beyond the rare surveillance-informed search and rescue support for aircraft in distress, initially followed the work NATS led in London's Terminal Control airspace many years ago. These benefits see aircraft downlinked Selected Flight Level (SFL) presented alongside controller assigned Cleared Flight Level (CFL) and frequent surveillance acquired updates enabling controllers to very quickly detect when an aircraft was about to execute an uncleared vertical manoeuvre (e.g. follow a flight planned step climb without seeking ATC climb clearance). This was supplemented by lateral Route Adherence Monitoring to detect when flights deviate from their track beyond existing permitted tolerances.

Accompanying its tools development, NATS was one of a handful of key ANSPs who led the development of new Advanced Surveillance-Enabled Procedural Separation (ASEPS) longitudinal and lateral separation standards recently approved by the ICAO Separation & Airspace Safety Panel (SASP). These standards see longitudinal separation minima safely reduced from the current five minutes (c. 40nm) to as little as 14nm, with lateral minima reduced from 23nm to as low as 15nm. These new minima, scheduled for publication within PANS-ATM in November 2020, provide substantial additional airspace capacity to enable flights to be assigned their requested trajectories (level, speed and route), whilst also enabling the removal of the blanket mandatory speed control that haa been a requirement of NAT operations for decades.

NATS estimates that this change will see the proportion of traffic assigned its requested trajectory increase from around 60% in 2017 to c.90% when these standards are fully deployed and available for its customers' use, with c.80% being assigned flexible speed options once speed control changes are permanently and consistently

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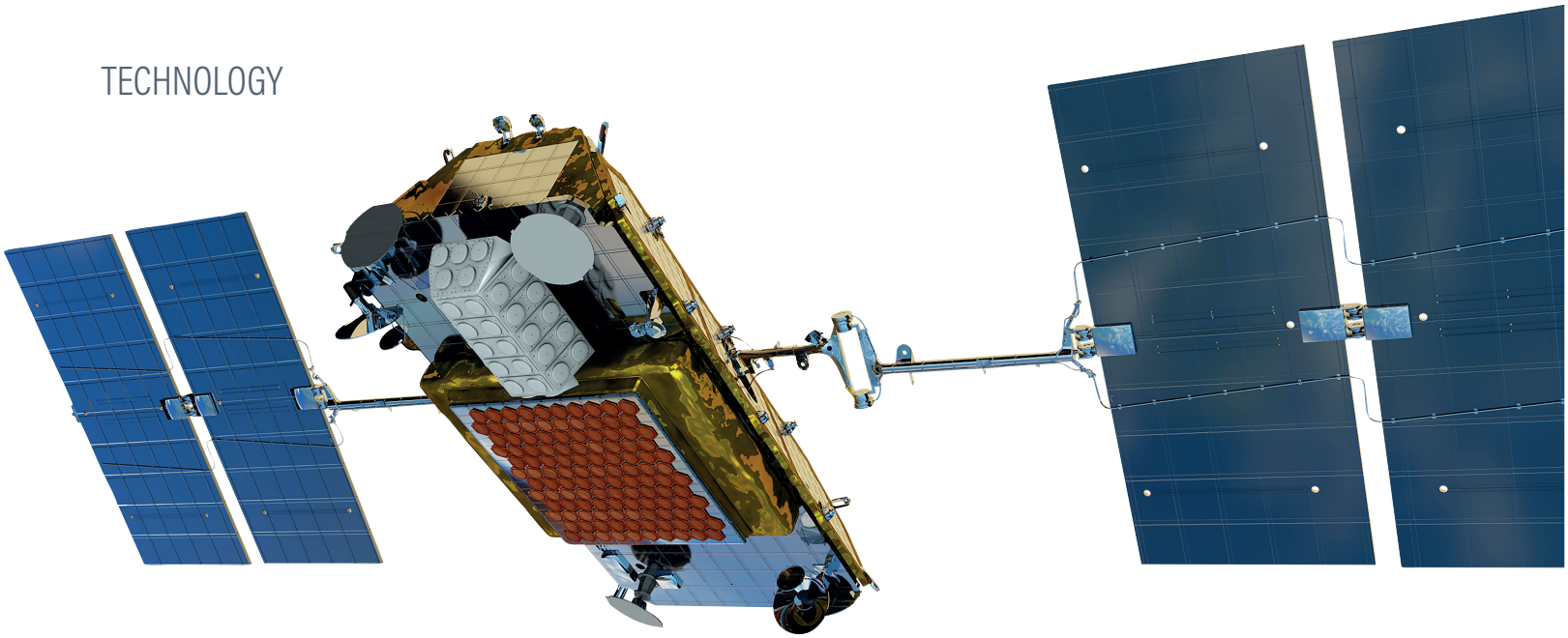


Above: The Iridum Next satellite has a wingspan of 9.4m

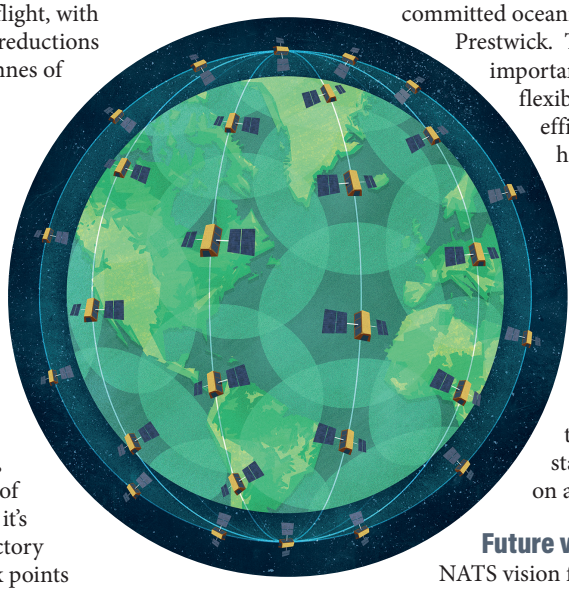
Left: Aireon's hosted payload network is carried on the Iridium Next constellation

implemented across the NAT region later in 2019. In total, across RP3, NATS expects the ADS-B programme to enable average customer fuel reductions of between 406kg and 649kg per flight, with corresponding reductions of up to two tonnes of CO2 per flight.

Early results

With 125 trial days elapsed, early results are very impressive. With traffic 2.2% higher than 2018 (and 1956 additional flights in 2019), the proportion of traffic assigned it's requested trajectory increased by six points (from 60% to 66%), enabling around 2934 fewer flights to be assigned a different level from that requested, the majority of which were previously cleared 2000 or more lower than requested. Additionally, 2300 fewer flights were re-routed from their assigned route and 108 fewer flights had their speed changed.

Significantly, with only 107 days of NATS' speed trial elapsed, 31,689 additional flights, around one third of all eastbound flights, were instructed to "Resume Normal Speed" for a total duration of 1.65 million minutes, an impressive service from a dedicated and committed oceanic team at Prestwick. This is an important step as it puts flexibility and fuel efficiency back in the hands of the customers, the airlines, while also opening up the option to one day 'stream' aircraft into busy airports from further out, in order to reduce the amount of stack holding on arrival.



Future vision

NATS vision for the future aligns closely with the NAT Service Development Roadmap, itself not mandated by but closely aligned with the SESAR and NextGen service development programmes. TELSTAR's delivery of ASEPS, and in particular the increase in network capacity, is therefore a key enabler for a number of progressive and beneficial future steps by removing a number of flight planning constraints that have existed for decades.

These include the progressive de-structuring of Shanwick's airspace, including the regression, and ultimate removal, of the NAT Organised Track System (NAT OTS) enabling access to this airspace by all flights (not just those operating along its entire length), bringing shorter flight times and reduced fuel use for airlines. As well as the removal of routine fixed assigned speeds, and the end of oceanic clearances.

These changes pave the way for greater integration of operations, enabling greater arrival management flexibility into busy airspace and airports such as the London Terminal Control Area andHeathrow.

The progressive migration of oceanic systems, from the ground to satellites, will continue to transform how services are delivered for many years to come. With traffic levels within the North Atlantic, the world's busiest oceanic airspace, handling close to 1800 flights on a busy day (and growing), the need for airspace to be safer, more fuel efficient and more predictable for airlines and controllers alike can now be met with this transformational technology and CONOPs, enabling NATS oceanic operations to demonstrate to other programmes worldwide that transformational change isn't just possible, it's happening today. ❖

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