Q1 MARCH 2025

AEROSPACE INNOVATIONS

News, views and analysis of the commercial and defence sectors

BATTERY DEVELOPMENTS FOR eVTOLs

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MRO IT for the Paperless Hangar

Fight Operations Data Analytics

Measurement Testing

Cabin IFEC Advances

AdaCore

AdaCore and the Future Airborne Capability Environment

The FACE™ approach is a government-industry initiative to reduce defense system life cycle costs through portable and reusable software components. It consists of a technical approach—a software standard based on well-defined common interfaces—and a business strategy for encouraging the development and deployment of FACE-conformant products.

- **AdaCore** has been an active member of The Open Group's FACE Consortium since 2012.
- **AdaCore** is committed to the success of the FACE approach, and both the Ada language and the company's product offerings directly support the initiative's objectives.
- **Ada** was designed for programming critical real-time embedded systems and has a long and successful track record in military and aerospace projects and in other high-assurance domains where safety and security are required.

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Aerospace Innovations brings you news, views and analysis of the commercial and defence sectors, in print and online, highlighting the latest innovations, technologies and solutions that are key to the future of the aerospace industry to meet performance and sustainability targets.

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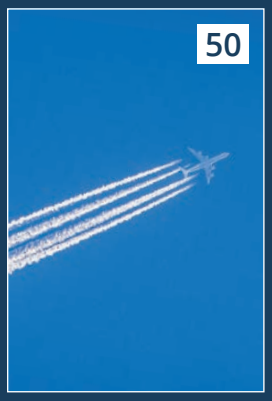

A New World Order?

On November 5th 2024 the geo-political landscape changed, perhaps more so than in any other recent decade. The new realities, whether they are welcome or not, are throwing up all sorts of questions about old and new alliances and the need for increased NATO defence spending. Prime Minister, Sir Keir Starmer, has announced that the UK will spend 2.5% of GDP on defence spending. Clouds are also hovering around expenditures on sustainability projects, which are needed to help fight off climate change. Even Airbus, a recent champion of Hydrogen projects, has now pushed back its hydrogen ambitions by a decade. We live in challenging times, and every day seems to throw up new questions, rather than answers. What is clear is that the aerospace and defence industry needs to gear up to meet these challenges like never before!

In our packed Q1 (March 2025) edition, Alex Preston interviewed several eVTOL/Advanced Air Mobility companies about advances being developed for powertrains and batteries. In his second article, Alex spoke with leading IFE and connectivity providers about the latest developments in cabin IFE systems and in-flight connectivity.

Ian Harbison, had an exclusive Q&A interview Andrew Barnett, Managing Director of Barnbrook Systems, about the company's novel E-Bag solution for the safe transportation of lithium batteries, and outlines Barnbrook's global expansion plans. Ian also interviewed several leading flight operations and connectivity companies about the advances being made in real-time data analytics for airline flight operations.

James Careless visited CAE's facilities in Canada and talked with the senior leadership team about the company's newly announced ATC training capabilities. James then spoke with some leading MRO software companies about the evolution of the 'Paperless Hangar'. Mark Robins looked into the subject of measurement testing, and talked with some leading testing providers about this subject.

Our guest feature article in this issue is from VIAVI Solutions, which looks at their Secure PNT Portfolio with Industry's First Edge Grandmaster Clock With 25G Precision Time Protocol and Multi-Orbit alt GNSS Resiliency.

We look forward to meeting those of you who will be attending the Embedded World 2025 show, taking place in Nuremberg, Germany on March 11th-13th 2025. Aerospace Innovations is proud to be an official media partner of this important annual gathering of engineers and software companies for various industries, including aerospace, defence, automotive, and industrial. We also hope to meet many of you who will be participating in our own Avionics & Testing Innovations Conference. The event is taking place on May 20th-21st 2025 in London.

Please enjoy reading this edition of Aerospace Innovations magazine, and we hope you find it to be informative and thought-provoking. We would be delighted to hear from you if you have any comments or suggestions about our publication.

Best wishes,

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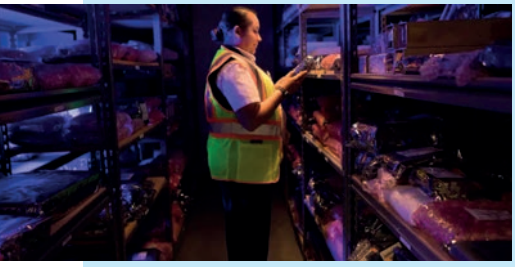
HAECO and Panasonic Avionics extend component MRO relationship

HAECO Component Overhaul and Panasonic Avionics has announced a five-year extension of their Repair Service Agreement (Authorized Repair Centre in the Chinese Mainland), further solidifying their successful relationship that began in 2011. This renewed agreement underscores both companies' dedication to delivering high-quality maintenance, repair, and overhaul (MRO) services for Panasonic Avionics' advanced components, ensuring the reliability and safety standards expected by their customers.
Bobo Ko, General Manager of HAECO Component Overhaul, said, "Our long-standing relationship with Panasonic Avionics Corporation is a testament to our mutual commitment to excellence and innovation. We look forward to continuing our successful collaboration and delivering superior MRO services to Panasonic Avionics and their customers."
Tom Eskola, VP Panasonic Technical Services at Panasonic Avionics, added, "We are delighted to extend our agreement with HAECO Component Overhaul, a trusted collaborator since 2011. Their exceptional service and dedication to quality are critical to our mission of providing the best in-flight entertainment and connectivity solutions."



Airbus A321XLR with Pratt & Whitney engine receives EASA type certification

The European Union Aviation Safety Agency (EASA) has issued the Type Certificate for the Airbus A321XLR powered by Pratt & Whitney GTF™ engines. This follows the certification of the CFM LEAP-1A powered A321XLR in July 2024 and paves the way for the first customer aircraft with Pratt & Whitney engines to enter into service later this year.

Christian Scherer, CEO Commercial Aircraft at Airbus said, "The A321XLR already displays its great versatility crossing the Atlantic in daily operations. With the certification and entry-into-service of the GTF-powered A321XLR we will see more operators introduce this game changing aircraft. It is also good news for our customers' passengers who will benefit from the convenience of new direct city to city connections with a heightened level of cabin comfort."

The A321XLR sits side by side with widebodies in an airline's fleet. It introduces the flexibility to add capacity, to open new routes, or even to continue operating existing ones when demand is variable. This is all while burning 30% less fuel per seat than previous generation competitor aircraft. The A321XLR's new Airspace cabin will provide passengers long haul comfort in all classes.

Avionica Pioneers Open-Source AI/ML for Flight Data Decoding, Empowering Operators with Unprecedented Access

Avionica, a global leader in aviation data solutions, announces a groundbreaking initiative to revolutionize flight data decoding. By leveraging state-of-the-art AI-driven deep learning models for analyzing aircraft data, including Flight Data Recorder (FDR) data, to extract critical flight parameters. Avionica is pioneering a machine learning approach that enables aircraft operators to analyze and interpret their flight data without reliance on OEM documentation.

This innovation marks a significant shift in the industry, where proprietary data formats have traditionally limited operators' ability to extract actionable insights. By applying AI-driven pattern recognition, Avionica's models identify and classify flight parameters directly from Flight Data Recorder (FDR) data, allowing operators to unlock a new level of autonomy over their data analytics and operational decision-making. By leveraging the latest technological advancements and the FAA's well-documented reverse engineering process, Avionica is giving power back to the operators.

Avionica plans to release the open-source AI models and decoder libraries in collaboration with the aviation community, inviting airlines, MROs, regulators, and researchers to participate in further development and refinement.

Archer Receives FAA Certification To Launch Its Pilot Training Academy

Archer Aviation received FAA certification to launch its pilot training academy. This certification, referred to as Part 141, is granted to a flight school by the FAA, signifying that it is a formally recognized and regulated institution for pilot training.

With this certificate, Archer can now train and qualify pilots as part of its newly launched training academy, with plans to build a pipeline of pilots in preparation for its planned commercial air taxis services with its Midnight aircraft.

Archer has now received the third certificate required by the FAA for it to launch air taxi operations when Midnight receives its Type Certification. It previously received its Part 135 Air Carrier & Operator Certificate from the FAA in June of 2024 and prior to that, in February of 2024, its Part 145 certification. Part 142 is the fourth and final certificate Archer will be pursuing—for which the application has already begun.

Aerox Acquires Oxygen MRO Omnigas Systems

Aerox® Aerospace Group, the parent company of aviation oxygen specialist companies Aerox® Aviation Oxygen Systems and Aerox® Fluid Power, announced the acquisition of Medley, FL based Omnigas Systems, Inc, a provider of aftermarket services for aerospace oxygen and fire suppression systems catering to commercial aviation, business aviation, and military customers.

This strategic acquisition of Omnigas underscores Aerox's commitment to delivering comprehensive aviation oxygen solutions to the global aerospace industry. Aerox® specializes in oxygen systems engineering and manufacturing for leading airframe manufacturers, Air Medical interiors manufacturers, and other oxygen system integrators. The addition of Omnigas enhances Aerox's capabilities to support a broader in-service fleet and a wider range of oxygen system brands beyond Aerox® systems. "Our acquisition of Omnigas Systems leverages Aerox's deep expertise and infrastructure in developing and manufacturing aviation oxygen systems for a global customer base. We are excited to welcome the experienced Omnigas team into the Aerox® family of companies." stated Scott E. Ashton, President and CEO of Aerox®. "Omnigas Systems brings robust capabilities in both oxygen components and fire suppression systems service and repair, as well as hydrostatic testing. We are confident that the integration of Omnigas will deliver exceptional value to our combined global customer partners." Omnigas Systems will continue to operate independently within the Aerox® Aerospace Group portfolio alongside Aerox® Aviation Oxygen Systems and Aerox® Fluid Power. Omnigas will be re-branded as "Aerox® Omnigas MRO."

Teledyne Completes Acquisition of Select Aerospace and Defense Electronics Businesses of Excelitas

Teledyne Technologies Incorporated announced the successful completion of the acquisition of select aerospace and defense electronics businesses from Excelitas Technologies Corp for approximately $710 million. The acquisition includes the optical systems business known under the Qioptiq® brand based in Northern Wales, UK, as well as the U.S.-based advanced electronic systems business.

The UK-based optical systems business provides advanced optics for heads-up and helmet-mounted displays, dismounted tactical night vision systems and proprietary glass used in space and satellite applications. In the U.S., the advanced electronics business provides custom energetics, including electronic safe & arm devices, high-voltage semiconductor switches and rubidium frequency standards for defense and space applications. The acquired business will now be included in Teledyne's Aerospace and Defense Electronics segment and operate under the name Teledyne Qioptiq.

"We are pleased to have expeditiously closed this acquisition, which represents our tenth corporate carve-out transaction," said Robert Mehrabian, Executive Chairman. "Teledyne Qioptiq adds new technology and highly complementary products and customers, and we are delighted to welcome this business and its employees to Teledyne."

Lynx Launches Unified Brand Identity to Empower Customers to Seize the Edge™ in Mission-Critical Computing

Lynx Software Technologies (Lynx), a global leader in scalable, safe, secure and resilient platforms for mission-critical systems, announced it has rebranded to Lynx, ushering in a new era of innovation and simplified integration. By uniting the capabilities of Lynx Software Technologies, CoreAVI, Thompson Software Solutions and Timesys under a single brand, Lynx is poised to address the unique challenges of the aerospace, defense, automotive, commercial and medical industries, enabling them to Seize the Edge™.

The strategic integration of the acquired capabilities amplifies Lynx's ability to deliver robust, certification-ready software solutions combining modularity, GPU and CPU compute capabilities, and Linux integration. Lynx's consolidated offerings empower organizations to overcome stringent safety and security requirements while accelerating time-to-market and reducing development complexity. In a market with a TAM exceeding $161 billion by 2030 and estimated CAGR of 7.1%, simplified, fast-to-market offerings are essential for capturing market share and meeting the rapidly evolving demands of safety-critical industries.

TASKING acquires LDRA

TASKING has announced the acquisition of 100% of LDRA, a provider of software tools for code analysis and software testing for safety-, mission , security- and business-critical markets.

LDRA has been a privately owned company with a team of more than 100 employees distributed across the United Kingdom (headquarters), United States, India and Germany. LDRA's tools achieve early error identification and elimination by enabling bi-directional requirements traceability, static and dynamic code analysis, and unit- and system-level verification on a wide variety of hardware and software platforms. LDRA's extensive reporting capabilities help critical application development teams to mitigate risk and demonstrate compliance to functional safety and security standards. LDRA's certification services complement the LDRA tool suite offering with industry-specific subject matter expertise.

The integration of LDRA technologies further enhance TASKING's safety- and security-oriented software ecosystem and broadens its capabilities as a trusted partner for embedded software development tools and services. LDRA's impressive portfolio of software tools that automate code analysis and software testing for safety-, mission-, security , and business-critical markets is highly complementary to TASKING's existing high-quality, functional safety-certified embedded software development tools and compilers.

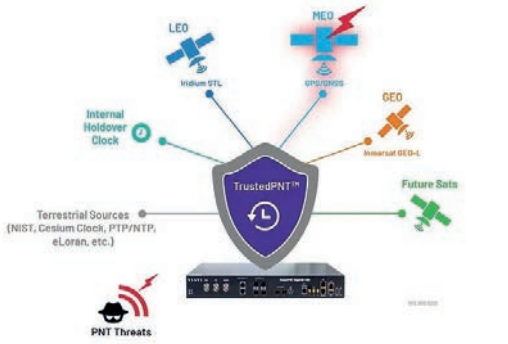
Avion Express and SmartLynx of the Avia Solutions Group (ASG) take off with AMOS

Swiss AviationSoftware (Swiss-AS) has announced that Avion Express and SmartLynx Airlines, two prominent members of the Avia Solutions Group (ASG), have signed up for our industry-leading Maintenance & Engineering solution AMOS. This marks a significant step in their journey towards enhanced fleet management and operational performance.

After an intensive evaluation process marked by in-depth demonstrations and rigorous discussions, Avion Express and SmartLynx Airlines have chosen to partner with Swiss-AS to implement the cutting-edge AMOS Airline Edition. For these airlines, AMOS represents a transformational leap in operational effectiveness and fleet optimisation. The airlines have selected the AMOS mobile suite. AMOSmobile/EXEC enhances the efficiency of maintenance teams by simplifying workflows, enabling technicians to perform tasks, access critical documentation, and finalise work packages directly on mobile devices, resulting in time savings and reduced errors. AMOSmobile/STORES optimises inventory processes, providing real-time insights into spare parts transactions, stock levels, and ordering, which accelerates turnaround times and ensures operational reliability.

By opting for the AMOS Operation Services (AOS), the airlines can benefit from Swiss-AS's extensive expertise in managing the AMOS servers and database. AOS handles key tasks like patch installations, system monitoring, and database management. By outsourcing these critical operations, the airlines gain a cost-effective solution supported by many years of experience, allowing them to focus on their core business while ensuring their systems remain robust and reliable.

VIAVI Expands SecurePNT Portfolio with Industry's First Edge Grandmaster Clock With 25G Precision Time Protocol and Multi-Orbit altGNSS Resiliency



SecurePNT EdgeGM 7000 powered with SecureTime GEO/LEO Service

VIAVI Solutions Inc. (VIAVI) today launched EdgeGM™ 7000, a highly resilient Edge Grandmaster Clock building on the industry-leading SecurePNT™ portfolio. EdgeGM 7000 offers up to 25G Precision Time Protocol (PTP) and multi-orbit SecureTimeSM altGNSSSM for the most comprehensive assurance of Positioning, Navigation and Timing (PNT) services used in critical infrastructure operations worldwide. This solution will be showcased during MWC Barcelona at VIAVI Stand 5A18 in Hall 5, from March 3 to 6, 2025.

Essential networks throughout the world – including 5G/6G telecommunications, AI hyperscale data centers, defense, public safety, transportation, aviation, energy and finance – rely on publicly available GPS and GNSS signals for efficient data synchronization based on timing and location. These vulnerable and single-source signals are occasionally unavailable or at risk of being jammed or spoofed, or satellites themselves can be attacked, with potentially catastrophic consequences. Governments around the world have begun mandating that critical infrastructure providers improve resilience of their networks through more responsible use of PNT services.

SecurePNT and SecureTime from VIAVI offer the most resilient timing in the industry, with multisource assurance combining signals from GNSS-dependent government and GNSS-independent commercial constellations across Medium Earth Orbit (MEO), Geosynchronous Earth Orbit (GEO) and Low Earth Orbit (LEO), respectively.

Global aviation cooperation in focus as ASD's Jan Pie assumes ICCAIA Chair

Leadership of the International Coordinating Council of Aerospace Industries Associations (ICCAIA) has returned to Europe, with Jan Pie, Secretary General of ASD), assuming the role of Chair. This follows ICCAIA's tradition of alternating leadership every two years between ASD and the Aerospace Industries Association (AIA) of the United States, reflecting the transatlantic partnership at the heart of the global aerospace industry.

ICCAIA serves as the global voice of the aerospace manufacturing industry, working closely with the International Civil Aviation Organisation (ICAO) to shape policies that prioritise safety, sustainability, and innovation in aviation. As the European representative within ICCAIA, ASD's leadership highlights Europe's commitment to these global objectives, ensuring collaboration across regions to tackle critical challenges in aviation.

Boeing Automates ANSP Compliance Services, Powered by Shift5

Shift5, the observability platform for onboard operational technology, and Boeing have entered into a global strategic reseller partnership to offer Shift5's Compliance Module to automate Aircraft Network Security Program (ANSP) compliance efforts for commercial and civil aviation operators. The partnership will drastically reduce the time and manual effort required by maintenance and security teams to identify and report anomalies in onboard data in e-enabled aircraft, allowing them to address credible cyber threats and potential safety issues to improve the safety and operations of fleets.

Federal Aviation Administration's (FAA) guidelines in Advisory Circular (AC) 119-1 and European Union Aviation Safety Agency's (EASA) guidelines in Common Requirements Regulation (EU) 2017/373 and the Single European Sky Framework require operators flying connected or e-enabled aircraft with advanced connectivity capabilities to create an ANSP to ensure their safety, integrity, and reliability are in alignment with regulatory standards.

Aviation operators are now able to automate compliance efforts for cybersecurity data created on board connected aircraft, through this partnership. The partnership leverages Shift5's ANSP Compliance Module software and Boeing's Aviation Business Solution's Cybersecurity Certified Information Security Professionals (CCISP) to deliver an industry-leading analytics solution for analyzing aircraft security log files. This new service will help operators of e-enabled aircraft to analyze large datasets to identify possible cybersecurity anomalies and determine mitigation actions.

Boom supersonic demonstrator aircraft breaks sound barrier 3 times on debut

XB-1, Boom's supersonic demonstrator aircraft, successfully broke the sound barrier three times during its first supersonic flight on January 28, 2025. Beginning with XB-1's historic first flight on March 22, 2024, the aircraft steadily progressed through a series of test flights at increasing speeds as it approached and ultimately exceeded Mach 1 – becoming the first civil supersonic jet to do so since Concorde. XB-1 is the world's first independently developed supersonic jet, and the first civil supersonic jet designed and built in America.

XB-1 provides the foundation for the design and development of Overture, Boom's supersonic airliner. XB-1 leverages state-of-the-art technologies to enable efficient supersonic flight including digitally-optimized aerodynamics, carbon fiber composites, advanced supersonic engine intakes, and an augmented reality vision system for takeoff and landing visibility. From thousands of hours reviewing ground and flight test data, to more than a few games of pre-flight pickleball, every number tells the story of how far the team has come on the journey to making supersonic a reality. The team accomplished the goal of safely breaking the sound barrier – not just once, but three times – during XB-1's first supersonic flight on January 28, 2025.

KEYVAN Aviation Partners with EFB Admin Services Int. to offer Innovative Navigation Application (EFB) to Private and Freelance Pilots

As one of the four companies approved by the European Aviation Safety Agency (EASA), KEYVAN Aviation, a global leader in aeronautical data and navigation services, has announced a strategic partnership with EFB Admin Services Int. to provide customized, accessible, and cost-efficient navigation solutions for private and freelance pilots. This innovative focuses on simplifying operations for pilots conducting technical transfer flights, or other ad-hoc missions for various operators or owners. Streamlining Operations for Pilots The collaboration is set to address the challenges faced by private and freelance pilots, such as the high costs and limited flexibility of existing navigation tools. With a user-centric approach, KEYVAN Aviation will provide a subscription-based service tailored to their operational needs, with the initial phase expected to serve over thousands of pilots globally.

Spirit Airlines Earns FAA's Diamond Award of Excellence for Aviation Maintenance Technician Safety

Spirit Airlines was recognized with the Diamond Award of Excellence by Federal Aviation Administration (FAA) this month. It's the FAA's most prestigious recognition for Aviation Maintenance Technicians (AMT) and highlights the carrier's unwavering focus on safety training.

"We put the safety of our Guests and each other at the forefront of everything we do, and receiving this recognition for the seventh year in a row is a testament to that commitment," said John Bendoraitis, Executive Vice President and Chief Operating Officer at Spirit Airlines. "We're incredibly proud of our dedicated Spirit Family whose expertise and hard work ensure we continue to uphold the highest safety standards across our operation."

Spirit's participation in the FAA's AMT Award Program ensures that 100 percent of the airline's maintenance technicians complete additional FAA-developed safety training courses throughout the year. Every eligible maintenance technician passed specialized, continuous training in aviation maintenance, regulations, and FAA rules annually to qualify for the award.

Alaska Airlines names new vice president of maintenance and engineering

Alaska Airlines has named John Wiitala as its new vice president of maintenance and engineering. In this principal leadership role, Wiitala will lead professionals throughout the division who maintain the highest levels of safety and compliance with more than 237 mainline Boeing aircraft across multiple maintenance bases.

Wiitala joins Alaska after 34 years with United Airlines, most recently as vice president and chief engineer of tech operations, safety and compliance, where he was responsible for the United fleet.

His responsibilities at Alaska will include line maintenance operations; maintenance of airframes, components and engines; stores and distribution; quality assurance; maintenance planning; engineering and reliability; and fleet projects.

Comply365 Appoints Chris Krackeler as Chief Revenue Officer

Comply365, a leading global provider of operational content, safety and training management solutions for the aviation, rail, defense and space industries, announced today the appointment of Chris Krackeler as Chief Revenue Officer, to further accelerate the organization's growth strategy. Chris steps into the role of CRO at a pivotal period for the Comply365 as it advances its mission to create a best-in-class, integrated offering to elevate safety, training and operational performance for Comply365's broad global customer base.

GOL Linhas Aéreas Strengthens Partnership with Sabre, Leveraging SabreMosaic to boost Revenue and Enhance Customer Experience

Sabre Corporation, a leading global travel technology company, and GOL Linhas Aéreas, one of the leading airlines in Brazil, announced the extension of their long-standing partnership. The renewed agreement includes the continued use of Sabre's Passenger Service System (PSS) and Global Distribution System (GDS), as well as the adoption of Sabre's Mosaic solutions, such as Ancillary IQ™ and Dynamic Availability, to support GOL's growth and retailing strategies to improve its revenue performance.

By integrating SabreMosaic modules, GOL aims to enhance its retailing capabilities and offer personalized experiences to travelers. Ancillary IQ™ will enable GOL to provide personalized and optimized ancillary offers by leveraging AI and real-time data to recommend the right products—such as seat upgrades, baggage, and priority boarding—tailored to each traveler. Meanwhile, Dynamic Availability optimizes pricing in real time by intelligently adjusting seat availability and fare conditions based on market demand and airline strategies. Additionally, GOL is implementing Sabre's Self-Service Reaccommodation solution to empower travelers with tailored rebooking options on their mobile devices, enhancing satisfaction and streamlining operations.

Air Premia Enhances Flight Safety with IATA Turbulence Aware

Air Premia (CEO Kim Jae-hyun, Yoo Myung-sub) announced today that it will introduce IATA Turbulence Aware, a cutting-edge safety tool developed by the International Air Transport Association (IATA), starting on March 1, 2025. This advanced system leverages real-time in-situ turbulence reports to enhance flight safety and passenger comfort. As of the end of last year, more than 25 airlines worldwide were contributing and utilizing Turbulence Aware data across more than 2,600 aircraft. By accessing real-time turbulence information, Air Premia's flight crews will be better equipped to avoid or mitigate the effects of turbulence, ensuring safer and smoother flights.

According to the Ministry of Land, Infrastructure, and Transport, airlines experienced 14,802 turbulence encounters in the first half of 2024, marking a 78% increase compared to five years ago. By adopting Turbulence Aware, Air Premia can shift from a forecast-based response to a real-time response, thereby improving its ability to secure safer flight paths.

The implementation of Turbulence Aware will enable Air Premia to effectively respond to Clear Air Turbulence (CAT) in airspace where turbulence was not predicted, and to adjust flight operations when predicted turbulence does not occur, reducing safety incidents for both passengers and crew.

Boeing Appoints Deasy as Chief Information Officer

Boeing has announced Dana Deasy as the company's new chief information digital officer and senior vice president, Information Technology & Data Analytics.

Elected to the role effective Dec. 31, 2024, Deasy will oversee all aspects of information technology, information security, and data and analytics. He will report to Boeing President and CEO Kelly Ortberg and serve on the company's Executive Council.

"Dana is a well-respected, global technology leader who has a track record of delivering on innovative technologies across large and complex organizations," said Ortberg. "With the need to stay vigilant to protect against cyber threats, and emerging technologies like artificial intelligence playing a larger role across all industries, our IT team will have a key role as we focus on meeting our safety and quality goals, delivering reliably for our customers and positioning ourselves for the future."

Deasy brings to Boeing more than 40 years of technology and leadership experience and a career that has spanned multiple industries. Most recently, he served as chief information officer at the U.S. Department of Defense and before that, at JPMorganChase, BP and General Motors. His career started in information management at Rockwell's Space Systems Division.

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An Airbus A321neoLR of Air Busan. On 30 January, one of the airline's earlier A321-200s was totally destroyed at Busan in South Korea when a battery caught fire in an overhead bin. There were no serious injuries. (credit: Airbus)

Burning Ambition

Ian Harbison spoke to Andrew Barnett, second generation Managing Director of Barnbrook Systems.

IH: Tell us a bit about Barnbrook Systems.

AB: It was founded by my father 50 years ago and now has about 50 staff. It works across aerospace, defence and transportation, with a focus on safety, reliability and innovation. We are able to design, engineer, prototype, and qualify in house to produce our own products and engineering solutions. At the same time, the company has a long history of overhauling out of production items by other companies. With numerous certifications, it is, unusually for an SME, working directly with major manufacturers and suppliers.

IH: You recently made an appearance on prime time BBC television?

AB: Yes! The One Show asked us to demonstrate E:BAG. This a joint development with Flair, combining their fire suppression bags with our BlueCube remote sensing and monitoring technology. We are aiming it at the airline market as a way of dealing with the increasing threat from lithium ion battery incidents. Cabin crew can simply drop mobile phones, laptops or e-cigarettes into the E:BAG then close it, the temperature sensitive smart fabric then extinguishes flames or prevents ignition. BlueCube monitors the temperature to show when the danger is over.

IH: Has it generated much interest?

AB: Yes, but it also attracted interest when we launched it at Farnborough, and we are now in serious discussions with Emirates, IAG, Qantas and Qatar Airways, as well as the Boeing Safety Board.

And airports such as Gatwick, Heathrow and Manchester are also viewing this as a solution, as they have regular problems with discarded e-cigarettes or items in passengers' carry-on bags catching fire.

An unexpected customer for us is TJ Waste and Recycling's Materials Recovery Facility which is close to us in Portsmouth. The facility burned down last year after a major blaze that might have been caused by a battery. They will use E:BAG technology to isolate any suspect items when they are sorting through rubbish.

IH: Any other aerospace applications for BlueCube?

AB: It is being used in Leonardo helicopters for air-to-air and helideck refuelling, to confirm that there is a secure connection and transfer can safely start. There have been three contract awards and we have now

(Credit: Barnbrook Aerospace)

(Credit: Barnbrook Aerospace)

delivered around 300 devices.

We also have a modified version called BlueDot, which is being adopted by Protium, a producer of green hydrogen, to enable the safe storage, use and transportation of green hydrogen systems, for airborne and non-airborne applications. Perhaps the best opportunity is hydrogen-powered airside vehicles. If every vehicle is electric, you probably haven't the charging infrastructure to cope.

However, at the moment, the most important thing is to be part of the development, to keep pushing the envelope and see what is achievable. And to work with the standards authorities. The CAA, FAA and EASA are all trying to grapple with this new technology. It is a good time to be involved but it could be a cash drain if you're not careful.

IH: You mentioned international agencies. Have you been affected by Brexit?

AB: Working outside the UK is a challenge and our solution is to set up overseas offices in Europe and the US just to make sure we have a seat at the table. Paperwork and politics cause the most problems.

In fact, our US office only opened in February 2025. It is located in McLean, VA, where four of the top five defence contractors have operations, as well as being close to the Pentagon in Washington, DC.

IH: You are a member of the Farnborough Aerospace Consortium?

AB: I think member bodies are extremely important these days but they need to be about more than just collecting more members. Collaboration should be the driving force to make sure the industry stays strong and is well represented. Unfortunately, SMEs tend to be not very good at this, being very protective and not looking at the bigger picture to see where they could link with other like-minded organisations to get on different platforms and win better business.

Equally, the large OEMs have to work with SMEs and understand that they are part of the solution. They are not going to steal any business but they can provide a rapid response to a problem that the larger company will not be able to react to with the same speed, just because of the size and complexity of the organisation.

Trade organisations should be constantly pushing this message, that everyone should be working together. There is a need for each side to learn the other's language because, when you get down to it, we're talking about the same thing for the same reason.

IH: What other sectors is Barnbrook involved with?

AB: The UK's rolling stock leasing companies and franchise operators form a significant part of the company's business, where we supply reengineered brake controllers for trains. Our tracking and monitoring technology is also

(Credit: Barnbrook Aerospace)

used in the transport industry, to help ensure on time performance. That covers maritime, buses and freight operations.

And we still have an interest in reverse-engineered 'sunset and legacy' products and systems for which operators can no longer find replacements or fix – such as engine controls and speed switches for older combat aircraft. That dates back to the time of my father and companies such as Plessey and TRW.

IH: How do you see the recovery from COVID?

AB: From a business point of view, there are fewer commercial aircraft flying, but they are newer models, so demand is lower for components for older aircraft. There are still staff shortages, so it is important to bring youngsters through, even if that can be a challenge at times – they tell me I'm too useful to retire!

We actually have a two tier training system. A two year traineeship programme with several local colleges includes two days a week at Barnbrook as their work placement., with the work carried out in line with the course requirements. The best candidates are then offered a full, four-year apprenticeship with the company. This again involves the colleges, for suitable additional courses.

By Ian Harbison

(Copyright: Evolution Measurement Ltd.)

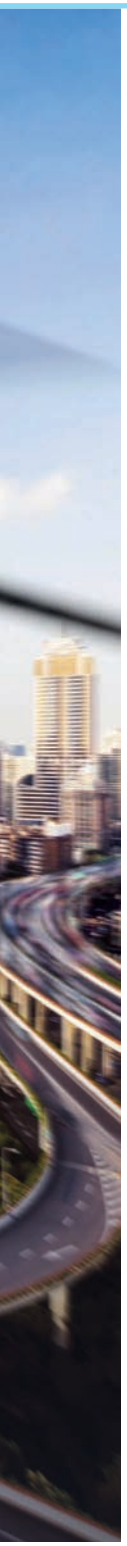
Aircraft Measurement Testing Flies High

Ensuring passenger safety by validating components and evaluating performance

Modern aircraft systems rely on precise measurement data to meet strict standards that confirm aircraft fly safe and can hold up to regular use and the elements over time. Measurement testing confirms successful operation under large temperature fluctuations, high vacuum environments, harsh atmospheric conditions, and even severe wear and impact forces.

"Instrumentation and measurement tools play a vital role in both enhancing and validating safety of a wide range of aircraft types and in the optimization of flight performance, safety, efficiency and emissions through aerodynamic optimization," says Iain Gordon, General Sales Manager, Evolution Measurement, Andover, United Kingdom. "In order to improve these parameters, understanding and therefore measurement, is essential and this is an important through all the development and testing phases and into daily operational service."

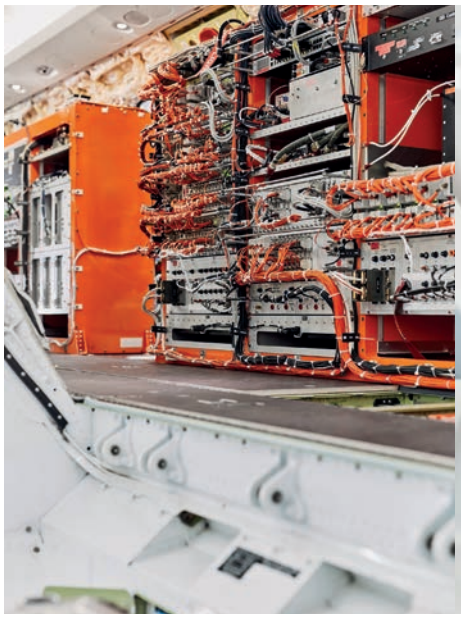
Precision measurement is an absolute necessity because even the smallest error can have significant consequences. Aircraft components must consistently meet exacting tolerances to ensure safety and performance. From the alignment of intricate components to the final



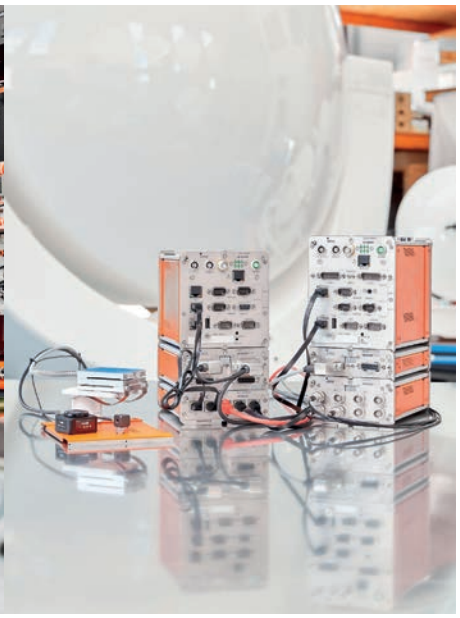
inspection of aircraft parts, precision tools play a vital role in maintaining these standards. To ensure the reliability of data acquisition and transmission during testing, Berlin, Germany-based imc Test & Measurement's flight testing system uses a telemetric data transmission. This is based on the IRIG 106 part telemetry standard, which ensures interoperability in aeronautical telemetry applications.

"At the heart of both flight test and test stand applications is a distributed and networked multi-channel data acquisition system capable of measuring hundreds of analog signals and a wide range of digital industrial buses such as Ethernet, CAN, RS232, RS422, RS485, ARINC-429, ASCB-D, MIL-STD-1553B," says Bernd Dippold, Key-Account Manager Aerospace at imc Test & Measurement. "In addition, virtually any data protocol can be captured, analyzed and processed via a programmable interface. Additionally, imc also provides data acquisition solutions for rotating components. In flight test applications, this large number of channels is often used to measure a variety of signals and record parameters across the entire aircraft, such as strain gauges, NVH, thermocouples and temperature sensors, or voltages."

Martin Stierli, Industry Lead Aerospace at Kistler Group, Winterthur, Switzerland, says, "Flight vibration testing is vital to verify the simulated data with the actually built structure. Impact force measurements can provide essential insights for bird strike events. There are countless other tests that are necessary for an aircraft." In production, consistent quality is essential. "Precisely measured and controlled joining or welding forces or regularly calibrated torque tools are just some examples where measurement solutions can make a significant difference in safety," Stierli adds.



Pilatus Aircraft under test (Copyright: imc Test & Measurement)



CRONOSflex and JDA telemetry for telemetric data transmission. (Copyright: imc Test & Measurement)

Instrumentation Insights

Las Winberg, Product Manager at GRAS Sound & Vibration, a subsidiary of Axiometrix Solutions in Holte, Denmark, confirms not only measurement tooling and instruments' importance in aerodynamic testing, but also noise and vibration analysis, and structural integrity verification during the design and manufacturing phases. "Accurate measurement data are crucial for optimizing designs, meeting regulatory requirements, and enhancing passenger comfort. Commonly used tools include wind tunnel microphones, precision accelerometers, strain gauges, and data acquisition systems. At GRAS Sound & Vibration, our microphones, including our specialized UTP (ultra-thin precision) microphones, are particularly valued for their reliability in challenging testing environments."

These instruments aim to uncover critical insights into the aerodynamic, acoustic, and structural characteristics of aircraft and their components. For example, Winberg says they can measure sound pressure levels to evaluate noise emissions or detect vibration patterns that may indicate fatigue or design inefficiencies. "The results provide engineers with actionable data to refine designs, improve fuel efficiency, and enhance overall safety. By simulating real-world conditions, these tools allow for adjustments before costly production phases."

Measurement results deliver important insights to fine-tune simulation models and provide an essential reality check. When an aircraft body or wing is excited, piezoelectric accelerometers deliver detailed information about the structure. For electric airplane or eVTOL designs, Stierli cites torque sensors that provide data on how much of the electrical power reaches the propeller. "Force sensors can measure the thrust, which includes assessing the propeller's efficiency. Pressure measurements inside battery enclosures help design them to be as lightweight as possible while ensuring complete safety. Piezoelectric high-temperature accelerometers and pressure sensors can deliver data from inside a turbine engine at up to 1000°C, aiding in the identification of potential combustion instabilities. The list of examples could go on and on."

Different Tools

Test and measurement for aircraft encompass a wide array of techniques and methodologies. The tools and equipment employed are as diverse as the systems they evaluate. For

Flight-test data analysis in real-time with imc data analysis software. (Copyright: imc Test & Measurement)

example, during the development of a new aircraft, extensive wind tunnel development work is conducted. As a key part of Evolution Measurement's portfolio, Gordon explains Scanivalve Pressure Scanners are built into the model in order to measure surface pressures across all of the flying and control surfaces. Data is gathered rapidly, accurately and synchronously and is used to optimize surface shapes to enhance efficiency, lift, drag and stability. "Streamwise 3D visualization and measurement systems also enable an understanding of the airflow topology off-surface from the model, helping the development engineers gather valuable wake data downstream from the model. When we move the tested model design to the prototype test flight phase, instruments such as the new EvoScann P10D Pressure Scanners are used on the aircraft to gather pressure data in real-world flying conditions."

These EvoScann Pressure Scanners are small, rugged and sensitive enough to be used in a wide range of locations on the aircraft to gather data in-flight, to enable real-world data to be used to validate experimental wind tunnel data taken under controlled environmental conditions, as well as validating the computational fluid dynamics data (CFD) that has previously been simulated. Furthermore, Evolution Measurement provides Avionic Testing equipment from D.Marchiori for daily use when the aircraft is in regular service, to validate the cockpit instrumentation ensuring that the pilot has safe, accurate and reliable data available to fly the aircraft before it's even left the hangar.

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Ground vibration tests with rotatable Kistler accelerometers. (Copyright Kistler Group)

Different from scanners, Dippold says component test stands can be characterized by an endurance test; the fatigue strength is recorded at several hundred measurement points with strain gauges, as in the case of the fatigue strength of winglets. In both cases, data synchronization during data acquisition ensures high accuracy and reliability of test results. "Flight test systems and test stand solutions are used for numerous different test applications. Many applications involve compliance with limit values within standards or the fulfillment of key parameters. In performance and endurance tests, for example on rotors, the development of various parameters such as temperature, speed, operational stability and electrical voltage is monitored over a defined period, aiming at optimization or the proof of fatigue and durability."

Kistler thrives on developing solutions for extreme conditions. Stierli says, "We offer sensors that operate at cryogenic temperatures, enabling successful testing of aircraft in the extreme cold of the stratosphere. Other sensors feature specially developed, in-house grown piezoelectric crystals, capable of withstanding temperatures up to 1000°C, providing insights into combustion processes inside turbines, afterburners or rocket engines."

Gordon explains new technologies, ruggedization and the miniaturization of these measurements have been key in accessing areas that were in many cases not measurable in the past. "This has enabled engineers to access new data to help speed the efficiency and accuracy of the measurement process. Innovative technologies in wind tunnel measurements have enabled better visualization of air flow and enable much quicker and more intuitive analysis of a model, minimizing downtime and enabling testing time to be maximized. This results in shorter project timescales as well as saving money and resources."

imc Test & Measurement offers smaller and lighter DAQ systems which provide faster sample rates, and easy installation of distributed satellite modules, connected by fiber-optic cables with the base system, which save time, weight and material in sensor cabling and are reducing EMI influence.

Choose the Right Instrumentation and Conditions

Choosing the right instrumentation equipment is crucial, especially with aircraft testing where tests often require significant effort and preparation time. If the captured data doesn't accurately reflect what you intended to measure, it can quickly become very costly. Therefore, Stierli believes, "It's always worth spending extra time discussing the requirements with experienced professionals to select the best equipment for the test. Where safety is paramount, unreliable measurement data is simply unacceptable. [Also,] tests involve significant resources and preparation. Inaccurate data can lead to costly setbacks, so investing time in consultations with experienced professionals ensures optimal equipment selection."

One often-overlooked aspect is the growing importance of testing under realistic conditions. For example, Winberg believes noise testing in operational environments is becoming critical as airlines and manufacturers strive to meet stricter environmental noise regulations. "Tools like GRAS KEMAR, capable of simulating human-like auditory responses, help bridge the gap between laboratory tests and real-world performance. This focus on realism not only aids compliance but also ensures higher customer satisfaction."

Gordon equates aerodynamics to being a compromise between lift, drag, stability, noise and performance, and aerodynamics optimization. "Pressure measurement is always critical, whether in development or daily lifecycle use of the aircraft. It's important to minimize or isolate external effects from the measurement chain and using the latest technology instrumentation provides huge advantages in doing this for example in being small enough to be located in optimal locations."

By Mark Robins

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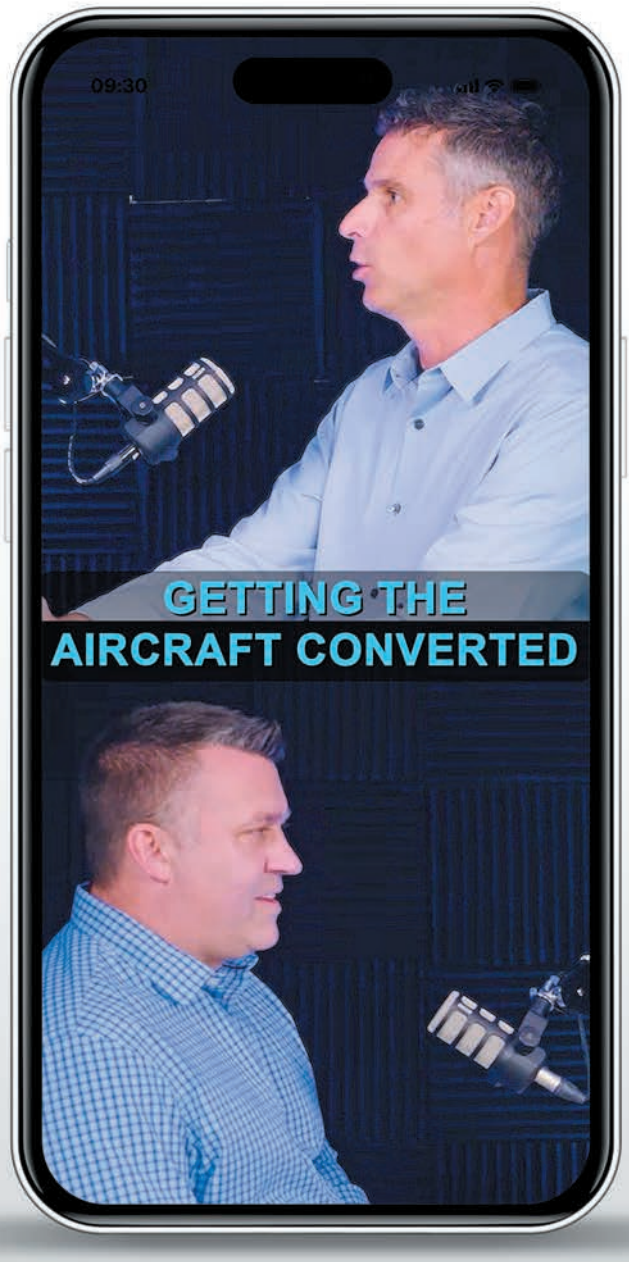

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Critical Communications:

Enabling Resilient PNT in the Face of High-Risk Vulnerabilities Inherent in Traditional GPS and GNSS Systems

Aerospace communication channels have always been strictly regulated with multiple international directives in place to prevent interference. Recent years have seen these networks increase in complexity, with position, navigation and timing (PNT) becoming essential across military and commercial applications.

In this article, VIAVI Solutions' Nino De Falcis examines the role of PNT in enabling secure and defense-in-depth communications, the inherent vulnerabilities in the global navigation satellite systems (GNSS) on which they rely, and how to address these risks.

Position, navigation, and timing (PNT) services have become indispensable for the safe functioning of a wide variety of essential services across sectors such as transportation, AI hyperscale data centers, telecommunications, energy, finance and defense. These services rely on highly accurate and secure signals to facilitate everything from guiding aircraft and maritime vessels to synchronizing financial transactions and ensuring the stability of power grids.

Recognizing the criticality of PNT resilience, governments worldwide are taking proactive steps to bolster the reliability and security of these services. Regulatory measures, mandates and frameworks are being introduced to minimize vulnerabilities and enhance resilience. For example, the US government's Executive Order

13905 emphasizes the need for the responsible use of PNT services to strengthen national resilience. This order outlines specific actions for enhancing the security and resilience of critical infrastructure by mitigating risks associated with the disruption or manipulation of PNT services.

Frameworks and Standards for PNT Security

To support these mandates, various frameworks and standards have been developed to guide organizations in enhancing their PNT systems:

- NIST 8323.1 Cybersecurity Framework for PNT Profile: Developed by the National Institute of Standards and Technology, this framework offers a comprehensive approach to assessing and mitigating cybersecurity risks specific to PNT services. It outlines a set of cybersecurity activities, desired outcomes and informative references tailored to the unique characteristics and requirements of PNT operations.
- IEEE Resilient PNT P1952 Standard: Developed by the Institute of Electrical and Electronics Engineers (IEEE), this standard defines a framework for assessing the resilience of PNT services against threats and hazards, addressing key aspects such as system architecture, redundancy and interoperability.
- DHS Resilient PNT Conformance Framework: Developed by the Department of Homeland Security, this framework provides a structured approach to evaluating and certifying

the resilience of PNT solutions

- CISA Federal PNT Services Acquisition Guidance: This guidance, issued by the Cybersecurity and Infrastructure Security Agency (CISA), helps federal agencies acquire resilient PNT services while ensuring compliance with national security directives.
- EU NIS2 Compliance of Verified GNSS Data Stream: This new EU directive covers cybersecurity and compliance requirements.
- UK Royal Institute of Navigation PNT Resilient Initiatives: From PNT best practices and resilience checklist to PNT guidance, various initiatives are shared to protect critical infrastructure operations from PNT disruption.

Together, these frameworks and guidance documents form a comprehensive toolkit for enhancing the resilience and security of PNT services, safeguarding critical infrastructure and national security interests.

High-Risk Vulnerabilities Posing Significant Risks to Critical Infrastructure

PNT services predominantly rely on signals from global navigation satellite systems (GNSS) such as GPS (United States), Galileo (European Union), and GLONASS (Russia). However, as a single source of failure, GNSS is inherently vulnerable to various threats that can compromise accuracy and reliability.

Of particular concern is the susceptibility of GNSS signals to intentional interference, notably jamming and spoofing. Jamming involves the transmission of radio waves that overpower the genuine GNSS signals, effectively denying access to positioning data. Spoofing is the transmission of counterfeit signals designed to mislead receivers and have them report false location or timing data. Meaconing is a sophisticated spoofing attack, whereby the signal is recorded and then played back, making it extremely difficult to detect and mitigate. Other malicious threats include cyberattacks on network timing targeting NTP/PTP protocols and GPS/GNSS receivers.

GNSS signals are also vulnerable to naturally occurring phenomena. These include multi-path errors, which are caused by signal reflections off buildings and geographic features. Similarly, ionospheric effects, particularly prevalent at certain latitudes and during solar storms, can induce signal delays.

Recent incidents highlight some of the vulnerabilities inherent in PNT services, particularly in critical sectors like aviation. In May 2024, Reuters reported on a sharp increase in GPS jamming and spoofing in regions close to conflict zones such as Ukraine – causing problems for modern airliners that still rely to a large degree on GPS. In extreme cases, pilots have been forced to disable GPS systems entirely, leading to flight delays and operational challenges.

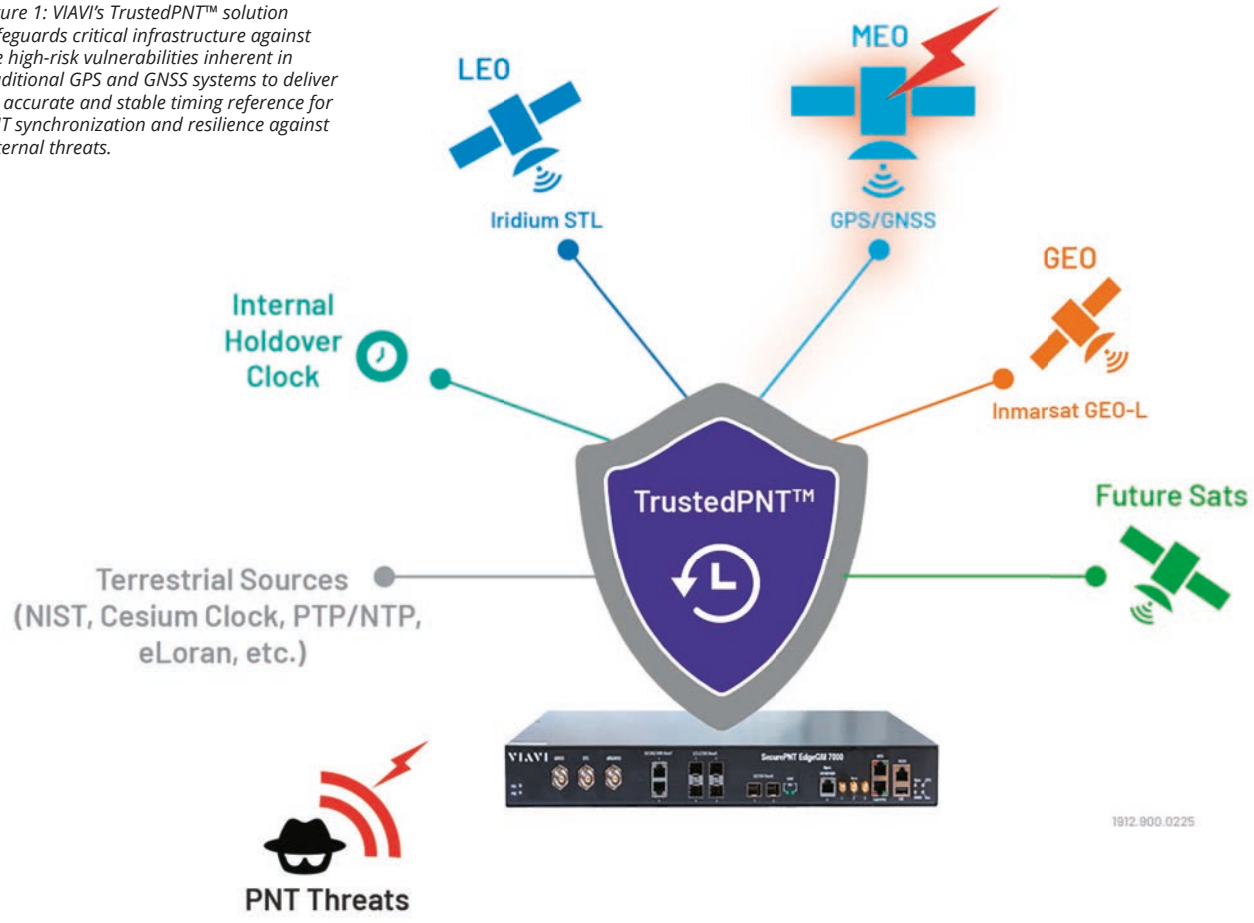


Figure 1: VIAVI's TrustedPNT™ solution safeguards critical infrastructure against the high-risk vulnerabilities inherent in traditional GPS and GNSS systems to deliver an accurate and stable timing reference for PNT synchronization and resilience against external threats.

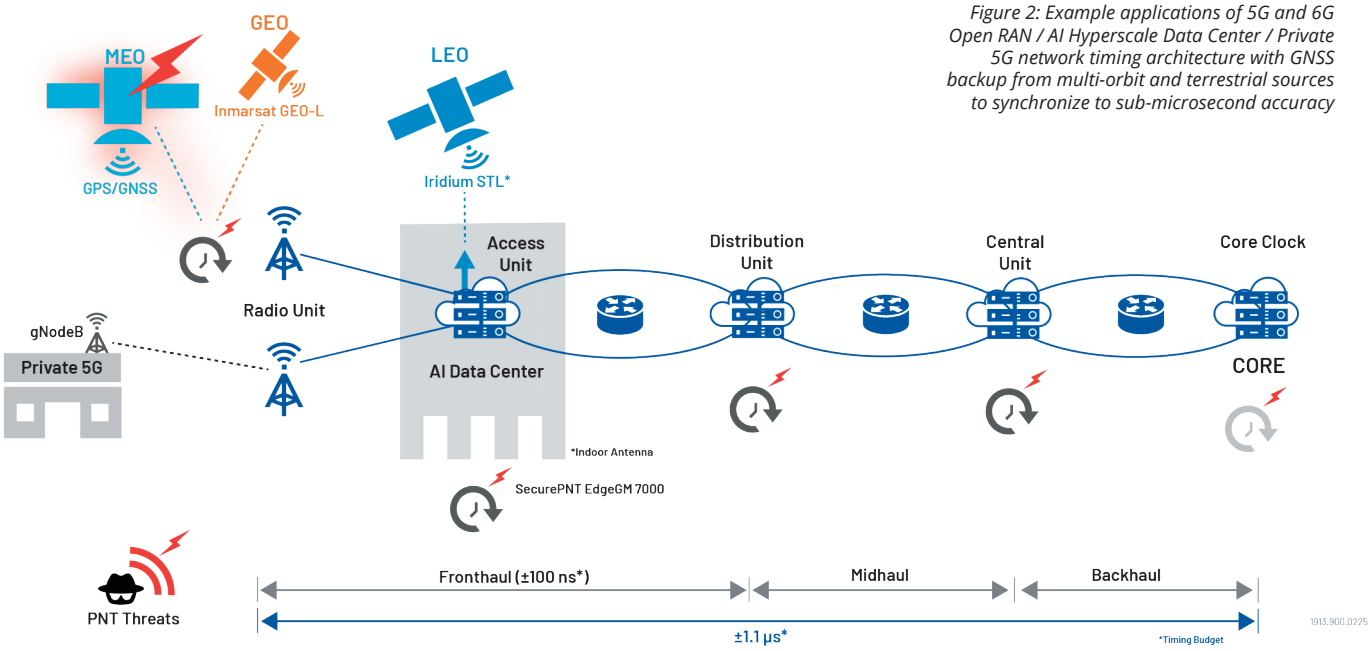


Figure 2: Example applications of 5G and 6G Open RAN / AI Hyperscale Data Center / Private 5G network timing architecture with GNSS backup from multi-orbit and terrestrial sources to synchronize to sub-microsecond accuracy

The National Business Aviation Association (NBAA) has also reported an uptick in incidents of GPS disruption. Pilots report navigation errors, flight deviations and compromised safety during critical phases of flight due to spoofing and jamming.

Such disruptions emphasize the urgent need for critical infrastructure operators to take steps to reinforce resilience and reliability.

Strategies to Improve PNT Resilience

Protecting these vital services is possible but requires a multi-layered approach, with robust signal authentication and multiple data sources being a key protection.

The use of multiple timing sources – adding alternative GNSS (altGNSS) from low-earth orbit satellites and enhanced GNSS (eGNSS) from geostationary satellites to information from traditional GNSS constellations – makes it more difficult for attackers to disrupt a system and use jamming techniques. For example, VIAVI's new SecurePNT™ EdgeGM™ 7000 series integrates advanced resiliency from multi-orbit space and terrestrial sources and high-speed Grandmaster clock capabilities – enabling it to authenticate, verify, qualify and learn from multiple timing sources.

Multiple timing sources also help safeguard against timing failures in 5G networks, which depend on Precision Time Protocol (PTP) and GNSS signals to synchronize to sub-microsecond accuracy. In 5G Open RAN architecture, multiple components including Radio Units (RUs), Distributed Units (DUs) and Central Units (CUs) rely on highly accurate timing for network efficiency and performance. Redundant timing sources from PTP grandmasters or atomic clocks help ensure the reliability of critical applications like 5G, where even microsecond-level timing errors can cause packet loss, lower throughput and handover failures – resulting in degraded performance and user experience.

Advanced antenna systems can also play a crucial role, employing sophisticated signal processing to identify and mitigate interference, whether it's intentional jamming or unintentional disruption. These systems can filter out spurious signals, ensuring that receivers lock onto the authentic GNSS transmissions.

As for natural vulnerabilities, enhanced algorithms that mitigate against multipath errors and atmospheric effects are being developed and are now starting to be implemented. These algorithms combine data from multiple sources, such as inertial sensors and terrestrial radio-navigation systems, and incorporate sophisticated signal processing techniques and atmospheric models to improve accuracy.

Conclusion

A wide range of critical services rely on GPS and other PNT systems – from navigation, route planning and collision avoidance for aviation, maritime vessels, railways and public transit systems to telecommunications networks and the synchronization of power grids, smart meters and other critical components in the energy sector.

As reliance on PNT services continues to grow, ensuring their resilience has become a top priority for governments and industries worldwide. With increasing threats from jamming, spoofing, and natural disruptions, a multi-faceted approach is essential. Alternative PNT sources delivering an accurate and stable timing reference offers a way to meet this challenge head-on, allowing networks to be deployed with uninterrupted connectivity while safeguarding critical infrastructure against emerging threats.

By Nino De Falcis, Senior Director, Global PNT Business Development, VIAVI Solutions

Play, Pause, Rewind

A look at the some of the dynamics of the wireless and seatback IFE landscapes

United Airlines' recent financial results are indicative of an industry enjoying positive demand trends for air travel.

For the full year 2024, the airline operated the most flights and carried the most passengers in its history as customers reacted positively to the carrier's ongoing investment in technology and the travel experience executed under its United Next plan. United Next is the company's long-term strategy to position the airline as a leading carrier, right sized with fleet flexibility and 'revolutionising the experience of flying United' with a vastly improved customer experience standard that places a premium on the overall comfort of flying.

This includes the agreement with SpaceX to bring Starlink's Wi-Fi service to more than 1,000 of the airline's mainline and regional aircraft, providing members of its loyalty programme MileagePlus free, fast, reliable internet connectivity on some passenger flights as soon as Spring 2025.

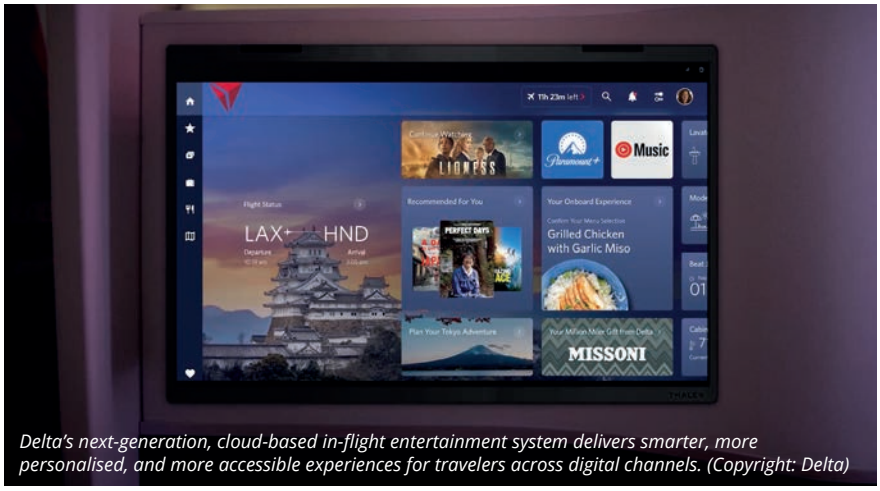
Additionally, the airline has surpassed 300 new and retrofit aircraft in 2024 featuring United's signature interior with bigger bins, seatback screens at every seat and Bluetooth connectivity, resulting in a 4.5 point improvement in customer satisfaction with inflight entertainment.

Delta's commitment to evolving the in-flight entertainment experience

Astrova from Panasonic is the company's most widely adopted IFE platform. (Copyright: Panasonic Avionics)

is also paying dividends. According to the carrier, two years of fast, free Wi-Fi has reinforced what the airline knew to be true when it went "all-in" on free Wi-Fi and seatback screens: connectivity and entertainment are more valued than ever, with customers that are increasingly digital savvy and seeking personalised experiences.

"Delta is constantly listening to our customers and evolving to meet their needs," said Julieta McCurry, VP of In-



Delta's next-generation, cloud-based in-flight entertainment system delivers smarter, more personalised, and more accessible experiences for travelers across digital channels. (Copyright: Delta)

Flight Entertainment and Connectivity. "We know they want an in-flight experience similar to what they have at home, including more ways to engage and stay entertained."

Delta Sync is Delta's personalisation brand accessed through membership of its frequent flyer programme, SkyMiles. Launched in 2023, it currently comprises Delta Sync Wi-Fi and Delta Sync Seatback.

Delta Sync Wi-Fi is transitioning from Intelsat system technology to Viasat for high-speed connectivity onboard domestic mainline routes (with the exception of the 74 aircraft in Delta's Boeing 717 fleet) and international-serving widebody fleets, and Hughes for streaming-capable connectivity to Delta's fleet of more than 400 regional jets as well as to the Boeing 717 fleet. In partnership with Hughes, Delta is exploring a connectivity solution that will enable simultaneous multi-network connectivity, expected to fly onboard in late 2025, providing more reliable streaming to personal devices and more stable performance across Delta's global network.

Coinciding with celebrations marking its centenary year, Delta is collaborating with Thales Avionics, to introduce a next-generation Delta Sync seatback experience onboard beginning with select new aircraft deliveries starting in 2026.

The forthcoming enhanced Delta Sync seatback is powered by FlytEDGE the first cloud-native IFE system. Features of the new system include an intelligent 4K HDR QLED display, offering a high-contrast, theatre-like viewing with over 1 billion vibrant colours, Bluetooth capabilities so passengers can pair their wireless devices, and Thales' Onboard Data Center (ODC) with 96TB of storage, – over fifty times the average Delta IFE system capacity - to enable edge caching, bringing immense volumes of content and instant streaming experiences to passengers.

Seatback survival

It wasn't that long ago that doomsday sayers were predicting the demise of the seatback screen, but as Andy Masson, Vice President Product & Portfolio Management at Panasonic says, the market has changed quite a bit over the last few years.

He explains that with the advent of personal electronic devices (PEDs) there was a big question mark over whether airlines were going to continue to install seat back IFE.

"Some airlines in certain regions never put IFE in, typically, because they were short haul flights. And the reality was the system was not cheap or particularly light, so, there was a penalty to pay for it," he says. "But some of the challenges of the past have quelled a little bit: the IFE solutions today are considerably lighter weight, so they're easier to install on aircraft.

The AirFi box, now in its third generation, is a leading portable IFE product thanks to its quick deployment, flexible open platform architecture, long battery life and exceptional safety qualifications. (Copyright: AirFi)

"The challenges around Head Impact Compliance (HIC) and certification, with our latest generation of seatback [Astrova] has largely been quelled because it's so good, it performs so well."

In conversation with Aerospace Innovations, Masson reveals that Panasonic has seen its revenue income from the wired seatback solutions exponentially increase. "More and more airlines are looking at seatback and I think what that is doing is creating a market force differential between the airlines that don't have it and do have it that's been recognised in ticket sales. So, you're seeing it is differential in passenger experience and expectation. And I think what that's now then doing is creating in those regional markets a more focused approach toward the seatback. We're seeing it becoming more of a hygiene factor."

Panasonic's next-generation Astrova IFE platform is its fastest adopted IFE solution with 70 airline program commitments in just two years since launch. As Masson alludes, this equates to over 250,000 screens across 1,000 aircraft. Summing up, Masson says Astrova is the company's lightest system with the best technology. Additionally, it's both modular and updatable, which was never previously the case. "So, it answers all the questions that the market was asking," he confers.

Staying connected

Supporting its IFE portfolio is Panasonic's connectivity services. As Masson says, "I think it's very rare to have Panasonic connectivity and someone else's entertainment system. If you have a connectivity system with us, you almost certainly sit in front of one of our seatbacks, like 99% of these, but we do offer our entertainment system with other connectivity systems."

Over recent years, the company has invested in enhancing its inflight connectivity (IFC) service with a substantial expansion of its global connectivity network. For example, in 2023, Panasonic added new HTS (High Throughput Satellites) and XTS (Extreme Throughput Satellites) capacity over North, Central, and South America, Europe, the Middle East, the Arabian Sea, Africa, and the Indian Ocean. The satellites also cover both the North and South Atlantic Ocean. It also extended its capabilities in Asia with additional HTS capacity over China and Japan.

The company is also advancing plans to launch multi-orbit connectivity services, incorporating an electrically steered antenna (ESA) capable of accessing a combination of GEO and LEO (low earth orbit) satellites. To facilitate this, it has signed a multi-year collaboration with Kognitive Networks to integrate secure multi-channel aggregation technology into its IFC services.

Wireless attraction

Wireless (or streaming) IFE is ideal as a standalone solution as well as being a great compliment to seatback for airlines that want to provide a more robust IFE experience.

Panasonic has had a wireless solution, eXW, for quite some time. As Ken Sain, Chief Executive Officer of Panasonic Avionics Corporation has previously commented, "Wireless IFE remains a critical component of many airlines' strategy." He says eXW can create a unique experience that combines passenger entertainment, digital apps, and onboard retail into a truly unique passenger experience with a competitive total cost of ownership and a compelling ROI.

AirFi's portable wireless IFE solution is classed as carry-on equipment, so no STC or further paperwork is required. Job Heimerikx, CEO of AirFi explains that, "The boxes have an impressive battery life, and we also offer a semi-embedded solution whereby a small cradle is installed into the overhead bin that connects the box to aircraft power. Our box is fully automated, taking cues from the aircrafts ADS-B signal so crew don't need to worry about turning the system on or off at the correct altitude. Given that 99% of passengers now carry Wi-Fi enabled devices with them onboard, wireless IFE is a solution that everybody can use and that airlines can deploy rapidly with little capital investment."

According to Heimerikx there are around 1,300 aircraft worldwide utilising the AirFi IFE solution daily, with a similar number of aircraft operating the company's mobile point-of-sale solution.

"As a bonus, our W-IFE solution forms the backbone of our connected crew and LEO connectivity solutions, so building upon a great entertainment experience with digital inflight retailing and instant messaging is very easy,"

Airlines are increasingly investing in seatback screens, as costs and other considerations can be offset by ancillary revenues. (Copyright: Panasonic)

says Heimerikx.

LEO is a lightweight and drag-free system thanks to AirFi's innovative window-mounted antenna.

Speaking to Aerospace Innovations, Heimerikx says that from an obvious (and wholly passenger-centric) perspective, activating LEO enhances the W-IFE experience by giving passengers the ability to send and receive text-based messages from work, friends or family. From a less-obvious perspective, the passengers' shopping experience onboard (which is tightly integrated with entertainment content as part of a "Mall in the Sky") can be enhanced in other ways.

"LEO enables online card payment validation, which gives airlines the confidence to sell more valuable items onboard," he explains. "Where before the fear of payment fraud limited the scope of inflight retail programs, now airlines can add more attractive and higher value items to the inflight selection. As well, airlines can utilise LEO connectivity to check inventory of third-party offerings like hotel rooms and car rentals. LEO's IP connection means that if airlines want to offer such items through the streaming IFE system, transactions can be completed and confirmed inflight, and the passenger can receive confirmation of their booking."

While these benefits improve the passenger experience, Heimerikx says the key benefit for airlines is operational. "LEO enables real-time communication with the ground, which means that crew can communicate with maintenance teams and catering units to speed restocks and repairs for faster turn times.

"Add this to reducing fraud and missed payments, which significantly boosts onboard ancillary revenues, and you can begin to see why it makes perfect sense."

According to the company, AirFi LEO was contracted for installation on 50 aircraft by Q1 2024 and these installations, plus a variety of expansions and new airlines that have since been added, are ongoing. More than half of the installations under contact have now been completed. "There have been a few delays, mainly tied to paperwork holdups administrative reasons than anything else," admits Heimerikx. "Any new technology will have teething issues with implementation, so this was expected. We're encouraged by how quickly these issues have been resolved and rollouts are now accelerating. We expect to complete LEO installations on our first 50-60 aircraft before the second half of the year."

Heimerikx says that AirFi does not push or require all wireless IFE customers to adopt LEO, but that they are seeing keen interest in the product from existing and new customers alike. "We designed LEO around providing true value to airlines and people can easily see this. Rather than enforcing technology, AirFi focuses on meeting the unique needs of each airline. We see ourselves as providers of a unique toolbox, allowing airlines to choose the solutions and tools that best serve them."

To help airlines in their choice further, AirFi is advancing its hardware with keen eye to creating and improving solutions to be profitable for the airline. "We develop hardware entirely in-house, ensuring full control over technology stack and enabling continuous innovation. Looking ahead, 2025 will be a significant year with the launch of AirFi's new-generation portable streaming box in the second half of the year. The "Jupiter Box" on from our first- and second-generation boxes, known as "Venus Box" and "Mars Box", respectively.

"In the shorter term, we're working on a new application for LEO that we think is going to delight everyone – but that's all we can say about that now!" Heimerikx teases.

Bluetooth benefits

One technology offering airlines an alternative to traditional inflight connectivity services is Bluetooth.

According to Ron Chapman, Chairman and President of ASIP Tech, the industry's focus has predominantly been on broadband Wi-Fi, largely due to the demand for video streaming. He believes that as a result, proposing Bluetooth as a solution can seem unconventional. "Airlines often struggle to embrace this concept initially, and shifting industry perspectives is inherently challenging," he observes.

Integrating a Bluetooth network allows airlines to connect all passengers, including crew members, using only narrowband and a single access point. This approach simplifies installation and reduces equipment costs, as traditional Wi-Fi systems typically require at least two access points and broadband connectivity to achieve similar coverage.

Chapman says that the appeal of the company's fflya solution lies in its proven, ultra-low-cost platform that not only offsets installation expenses but also generates new revenue streams while addressing key operational challenges for airlines.

"On short-haul flights, live

streaming isn't essential, as passengers often bring their own content," says Chapman. "Eliminating the need for streaming reduces data requirements to short bursts—such as texts, telemetry, and credit card transactions—which are well-suited for Bluetooth."

As Chapman explains, fflya is designed to keep passengers within the airline's booking app. Notably, major airlines like Delta and United now require passengers to download their apps for free connectivity.

"We provide self-contained PODs for each module, which are integrated into the airline's app. Our Bluetooth messaging functions similarly to an eSIM but is accessible exclusively through the airline's app.

"All our modules aim to create marketing and revenue opportunities for airlines by retaining passengers within the airline's ecosystem. Our efficient Bluetooth network and algorithms result in minimal data costs per transaction. Additionally, our custom gateways offer real-time access to every flight, enabling live promotions and advertising control to boost in-app sales.

"Unlike Wi-Fi, where passengers gain unrestricted internet access and airlines lose marketing opportunities, fflya engages the audience by keeping them within the airline's-controlled environment. Offering free Wi-Fi often means paying to provide passengers access to external platforms, leading to missed revenue opportunities—a counterintuitive approach given the captive audience onboard."

This is a point picked up by Masson, who argues that with W-IFE, the airline is reliant on a passenger to bring along their own device. "When that happens, they're typically going outside of the airline's environment. If you're an airline and you have a digital presence, you want, ideally to keep your passengers inside your digital environment." Panasonic characterises the digital channel through three channels: airline website, airline app (both pre-flight environments) and the onboard IFE system.

Walled garden

"If you have your own solution, you have a way out of the airline's digital environment. If you bring a tablet or a smart phone on board, more often than not, you're going to have your own content or content provision that you're bringing with you," says Masson. "Or if you sign up to the connectivity solutions, and they're getting better and better all the time, you're again putting yourself outside of the airline's environment." Passengers may then visit apps like YouTube or Netflix, and access their library of download or

United Airlines' investment in customer experience is paying off with high NPS scores and improved customer loyalty. (Copyright: United Airlines)

purchased content.

"That's the differential between the wireless environment and the seat back environment. When you're in the seat back environment, then the airline can get you with targeted digital advertising, and they will make significant ancillary revenue from that, particularly if they can personalise that to your persona. If you're in their application, and you're in their website, and they know you as a traveller, a business traveller, and you're going from London to LA and they can build a persona around you. At that point, if you log into your seat, log in to get extra amenities, or you want extra miles or something, they can then target you with specific advertising. We see this on pre roll videos. And that's where the beauty of the seatback comes in for the airlines: it's not just a way of increasing digital engagement."

A notable development that may elevate Bluetooth's prominence is Ryanair's creation of a Bluetooth Order to Seat feature within their app, "a concept we've advocated for years and previously tested on Wizz Air," says Chapman. "In early 2023, we introduced "BOB" (Bluetooth On Board), intending to deploy the Bluetooth network without Satcom initially. It's encouraging to see this concept gaining traction." Over the past year, Chapman says they've observed a shift in interest, with multiple programs currently undergoing various stages of evaluation with seven different airlines.

Regarding Wizz Air, Chapman says his team completed initial passenger trials on six of Wizz Air UK's A321ceo aircraft. Wizz Air planned to issue an RFI for fleet-wide implementation; however, challenges related to NEO engine issues led to the relocation of the fflya equipped ceo aircraft to the EU and Dubai, pausing the program. Tens of thousands of passengers downloaded and used the app, averaging 15 messages per passenger—70% via WhatsApp, 29% SMS, and 1% email—aligning with Wizz Air's demographic.

"We are optimistic that once these issues are resolved, live connectivity will return to Wizz Air's agenda. Thanks to our collaboration with Wizz Air, we also conducted a live flight test of in-app payment and lab integration with Teledyne's AID. These are critical operational aspects, as achieving 100% coverage for live payments necessitates a roof antenna, and managing live AID data via Satcom is crucial to avoid unexpected costs."

In 2024, ASIP introduced its custom-designed second-generation Iridium Certus100 airline module, recently commissioned on a Boeing 767. This advancement is significant claims Chapman, as in addition to free messaging, it now supports three interfaces for live payments (in-app, EPOS, and content server) plus AID and incorporates cockpit voice capabilities with a CVR interface, thereby expanding support for crew operations.

AirFi LEO is an antenna, smaller than a pen placed inside one window on each side of the plane in just a few hours. (Copyright: AirFi)

Whatever camp in you're in, seatback or W-IFE, with the support of inflight connectivity airlines can open huge revenue streams, and more importantly engender passenger loyalty.

By Alexander Preston

AVIONICS AND TESTING INNOVATIONS

Conference and Exhibition

20th-21st May 2025

London, UK

www.avionicsandtesting-innovations.com

Preliminary Conference Programme and Guide

Join us at **Avionics & Testing Innovations Conference & Exhibition** in London on 20th-21st May 2025, the premier event for industry professionals shaping the future of flight, flight deck and cockpit capabilities for the commercial and defense sectors.

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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025

London, UK

Dedicated Conference & Exhibition for the Avionics and Testing Community

Avionics and Testing Innovations delivers a premier platform for the international avionics, testing and certification industries, across commercial and defence aviation, to learn, network and source new information, products and services at one unique annual event.

Single European Sky (SESAR 3 JU – a key enabler of the European Commission's Sustainable and Smart Mobility Strategy) and NextGen continue to dominate the aerospace industry, with targets of ensuring the utilisation of technology to increase traffic, improve aircraft and control communications whilst enhancing safety in an ever increasingly busy sky. Safety in all aspects of aviation is something we encourage active discussion and information sharing at the conference.

With many platforms currently in use, how does the industry ensure consistency, integration and reliable communication between and across these platforms to meet these objectives?

Avionics and Testing Innovations offers a leading conference programme, with excellent content and discussions, which includes strategic and technical details, delivering high level and quality presentations for both the commercial and defence sectors, fixed wing and rotorcraft.

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- For what the Pilot wants, the Aircraft needs and Industry must have.
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Avionics and Testing Innovations will discuss topics and issues of the day and demonstrate and showcase new products, developments, technologies and services available on the market, and also key elements of the upgrades and retrofits market, as well as research and innovations delivering the transformation to the Digital European Sky.

This Preliminary Conference Guide, provides you the information you need to plan your participation at the event.

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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025

London, UK

Who is it for?

Avionics and Testing Innovations is designed for a broad representation from civil, government and military organisations, of senior management, project leaders, senior engineers, executives and decision makers who have the authority to purchase, or influence the purchase of products and services, from the following sectors:

- Airlines and Operators
- End users
- Airframers
- Integrators
- Prime contractors
- Design & Planning
- Aviation electronics and avionics manufacturers, fixed wing and rotorcraft
- Testing and Certification
- International Defence Agencies / Ministry of Defence
- Armed Forces

Delivering a complete value – added chain:

- **Airlines, Operators, End Users & Airframers**
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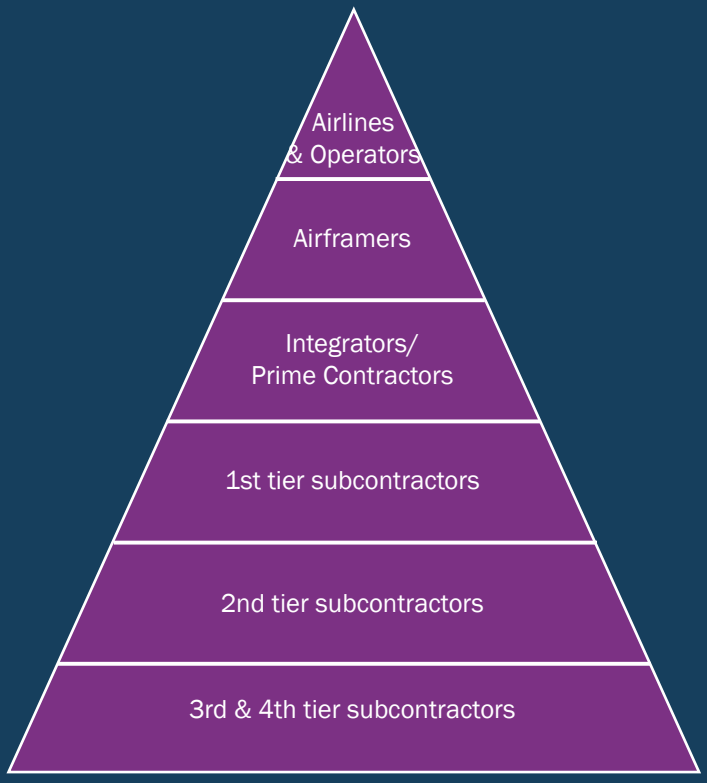
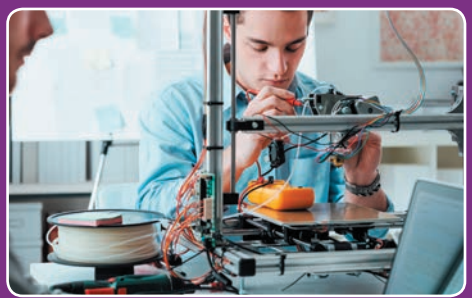
- **3rd tier subcontractors** - produce machine components and sub assemblies, focusing on basic materials or manufacturing processes
- **4th tier subcontractors** – specialising in production of particular components and specific processes

Testing and **certification** are integral parts of the aerospace supply chain. Specialised testing facilities, often operated by Tier 1 suppliers or independent testing organizations, ensure that components and systems meet rigorous quality and safety standards.





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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025

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Avionics & Testing Innovations is the premier platform for the international avionics and aviation electronics industry to learn, network and source new information, products, technologies and services at one unique annual event.

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5. Discover the latest and future avionics technologies and solutions at the exhibition with leading solutions providers
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7. Learn about the latest trends facing the avionics and aviation electronics

Job Titles (Examples of):

- Avionics Supervisors
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- Director/Head of Avionics
- Senior Avionics Engineers
- Senior Avionics Systems Engineers
- Avionics Engineers
- Avionics Software Engineers
- Avionics Technicians
- Design Engineers
- Senior Avionics Hardware Test Engineers
- Avionics Systems Specialists
- Nav and Comms Engineers
- Certification Managers
- Senior Certification Engineers
- Certification Engineers
- Director/Team Lead of Certification
- Certification and Compliance Engineers
- Avionics Testing Engineers
- Senior Test Engineers
- Director/Head of Testing
- Flight Test Engineers
- Cybersecurity Engineers
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- Validation Engineers
- Systems Integration Engineers
- Embedded Software Engineers
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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025
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All Access Delegate – Commercial & Industry	All Access Delegate – Military/Defence & Public Sector	All Access Delegate – Research/Student
~~£ 695~~ **£ 495**	~~£ 295~~ **£ 195**	~~£ 295~~ **£ 195**
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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025
London, UK

Schedule of Events

Tuesday 20th May

	AVIONICS TRACK	TESTING TRACK
9.00am-10.30am	Joint Opening Keynote	
10.30am-11.00am	*Networking Coffee Break*	
11.00am-12.30pm	Latest in Regulations and Mandates	Digitalisation and New Tools for Testing and Certification
12.30pm-2.00pm	*Networking Delegate Lunch*	
2.00pm-3.30pm	Connectivity and Communications	Complex Systems (Hardware and Software) Testing and Certification
3.30pm-4.00pm	*Networking Coffee Break*	
4.00pm-5.30pm	From Air to Ground	AI and ML in Testing
5.30pm-7.30pm	*Networking Reception in Exhibition Hall*	

Wednesday 21st May

	AVIONICS TRACK	TESTING TRACK
9.00am-10.30am	AI and Automation in the Cockpit	Digital Twinning and Simulation
10.30am-11.00am	*Networking Coffee Break*	
11.00am-12.30pm	Cyber threats and security in Avionics and Air to Ground	FACE Developing Technical Standards & Updates
12.30pm-2.00pm	*Networking Delegate Lunch*	
2.00pm-3.30pm	Latest Technologies & Developments in the Cockpit/Flight Deck	Multi-core and Multi-systems
3.30pm-4.30pm	*Walk the Exhibition Floor*	

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AVIONICS TRACK DAY ONE PROGRAMME
Tuesday 20th May

9.00 - 10.30am

JOINT OPENING KEYNOTE
Chair: Alex Preston
Alexander Gerritsen, Chief Pilot, easyJet, Netherlands
Alicia Taylor, FACE Consortium Director, The Open Group
Vincent De Vroey, Civil Aviation Director, ASD

10.30am-11.00am **Networking Coffee Break in Exhibition Hall**

11.00am-12.30pm

Latest in Regulations and Mandates
As the industry transitions from the Single European Sky (SES) operational framework to a new European Union Aviation Safety Agency (EASA) framework, what are the challenges of the new framework for aviation, in particular for manufacturers and ANSPs? What's the latest with SESAR 3 in delivering the Digital European Sky? How will the new framework, comprising five regulations, increase interoperability, make the performance of ATM ground equipment more uniform, and support the introduction of innovative technologies to reduce air congestion? How do Air Navigation Service Providers (ANSPs) navigate the implementation process of the new framework? Standardization and simplification of regulations are key objectives to ensure a smooth transition. The ongoing debate between EASA and the Federal Aviation Administration (FAA) highlights the complexities of international cooperation in aviation regulation. Additionally, the rapid development of drones and EVTOL aircraft necessitates updates to existing regulations to accommodate these emerging technologies.
Chair: TBC
Common Project 1 (CP1) Update - Heiko Teper, Head of Strategy and Technical Execution, SESAR Deployment Manager
DO326A - Airworthiness Security Process (Cyber) (EUROCAE - ED200-2 - WG72) - Mark Watson, Technical Programme Manager, EUROCAE
Evolution of Dynamic Airspace Reconfiguration to Accommodate U-space Traffic in Shared Controlled Airspace Above 500 ft - Sergio Ruiz, ATM and U-space innovation expert, EURCONTROL Innovation Hub
Reducing the administrative burden on DOAs whilst maintaining standards - Ian Devine, Managing Director, Devine Aero Consultancy, Germany

2.00pm-3.30pm **Networking Lunch in Exhibition Hall**

2.00pm-3.30pm

Connectivity and Communications
The advent of 5G networks has brought significant advancements in connectivity, but also presents challenges, such as spectrum scarcity and potential interference with avionics systems. Spectrum co-existence strategies and advancements in datalink technology over Internet Protocol (IP), such as ACARS over IP, are essential to mitigate these issues. What is the status of connectivity systems for data transfer, Datalink implementation and future upgrades? Satellite communication (SATCOM) links play a crucial role in connecting aircraft to avionics and mission systems, providing secure and reliable data transmission. How can LEO and GEO Satellites contribute to the IFC connectivity equation? How is the transition from ACARS to remote data access offering significant improvements in efficiency and security? Centralized SATCOM-based data monitoring enables real-time insights and proactive maintenance, whilst integrating satellite technology with aircraft and ground stations creates a robust relay network, enhancing connectivity and enabling the seamless integration of new wireless systems. As the industry looks towards the future, 6G promises hyperconnectivity, with even higher speeds, lower latency, and enhanced capabilities, further revolutionizing communication and data exchange.
Chair: Alex Preston
The future of ACARS Datalink, Cellular & Wi-Fi Gatelink & Satellite Data Communications in Aviation - Willie Cecil, Senior International Sales Director, FLYHT Aerospace Solutions
QKDSat Project – Quantum Key Distribution Satellite (QKDSat) - Senior Representative, Honeywell*
Validation for ATN IPS Standard - Chair of WG-108 and WG-92*
SatCom / LDACS - Spectrum Co-existence - TBC

3.30pm-4.00pm **Networking Coffee Break in Exhibition Hall**

4.00pm-5.30pm

From Air to Ground
Safer skies rely on Air Traffic Management (ATM) systems that rely on Air Navigation Service Providers (ANSPs) to ensure safe and efficient air traffic flow. ANSPs operating remote centres and towers managing airspace architecture, an integrated ATC, and coordinating aircraft movements, have an increasing workload. How do developments in 4D trajectory based ops (TBO) support air traffic flow? What's the latest in Performance Based Navigation (PBN), and IRIS Air Traffic Modernization Programme? Artificial intelligence (AI) has the potential to revolutionize ATM by improving separation standards, optimizing ground movement, and streamlining take-off procedures. What are the current discussions on AI teaming and online machine learning? By considering factors such as UAM, EVTOLs, UAVs, drone traffic, helicopter operations, and other aircraft types, AI can also assist in developing more efficient and resilient airspace management strategies.
Chair: Simon Brown, easyJet
TBO support and 4D trajectories - Okuary Osechas, WG-85 Chair
Performance Based Navigation - Senior Representative, EUROCONTROL
Space Based ADS-B - Senior Representative, Aireon*
IRIS Update - TBC

5.30pm-7.30pm **Networking Reception in Exhibition Hall**

TESTING TRACK DAY ONE PROGRAMME
Tuesday 20th May

9.00 - 10.30am

JOINT OPENING KEYNOTE
Chair: Alex Preston
Alexander Gerritsen, Chief Pilot, easyJet, Netherlands
Alicia Taylor, FACE Consortium Director, The Open Group
Vincent De Vroey, Civil Aviation Director, ASD

10.30am-11.00am **Networking Coffee Break in Exhibition Hall**

11.00am-12.30pm

Digitalisation and New Tools for Testing and Certification
The evolving landscape and digitalisation of avionics hardware and software testing and certification brings opportunities, but also challenges. Staff shortages and the need for skilled engineers with digital capabilities are significant concerns, as well as there is a growing interest in model-based approaches and alternative languages. Addressing these challenges requires effective training programs and strategies to attract new talent. The digital transformation of avionics testing necessitates a proactive approach to workforce development and the adoption of advanced testing methodologies, such as testing for data leaks and exploring the potential of virtual health monitoring or formalising Human Machine Interface (HMI) certification in the context of avionics systems. It is essential to invest in innovative testing tools, methodologies and digitisation to ensure the safety and reliability of software systems..
Chair: Alex Preston
Mark Roboff, Chief Vision Officer | G34 Aerospace AI Implementation and Certification Committee, SkyThread | SAE International
EFB testing requirements for EASA/FAA/ANAC EFB approval - Klaus Olsen, EFB Admin Services
How digitization is enabling faster certification of eVTOL aircraft – Aziz Tahiri, VP Global A&D and Industry Team Lead, Hexagon
Digital Security by Verification: Fuzz Testing on CHERI - Paul Butcher, UK Programme Manager, Head of Dynamic Analysis, AdaCore

12.30pm-2.00pm **Networking Lunch in Exhibition Hall**

2.00pm-3.30pm

Complex Systems (Hardware and Software) Testing and Certification
New complex chips, often with multiple levels of cores, makes it difficult to understand their internal behaviour and design effective testing strategies, highlighting the challenges of certifying Systems on Chips (SoCs) in the context of multicore architectures. Issues such as power management, firmware updates, and the use of GPUs further complicate the certification process – what is the best test approach and how much data is needed to determine a successful test? Data bus testing from ARINC 429 to 1553, how do you best test data on the bus? The ability to handle in-flight changes, which are more common in military applications but increasingly in civil aviation, requires specific testing approaches and standards. What are best practices with Hardware-in-the-Loop (HIL) and Software-in-the-Loop (SIL) testing? How do we achieve DO-178C Compliance? Overall, the visualisation, validation and certification in avionics systems necessitates a comprehensive understanding of the underlying hardware, software, and communication protocols.
Chair: Matt Jackson, PACE Aerospace
Recent advancements in the testing of safety-critical embedded avionics software in accordance with DO-178C standards - Sundarapandiyan Sivasankaran, Software Engineer, Boeing
Defining Quantifiable Measures for Data Coupling and Control Coupling - Antoine Colin, Chief Technology Officer, Rapita Systems
DO-178C DAL-D certification of Linux: challenges and lessons learned working on a European project - Massimiliano De Otto, Sr. Field Application Engineer, Wind River

3.30pm-4.00pm **Networking Coffee Break in Exhibition Hall**

4.00pm-5.30pm

AI and ML in Testing
AI and ML have provided some great opportunities for assisting speed and quality of testing, when such large amounts of data require analysis, and highlighted the importance of a robust testing strategy for AI systems. While AI can effectively analyze and digest large datasets, ensuring the quality of the AI algorithm and the accuracy of its model is paramount. Factors such as avoiding biases, balancing accuracy with computational costs, and considering on-board processing limitations must be carefully addressed. How can AI assist when an aircraft is in flight, no longer 'connected'? Qualifying an AI tool involves defining parameters, setting targets, and identifying patterns within the data. How can accuracy be achieve with several AI algorithms running concurrently?
Chair: Marc Gatti, Thales Avionics
Towards an innovative non-intrusive IA accelerator to handle information overload - Jacques Gatard, CEO & Co-Founder, Embrya
Title TBC - Matt Jackson, Technical Product Manager HMI and Embedded Systems PACE Aerospace
How AI/ML can accelerate a test program - Practical Used Cases on AI in Testing - Jérôme Roumagnac, Airframers Key Account Manager, Spherea
The role AI/ML and big data play in creating an operations to design/engineering safety loop - Mark Roboff, Chief Vision Officer | G34 Aerospace AI Implementation and Certification Committee SkyThread | SAE International & Gary Brown, Aircraft Advanced Safety Specialist, Airbus

5.30pm-7.30pm **Networking Reception in Exhibition Hall**

AVIONICS TRACK DAY TWO PROGRAMME
Wednesday 21st May

9.00am-10.30am

AI and Automation in the Cockpit

The integration of artificial intelligence (AI) into aviation is rapidly transforming the industry. As AI capabilities advance, there is growing interest in exploring human autonomy, where AI systems share operational responsibilities with pilots. While regulations are evolving to address the implications of AI and Machine Learning in aviation, the relatively unregulated nature of EVTOL aircraft provides an opportunity. The EUROCAE WG114 working group is actively involved in developing technical standards for AI in aviation. AI can significantly enhance cockpit operations by assisting with data analysis and providing valuable insights. Automation and workload balance are also key considerations, as the increasing complexity of aircraft systems raises questions about the optimal number of crew members required. Connected flight management systems (FMS) play a vital role in facilitating data exchange and providing pilots with advanced decision-support tools. By emulating flight management functions, how can AI assist pilots in making better informed decisions and optimizing flight operations?

Chair: Jacques Gatard, EMBRYA

Connected FMS - Jon Merritt, Associate Director, Flight Deck Solutions, Collins Aerospace*
Alexis de Cacqueray, System Engineer for Military Avionics, Airbus (WG 114 member)
Marc Gatti, Directeur Scientifique & Relations Académiques - HDR, Thales Avionics
Situational Intelligence in the Cockpit: AI's Transformation of Flight - Sylvian Alarie, VP of Engineering, Daedalean AI

10.30am-11.00am

Networking Coffee Break in Exhibition Hall

11.00am-12.30pm

Cyber threats and security in Avionics and Air to Ground

The aviation industry faces a growing threat of cyberattacks that could compromise the safety and security of flight operations, both in the sky and on the ground, but what are these latest threats? How can aircraft avoid data leaks? GPS spoofing and jamming also pose specific risks to GNSS systems. With the increase in remote centres, how do we secure these developments? In addition to traditional cybersecurity measures, ensuring the integrity and reliability of wireless communications is crucial. Protecting avionics and air-to-ground systems from cyberattacks is vital for maintaining aviation safety.

Chair: Alex Preston

GPS spoofing and jamming threats to GNSS systems - Adam Price, Vice President - PNT Simulation, Spirent Communications
Thales 6 / Thales Cyber*
Senior Representative, TXT
Senior Representative, Lynx Software Technologies*

12.30pm-2.00pm

Networking Lunch in Exhibition Hall

2.00pm-3.30pm

Latest Technologies & Developments in the Cockpit/Flight Deck

Advancements in technologies plays a key role in the development of an efficient aircraft and enhance capabilities. How can Synthetic aperture radar (SAR) technology offer advanced capabilities for monitoring and surveillance in aviation? What can sensors and data fusion do for avionics, enhancing situational awareness and improving safety? How can fibre optic intercom systems provide interference-free communication, ensuring clear and reliable communication between crew members? How can Modular Open Systems Approach (MOSA) deliver affordable systems? The ongoing digitization and miniaturization trends in avionics lead to an increase in components and electronic devices, such as chips and GPUs, generating significant heat, particularly at high altitudes where air is thinner, so effective cooling solutions are essential to maintain the reliability and performance of avionics systems. By embracing new technologies, the aviation industry can also contribute to environmental targets by improving fuel efficiency, reducing emissions, and enhancing operational efficiency.

Chair: Matt Jackson, PACE TXT

Designing for the Future: Challenges and Opportunities of Selecting the Right Processor Architecture for Avionics Systems - Stefan Harwarth and Olivier Charrier, Wind River
Safety Critical Multicore for Complex Avionics - Vice President, Marketing DDC-I Inc, USA
Why build a Certifiable avionics UI reference Platform? - Mark Tootell, Regional Sales Manager, SYSGO UK
Chip and GPU System on Chip developments - Senior Representative, NXP*

3.30pm

Conference Close

4.30pm

Exhibition Close

**invited*

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TESTING TRACK TWO PROGRAMME
Wednesday 21st May

9.00am-10.30am

Digital Twinning and Simulation
Digital twins are used for modeling, simulation and optimization, but the quality of the digital twin depends on the validity and accuracy of the data used to build it. While the level of scrutiny required for different types of digital twins varies, it's crucial to ensure that the data is mapped correctly and meets quality standards. Airlines possess vast amounts of data, which can be used to build digital twins of their aircraft. However, certifying or qualifying a digital twin requires careful consideration of factors such as the component level or the entire aircraft being modeled. By combining AI with digital twins and utilizing model-based system engineering, the potential for data-driven insights and optimization increases significantly. How accurate and reliable is Real-time Simulation Testing? However, challenges like limited access to physical hardware and the need for accurate simulation and emulation must be addressed to ensure effective verification and testing.
Chair: Alex Preston
Shift-Left and Continuous Functional Testing with System Simulation - James Hui, Product Line Manager, Wind River
Model Based Systems Engineering (MBSE) Approach - Jon Forde, Aeralis
Real-time Simulation - Senior Representative, RTI*
Senior Representative, TXT*

10.30am-11.00am

Networking Coffee Break in Exhibition Hall

11.00am-12.30pm

FACE Developing Technical Standards & Updates
The Future Airborne Capability Environment (FACE) is an open real-time standard for making safety-critical computing operations more robust, interoperable, portable and secure in the aerospace domain. The FACE approach is a government-industry software standard and business strategy for acquisition of affordable software systems that promotes innovation and rapid integration of portable capabilities across programs, including standardized approaches for using open standards within avionics systems and standards that support a robust architecture and enable quality software development for portability of applications across multiple FACE systems and vendors. What are the latest standards and how are the FACE standards developing for future programs? How do these standards affect programs such as Pyramid and ECOA?
Chair: Alicia Taylor, Director, FACE Technical Standards
Senior Representative, Thales UK*
Senior Representative, BAE Systems*
Gary Gilliland, Vice President Marketing, DDC-I
Ehsan Salehi, Senior Solution Architect Engineer, FACE Verification Authority Lead, LDRA

12.30pm-2.00pm

Networking Lunch in Exhibition Hall

2.00pm-3.30pm

Multi-core and Multi-systems
The complexity of multi-core and multi-system architectures, often built using heterogeneous components like Systems on Chip (SoC), and the mixing of multi-core processors with Open Systems Architecture, provide challenges to test avionics systems, and make it difficult to understand their behavior and define comprehensive testing requirements. Traditional testing methods, designed for single-core systems, are not adequate for verifying the correctness and behavior of multicore systems. Issues like data control coupling, safety critical multicore timing analysis, determinism and the need for extensive coverage testing further complicate the process. What are the latest AMC20-193 guidelines, having replaced CAST-32A? It is important to understand the underlying hardware and software components to effectively test and verify multicore and multisystem avionics systems.
Chair: Alex Preston
Mitigation and Management of Interference in Multicore Processors for A(M)C 20-193 - Stefan Harwarth, Specialist Systems Architect, Wind River
DO-178C Certification and MCPs: The Bigger Picture Beyond WCET - Andrew Banks, Technical Specialist, LDRA
Multicore in MOSA/SOSA - Michael Gilgien, Manager Systems and Software Engineering, Mercury Systems International*
TBC

3.30pm

Conference Close

4.30pm

Exhibition Close

**invited*

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AVIONICS AND TESTING INNOVATIONS

20th-21st May 2025

London, UK

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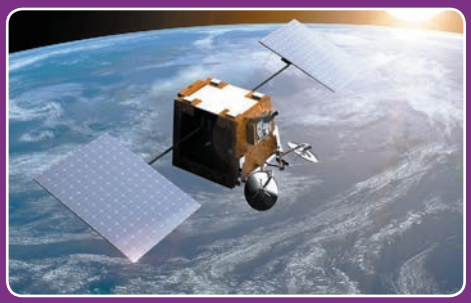

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CAE Opens First-Ever Air Traffic Services Training Centre

CAE is known for building world-class flight trainers. But on January 16, 2025, the company changed its game by officially opening up CAE's first-ever Air Traffic Services Training Centre (ATSTC) on its campus in Montreal, Canada. This ATSTC has been created in association with NAV CANADA, Canada's privately-owned air navigation service provider (ANSP) that staffs civilian air traffic control towers nationwide.

Moving into a new aviation market is a major step for CAE and the company knows it. This is why the January 16th opening was such an uncharacteristically public, even splashy, event for CAE, which historically has kept a low profile in such circumstances. Launching the ATSTC is such a major milestone for the company, in fact, that CAE invited aviation journalists from around the world for a three-day press event on site that culminated in the official opening.

In turn, the opening itself attracted so much media attention with television cameras everywhere, that one might think they had stumbled into a Hollywood premiere by mistake.

Aerospace Innovations magazine was one of the select few who were invited to cover the CAE ATSTC media event in full, which included tours of the company's Montreal factory and numerous interviews. The innovations we saw in those tours — which included interactive augmented reality simulators operating smoothly on Apple Vision Pro goggles and in-the-lab conversions of single engine gasoline aircraft to electric propulsion — will be covered in an upcoming

CAE's headquarters and ATSTC in Montreal, Canada. (Copyright: CAE)

edition of this magazine. In this story, we will tell you all about CAE's groundbreaking entry into the air traffic control training market.

An Ongoing Shortage of Air Traffic Controllers

There's a very simple reason why CAE is entering the air traffic control training market: The current framework for producing air traffic controllers just isn't keeping up with demand.

As a result, the world has been suffering a chronic shortage of air traffic controllers, even though the pay is relatively good. It's not just a matter of the Baby Boomers retiring, although that is having an impact. Because air traffic control is such a demanding, stressful and high stakes profession, most people aren't suited to do the job. Meanwhile, those who are suited take a long time to train.

A recent article on CNN.com entitled, 'America desperately needs more air traffic controllers. So why is it so tough to hire them?' puts the shortage's impact into perspective. "The Federal Aviation Administration, which runs the air traffic system, stepped up the pace of hiring in 2024 under President Joe Biden," wrote CNN's Chris Isidore. "But even though 2,000 qualified applicants were hired last year, they might only just barely replace the 1,100 who left the job either through retirement or due to the heavy toll the stressful job takes on those who enter the field. That's because nearly half of those hired in any given year will wash out of the program before they get to actually control aircraft after about three years from their initial start date. So

> **"We're cementing CAE's position as the trusted leader in aviation workforce development."**
>
> **Marc Parent, CAE's President and CEO**

CAE's Linda Wallace, an instructor for ATC and FSS, teaches at CAE's ATSTC. (Copyright: CAE)

even with an increase in the pace of hiring, it could take as much as 8 to 9 years to reach full staffing."

In Canada, the ANSP NAV CANADA has historically been the sole source of air traffic controller training. But they too are having trouble keeping up with demand. This is why, as we will see, NAV CANADA is more than happy to partner with CAE to bolster ATC training capacity in Canada.

This fact also explains why CAE's ATSTC has actually been operating in 'soft launch mode' since October 2024. If all goes to plan, CAE hopes to train approximately 500 air traffic professionals in its ATSTC by 2028. In this system, CAE's instructors are providing initial training for air traffic controllers (ATC) and flight service specialists (FSS) to students from across Canada using NAV CANADA's existing training curriculum and courseware. Concurrently, NAV CANADA is continuing to deliver basic training, all specialty courses, and on-the-job training to Canadian ATC/FSS students, with the higher levels of Air Traffic Services training still being solely provided by this ANSP.

The Big Day

Thursday, January 16, 2025 was a relatively typical winter's day in Montreal. The temperature was below freezing and a light snow was falling. An intermittent wind kept things brisk for anybody walking outside.

At CAE's ATSTC low-rise building at 8585 De la Côte-de-Liesse Road — which backs onto the southeast end of the city's Montréal-Pierre Elliott Trudeau International Airport (aka Dorval Airport to the locals) — things were buzzing prior to the official opening. A podium had been set up in front of a bank of monitors at the building's reception desk, CAE's white logo splashed across blue screens on the wall. On the other side of the podium, a host of TV cameras battled with invited guests for space on the lobby floor to watch the upcoming event. And reporters being reporters, at least some of them eyed the well-stocked buffet tables to the side of the room that had been set up to celebrate the occasion.

At the appointed time, CAE President and CEO Marc Parent stepped up to the podium after an appropriate introduction, and got the official opening ceremony underway. For the record, Parent has served in this position since 2009, having joined CAE four years previously as Group President, Simulation Products before retaining three promotions to reach the top.

According to www.cae.com, "Mr. Parent has 40 years of experience in the aerospace industry. He started his career in 1984 with Canadair [later Bombardier] as an engineer on the Challenger and Canadair regional jet programs. Beginning in 1993, he held positions of increasing scope in aircraft product development." These products included the Challenger 604 business jet, the Q400 turboprop, followed by other versions of the Challenger and the CRJ 200 Regional Aircraft product line. Parent's honours include being appointed as a Member of the Order of Canada (the country's highest honour) and induction into Canada's Aviation Hall of Fame, among many others.

This is the acclaimed aerospace executive who has diversified CAE into the ATS training space. Judging by his comments as first speaker during the CAE ATSTC's official opening ceremony, Marc Parent feels a sense of pride and confidence in doing so.

"Thank you for joining us today on this fantastic day: The inauguration of our new and first-in-world Air Traffic Services Training Centre," Parent told the packed CAE lobby. "We're extremely proud to celebrate this groundbreaking milestone, CAE's entry into the air traffic services training business." He then said that this expansion was "a natural extension of our core mission at CAE, which is —

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and we consider it a noble mission — to make the world a safer place. That's really what we wake up in the morning wanting to do and what fills every single employee in this company with the pride they have in accomplishing that noble mission. And we've been doing that for over 75 years."

According to Marc Parent, taking CAE into the air traffic control sector not only expands the global training ecosystem for this profession, but also ensures that critical roles in aviation are being filled by highly skilled professionals; "again to keep our skies safe," he said.

Parent then observed that global demand for aviation services continues to grow, noting that "the number of airline passenger traffic jets is going to double over the next 10 years. And what does that mean? That means more pilots are needed, it means more air traffic controllers are needed around the world — and those people haven't even started training!" he said.

As a result, the timing of CAE's decision to move into air traffic controller training "couldn't be more significant," said Parent. "We're not just meeting an industry need here, we're cementing CAE's position as the trusted leader in aviation workforce development."

He then made clear how vital this move is to the future health of his company. "This ATS business, for us, isn't just important for what it achieves today: It's foundational for CAE's future growth," said Parent. "So in conclusion, we are celebrating not just a facility, but a vision: A vision for what CAE can achieve in the future."

NAV CANADA Equally Enthusiastic

The enthusiasm for the new ATSTC that was expressed by CAE's Marc Parent was matched by Mark Cooper, President and CEO of NAV CANADA. Apparently his entire company feels the same way. Speaking at the podium after Parent had concluded, Cooper said, "I think it's a measure of our commitment that literally the entire executive team of NAV Canada wanted to be here today. I don't think that's ever happened before."

For the record: NAV CANADA was established in 1996 when the Canadian government sold off its air traffic control system to the private sector. Funded by fees charged to aircraft operators, NAV CANADA manages 18 million square kilometres of Canadian civil airspace plus the North Atlantic oceanic airspace under Canada's control.

Continuing his remarks, Mark Cooper reinforced his point about NAV CANADA's enthusiasm for the CAE ATSTC project by noting how quickly it received approval and support from his company. "Marc [Parent] made a comment about how quickly it went," said Cooper: "It did. This is unprecedented how quickly we moved from an RFP through a contract signature into execution. There's a joke that goes around in air traffic that ANSPs, like ourselves, move at the pace of icebergs — and some people say we don't [even] move that quickly."

Switching to a more serious tone, Cooper said the collaboration between CAE and NAV CANADA in creating and operating the ATSTC should address "both our current needs and our future needs in air traffic operations. It's essential for us that we invest in high quality training to maintain and enhance the standards [that] we have. We stand, as Canada, in a really fantastic position at the crossroads of global aviation, and it's incumbent on us as a company to deliver those standards because we connect the country. We are part of the social fabric, whether the people realize it or not. You don't get your parcels and you don't get to travel if we are not delivering a service."

"That's why we picked a company like CAE to help us live up to those standards because we can't fail," said Cooper. "Things cannot go wrong." He then cited the importance of the ATSTC graduating close to 500 students by 2028 to help NAV CANADA keep Canadians flying. "That is imperative to us as we look to rebuild our staffing to meet future demands," he told the audience. With air traffic expected to increase in Canada up to 60% by 2050 — "and that doesn't include the other

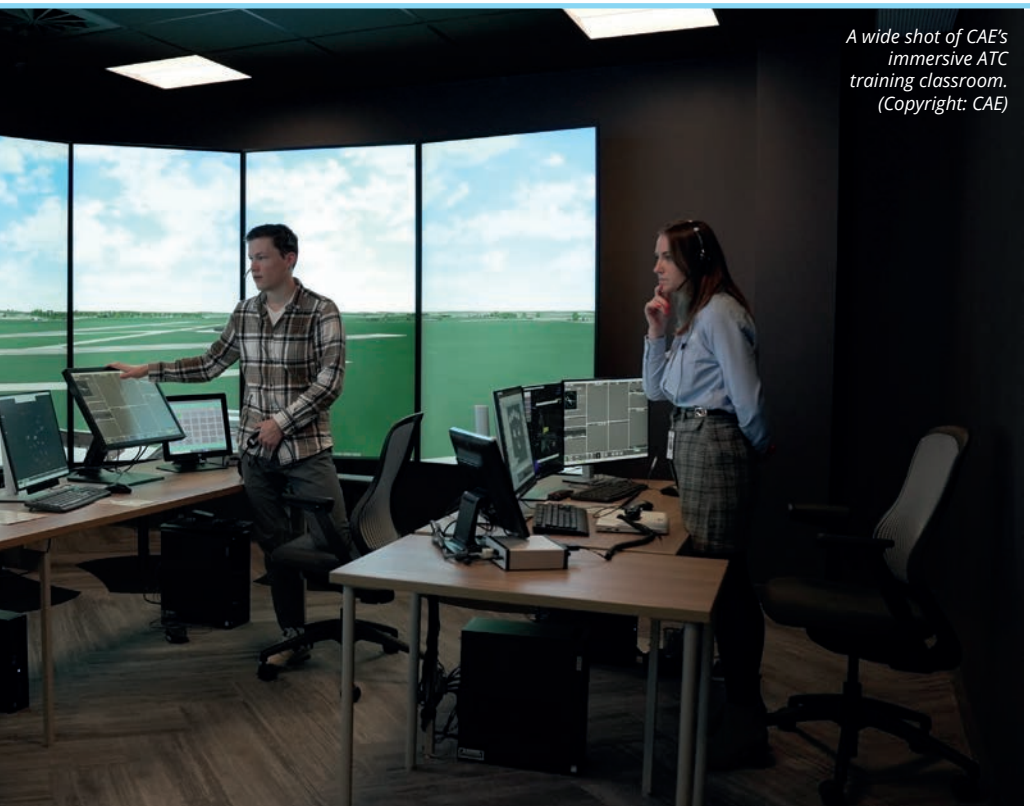
versions of transport that we don't yet see like air mobility" — more air traffic controllers are vitally needed in this country, and soon.

The good news: NAV CANADA has real faith in CAE's ATSTC providing a real solution to the shortage of air traffic controllers in Canada. "I would happily just close and just say we are filled with optimism," Cooper said.

The Person in Charge

Every successful enterprise needs someone at the top to make it work. When it comes to CAE's new ATSTC, that person is Marie-Christine Cloutier. She is CAE's Vice President – Strategy, Performance & Marketing and Head of the company's new Air Traffic Services (ATS) division.

Cloutier opened her comments during the opening ceremony by thanking NAV CANADA for their support in this enterprise. She then noted that, "As Mark [Cooper] previously mentioned as well, to meet the high demand in air traffic service personnel, CAE will increase NAV CANADA's training capacity by training close to 500 additional students by 2028. Indeed, we are the first approved training organization for air traffic services in Canada. Having successfully navigated through audits from



A wide shot of CAE's immersive ATC training classroom. (Copyright: CAE)

both NAV CANADA and Transport Canada [the federal department that regulates Canadian airspace], I think we can acknowledge that it's quite an achievement."

Speaking as the person responsible for CAE's ATSTC, Marie-Christine Cloutier outlined her top two priorities at this point in time, through the training that will be provided by 36 skilled ATS instructors that the company has hired from around the world. Their first priority will be to deliver the high standard of training already being provided by NAV Canada, said Cloutier. Second, and not surprising given CAE's existing global reach, this ATSTC will seek to serve ANSPs outside of Canada who are also grappling with ATS/FSS staffing shortages. Finding potential ATS/FSS candidates and "training them to meet all the safety standards fast enough to help ANSPs worldwide is going to be our next challenge, like we've done with NAV CANADA," she said.

Moving into Defence?

At present, CAE's ATSTC is focused on training ATC/FFS personnel for civilian aviation. However, the company also foresees business opportunities in the defence space. "There's definitely potential there, and we do have many defence and security training facilities that we want to leverage as part of it," said Cloutier, speaking to reporters after the opening ceremony had concluded. "I mean, we have partnerships between defence companies and ANSPs with our defence and security business segments. So yes, there's definitely something that we want to explore, plus this could be a point of entry into different countries."

> **"It's not a transformation, but an extension of what we do."**
>
> **Marie-Christine Cloutier CAE's Vice President – Strategy, Performance & Marketing and Head of its Air Traffic Services (ATS) division**

Reflecting more generally on CAE's move into air traffic control training, Marie-Christine Cloutier explained it as a response to the company's ongoing 'aviation talent forecast' which it compiles every two years. "The last one that we issued, talked about 1.3 million aviation professionals being needed for the aerospace world, from pilots to cabin crew to maintenance technicians," she said. "A lot of the comments that we received in response to that forecast was: 'well, there's also a shortage in air traffic controllers and flight service specialists. Aren't you addressing that?'"

This feedback, plus NAV CANADA's desire to find outside help to boost its ATC/FSS training output, is what inspired CAE to move into this training market. As this move is an addition to the company's traditional flight training business, "it's not a transformation, but an extension of what we do," said Cloutier, "leveraging our existing training capabilities and pilot training and cabin crew training to air traffic controller training."

A Transformative Force?

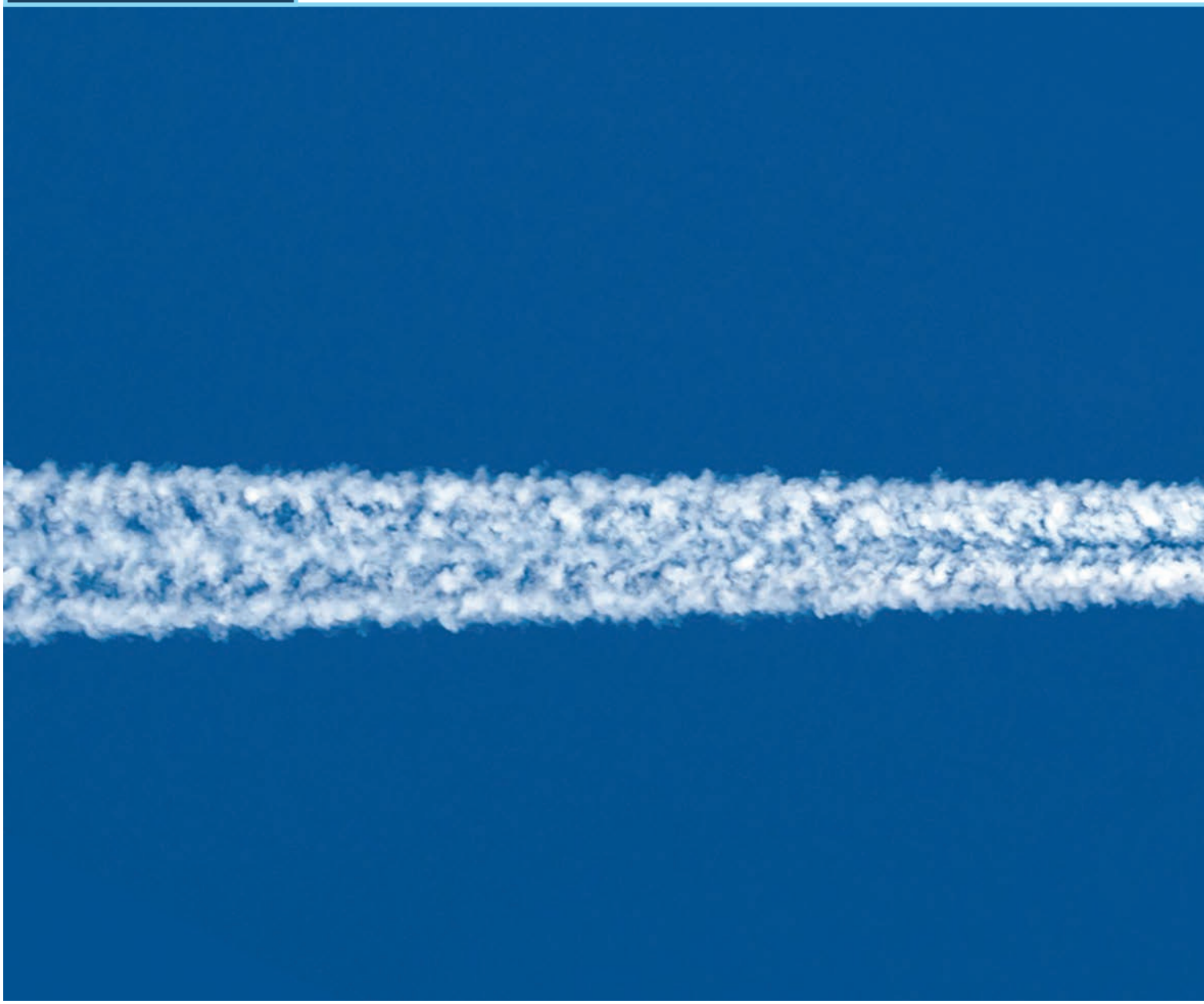
It is early days for CAE's move into air traffic control training. And given that the company is starting in the Canadian market first, it may be premature to suggest this, but this could be the beginning of a new global presence in this aviation sector.

Or not: When CAE was established in 1947 as Canadian Aviation Electronics Ltd. by ex-RCAF pilot Ken Patrick, it started by serving Canada first. And the company didn't get into simulators until the 1960s, when the Canadian government gave it a contract for six F-104 Starfighter simulators. The success of that contract led to CAE building 26 more simulators for five other NATO countries, and the rest as they say, is history.

Today, even though CAE maintains its headquarters and manufacturing facility in Montreal, the company now has approximately 13,000 employees in more than 240 sites and training locations in over 40 countries worldwide.

So can CAE use its first ATSTC as a launching pad for global air traffic control training facilities? History suggests that it can.

By James Careless



Forward Looking

It seems simple. Modern aircraft produce huge amounts of data and there is the computing capacity to take it, combine it with data from other sources and produce solutions to help keep flight operations safe, smooth and efficient.

Unfortunately, it is much more complicated than that, especially when weather is involved. Take the example of contrail avoidance. Contrails are produced when aircraft fly through cold, moist air. On busy airways, they can persist and merge to produce high altitude cloud that prevents heat from escaping into the atmosphere.

Murray Skelton, VP Weather Solutions and Business Development at FLYHT Aerospace Solutions, explains that these rivers of cold, moist air in the atmosphere cannot be easily measured in real time from space, in flight or on the ground. Therefore, it is impossible to have completely accurate forecasts of where they might occur – it is around 70% with current modelling.

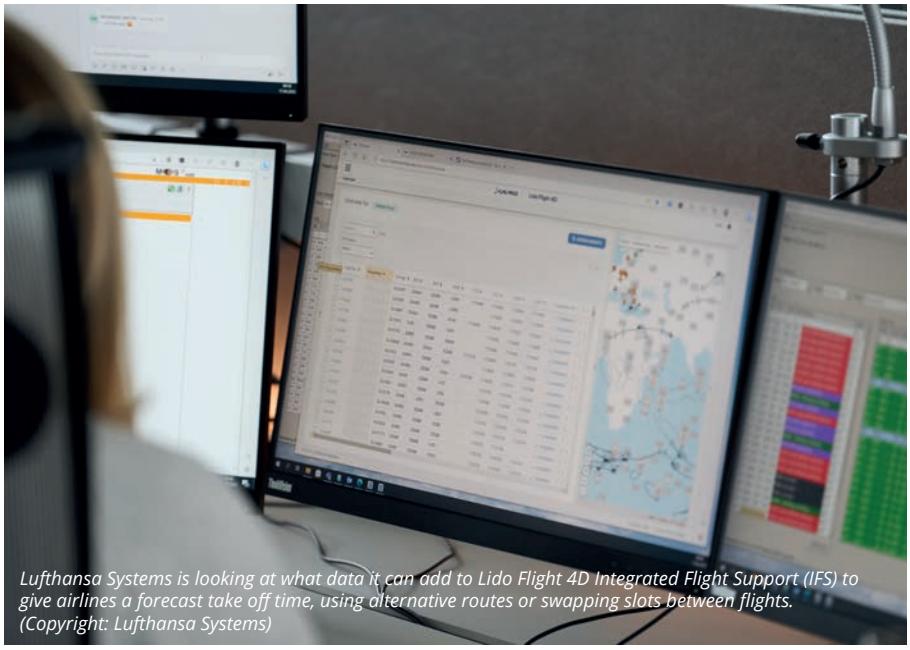
The biggest problem is impactive contrails that are produced in clear skies between dawn and dusk. These have a warming effect of 100mW/m^2, according to the UN World Meteorological Organisation, of

(Copyright: alexandrumagurean)

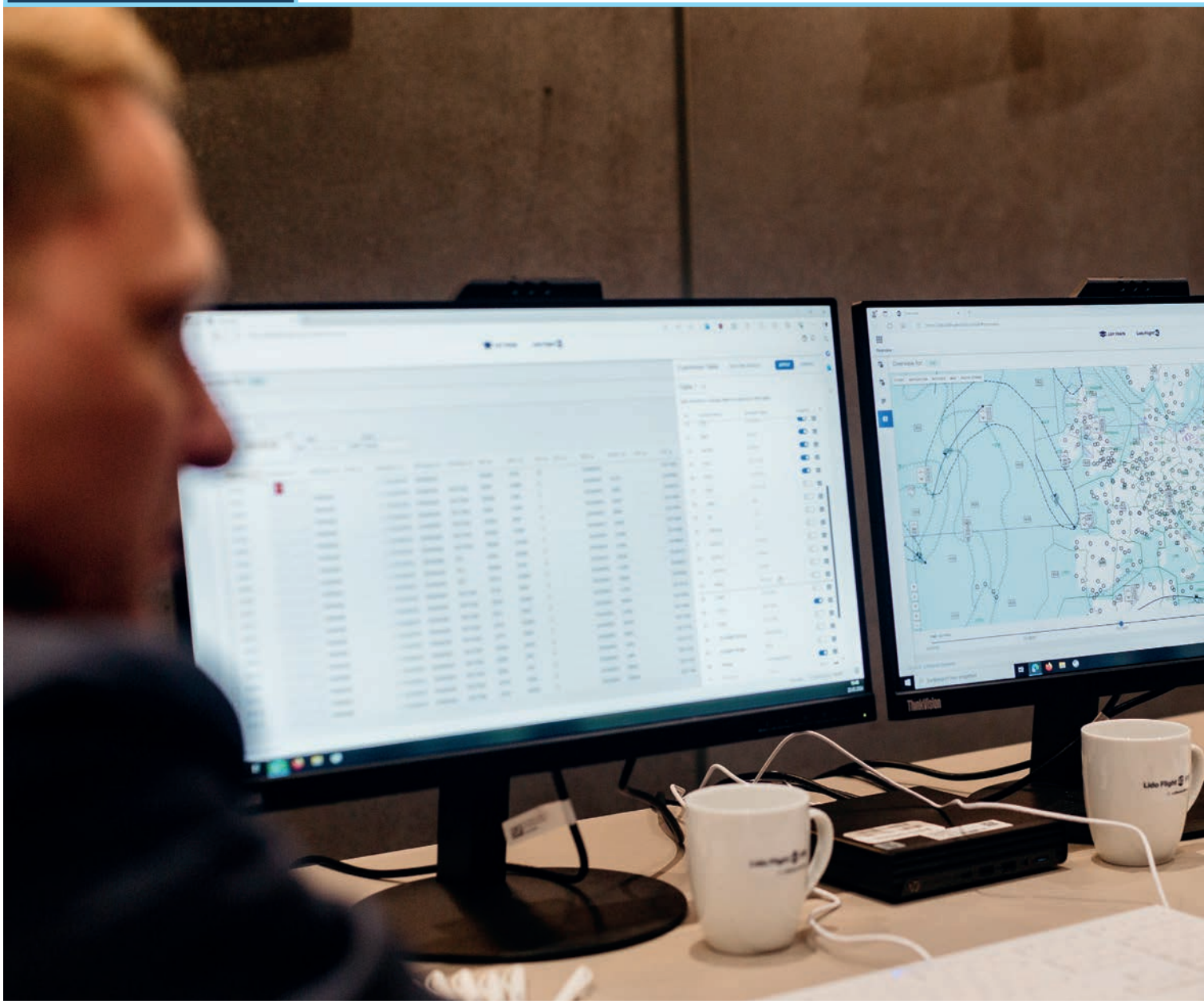
which the company is a member. As contrails, unlike moisture levels, can be seen by satellites, it is easy to confirm that a particular flight has successfully avoided the issue. This is important as Europe and the UK are understood to be possibly introducing carbon trading for this.

ICAO has said that, with good predictive models, they could generate contrail avoiding routes with UK NATS and EUROCONTROL, with a cost of $4-5/flight. With the exception of the US, which has backed away, the rest of the world is showing interest.

The height difference to avoid the problem can be as little as 500ft, but the current mandated vertical separation is 1,000ft. This could



Lufthansa Systems is looking at what data it can add to Lido Flight 4D Integrated Flight Support (IFS) to give airlines a forecast take off time, using alternative routes or swapping slots between flights. (Copyright: Lufthansa Systems)



change with the next generation 4D ATC systems that will enable reduced distances between aircraft.

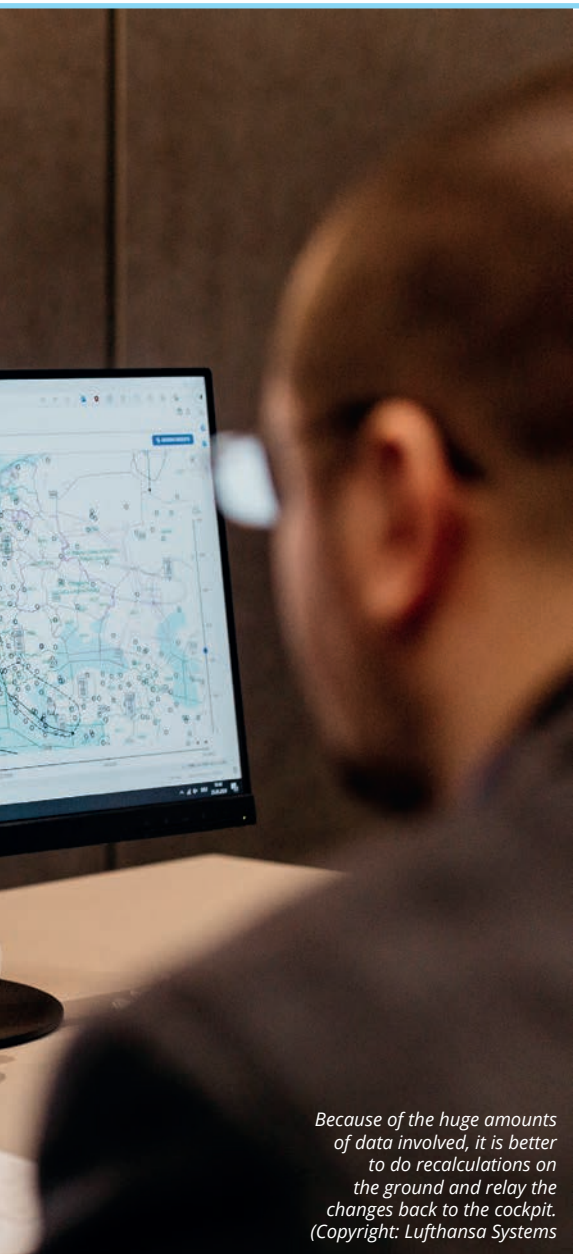
The real need is for real time information on the atmosphere around each aircraft and FLYHT has developed a system involving water vapour and pressure sensors that can send data via satcoms. It is currently flying on 100 aircraft of Southwest and UPS, feeding data to the US National Oceanic and Atmospheric Administration, although given the size of the country, this is a tiny step. From May, it will be flying on 12 Embraer 135/145 of Scottish regional airline Loganair, feeding data in real time to the UK Meteorological Office. These are operated in the Scottish highlands and islands. He adds that the data in both places will be available for general forecasts, not just for aviation.

The cumulative data from aircraft flying through the same area will see the moisture level change and trigger an alert when it is close to the contrail level.

As noted, a relatively small change of altitude can solve the problem but this can be difficult in a congested air traffic area like Europe, as exemplified by the D-KULT project (demonstrator - climate and environmentally friendly air transport), which is sponsored by the Bundesministerium für Wirtschaft und Klimaschutz (BMWK, German Federal Ministry for Economic Affairs and Climate Protection) through its LuFo Klima Civil Aviation Research Programme.

This three-year project, which ends in May 2025, is running extensive simulations to develop eco-efficient flight trajectories, considering non-CO_2 emissions in European and especially in German airspace. It is also considering how to minimise noise and operating costs.

Balancing the different targets in the mathematical sense is a complex task, as shown by the fact the lead coordinator, the Deutsches Zentrum für Luft- und Raumfahrt (DLR, German Aerospace Center) is working with the Institute of Atmospheric Physics (co-coordinator), Institute for Flight Systems, Institute for Air Transport, Institute for Flight Guidance and the Institute for Aerospace Medicine. Additional



Because of the huge amounts of data involved, it is better to do recalculations on the ground and relay the changes back to the cockpit. (Copyright: Lufthansa Systems

partners include: DFS Deutsche Flugsicherung, DWD Deutscher Wetterdienst, Jeppesen, PACE, Deutsche Lufthansa and Lufthansa Systems. Associated partners are Airbus Operations, European Air Transport Leipzig (DHL), and the Federal Association of the German Aviation Industry (BDL).

One of the partners, Lufthansa Systems, is involved via Lido, its suite of applications used across a wide range of flight operations. Max Hoffmann, Head of Flight Planning Software at Lufthansa Systems, explains that weather data showing where contrails might form is used to define the most cost optimal or fuel optimal routing for the aircraft. And as there is CO_2 trading now, he anticipates that a similar system might evolve for non-CO_2 emissions in the future. That means any deviation from the optimum route to avoid contrails will have to take into account potential increases in fuel consumption and CO_2 emissions and balance them against the penalty for producing contrails. He says the company can integrate this function into its flight planning solution Lido Flight 4D but it is up to the airlines to decide if they wish to use it.

D-KULT plans to run a large scale of simulations of typical weather situations. Research data is showing that if 3-5% of the flights are optimised for contrail avoidance, the overall impact is reduced by 17-18%. However, some airways are more crowded than others, so lots of aircraft avoiding a certain area could cause delays for arrivals. The potential environmental and financial impact of that would probably be much greater, so needs to be investigated.

The company is also looking at flight optimisation from the cockpit. Typically, flight plans are generated between 12 and three hours before departure, maybe one hour before at the latest as the necessary fuel has to be delivered to the aircraft. For long haul flights of 12-15 hours, the weather along the route is usually pretty stable but there are other factors that could be considered, for example, passengers missing their flight and their baggage removed, or missing cargo, makes the aircraft lighter and so will climb differently, or the assigned flight levels may be different from that in the flight plan. These have a direct effect on fuel burn, so the aircraft can arrive

at a certain point in the flight lighter or (more usually) heavier than expected. That is a good time to do a recalculation, he says.

However, the amount of data needed, even with increased onboard connectivity, makes it difficult to do that recalculation in the cockpit. Instead, the fuel load is communicated to the ground, where the flight plan is reprocessed and sent back to the aircraft. He notes that vertical optimisation is relatively simple, as the same route is maintained but at an altered, ATC-approved altitude. Horizontal optimisation, or a change of course, is much more complex, involving a combination of new waypoints and ATC centres.

There are some situations where this service would be useful, including technical or medical diversions, or the offer of a more direct route from ATC. An independent crosscheck would confirm the best route or whether the more direct route actually produced fuel savings.

This concept is currently being trialled with a number of airlines using simple data at the moment. It also involves Lufthansa Systems FlightNav, the Lido department in Zurich, which covers pilot apps, so pilots could select parameters for themselves, perhaps avoiding countries or defining a minimum altitude at certain points along the route.

It is a development of the Vertical Inflight Optimization service (Lido IFO), which has shown potential savings starting at 0.55% of trip fuel for long- and short-haul operations. Suggestions are based on up-to-date weather and compliant with restrictions as they are calculated with the same optimisation engine used for regular flight planning. They are sent via ACARS. Importantly, Lido IFO will only send actionable suggestions to the crew.

A third development is management of slot delays. If an aircraft picks up a delay of 20-40 minutes , the ground centre gets the information from the aircraft or from ATC, for example, EUROCONTROL's Network Manager Operations Centre (NMOC). He says this is especially important in summer when flights are at their busiest and there is more chance of thunderstorms. The company is looking at what data it can add to Lido Flight 4D Integrated Flight Support (IFS) to give airlines a forecast take off time, using alternative routes or swapping slots between flights. That swapping could involve a flight with lots of connecting passengers or a flight with high value customers, that can take precedence over other flights.

Larger airlines have dedicated teams to working out alternatives that will allow the aircraft to reach the airport in time but is a highly manual effort, he says, while Lido Flight 4D IFS could do it automatically, although this would have to be tailored to each airline's specific operational requirements. Automation would free up those staff to deal with extremely critical situations.

By Ian Harbison

FLYHT has developed a system involving water vapour and pressure sensors that can send real time data via satcoms to detect the risk of contrail forming. Its AFIRS EDGE+ systems can send aircraft health data a few minutes after landing. (Copyright: FLYHT Aerospace Solutions)

(Copyright: Ian Harbison)

Finding Solutions

It is all very well that aircraft condition monitoring systems (ACMS) generate huge amounts of data but the cost of transmitting it in flight can be prohibitive. FLYHT has developed the Automated Flight Information Reporting System (AFIRS).

This is a Quick Access Recorder (QAR) that can offload terabytes of data within seven minutes of landing, activated by weight on wheels. This can be sent via satcom, 5G, 3G and 4G/LTE. The data is analysed to provide actionable intelligence to deal with maintenance problems before they affect operations. The troubleshooting and analysis data allows Maintenance Control to interpret current messages, explore current and historical data, and then send action messages and launch troubleshooting guidance to resolve technical issues as soon as possible. The system can also eliminate in-service failures via a system that enables detection and removal of components just prior to failure. It also gives Maintenance Control the operational status of the entire fleet, with instant updates when conditions change. Visual displays provide location and health status for each aircraft.

Avionica has also just announced an initiative to leverage AI-driven deep learning models for analysing aircraft data, including Flight Data Recorder (FDR) data, to extract critical flight parameters. This machine learning approach will enable aircraft operators to analyse and interpret their flight data without reliance on OEM documentation. Historically, OEMs have used proprietary data formats to limited the ability of operators to extract actionable insights. By applying AI-driven pattern recognition, Avionica's models can identify and classify flight parameters directly from FDR data, allowing operators to unlock a new level of autonomy over their data analytics and operational decision-making.

The company has delivered more than 11,000 QARs, with Supplemental Type Certification (STC) earned on more than 450 models, including air transport, business, and general aviation aircraft. As part of its AI initiative, the company plans to release the open-source AI models and decoder libraries to airlines, MROs, regulators, and researchers to foster collaboration in the aviation community and to invite them to participate in further development and refinement. By working together in this way, it should be possible to use these AI-powered analytics tools to unlock new possibilities for flight safety, efficiency, and operational intelligence.

An often overlooked aspect of airline operations is the airport itself. Outside the control of the airline, any problems can have a serious effect on schedules if there are problems.

Tools like Collins' AirPlan receives data from multiple source through a single application, allowing airport operations to quickly and easily move staff, deploy ground crews and complete flight check-ins to resolve a problem, among other tasks. Examples include passenger flow and behaviour data to optimise airport throughput, reducing queue times. Flight data improves data accuracy for better aircraft turnaround times, lowers operating costs and allows for more sustainable flights. Baggage tracking data improves the handling process, reducing the number of lost or damaged bags. Maintenance and resource data helps airports monitor the condition of airport infrastructure, equipment, electricity and water usage for facility and sustainability improvements.

The Push to Paperless MRO Management

Moving to paperless MRO management systems is a win-win for all involved


(Credit: Swiss-AS)

There is no doubt that ERP (Enterprise Resource Planning) software has revolutionized the business world, with its ability to centralize, rationalize, and clarify the integrated operations of any company. This is why ERP platforms have been tailored to meet the needs of the MRO industry, to provide these companies with more efficient and cost-effective operations, and customers with faster service and better price clarity.

Given the MRO industry's historical reliance on paper-based documentation — both for managing repair projects and accessing OEM information to do the repairs — moving the industry away from paper is not an easy task. However, thanks to the sophistication of MRO software-based management systems as they now stand, the push towards a paperless future is well underway.

How Capable are Paperless MRO Management Systems?

The possibility of a paperless future begs a question: Are today's MRO management systems truly capable of handling all aspects of this very complex business sector digitally?

According to Chris Clements, Senior Sales Representative with Swiss AviationSoftware Ltd. (Swiss-AS, maker of the MRO software solution AMOS), the answer is an unequivocal 'yes'. "Any decent MRO software solutions on the market should be capable of enabling paperless processes and generally are," said Clements. "AMOS has been used paperlessly since 2016 and continues to support customers in their drive for digitalisation."

Saravanan Rajarajan (Saran) is Associate Vice President of Aviation Solution Consulting at Ramco Systems. "Ramco Aviation Software has the necessary capabilities to make the process entirely paperless," he said, echoing Clement's certainty. "For example, the software can manage OEM technical documentation in digital formats, render these documents into mobile applications for mechanics' consumption and even perform dual authenticated digital sign offs."

However, software alone is not enough for MROs to go entirely paperless, Rajarajan cautioned. "For example, if the MROs' customers still need paper-based documents or if the regulatory bodies overseeing the customers do not permit digital signatures, this may lead to a mix of paper and paperless-based processes."

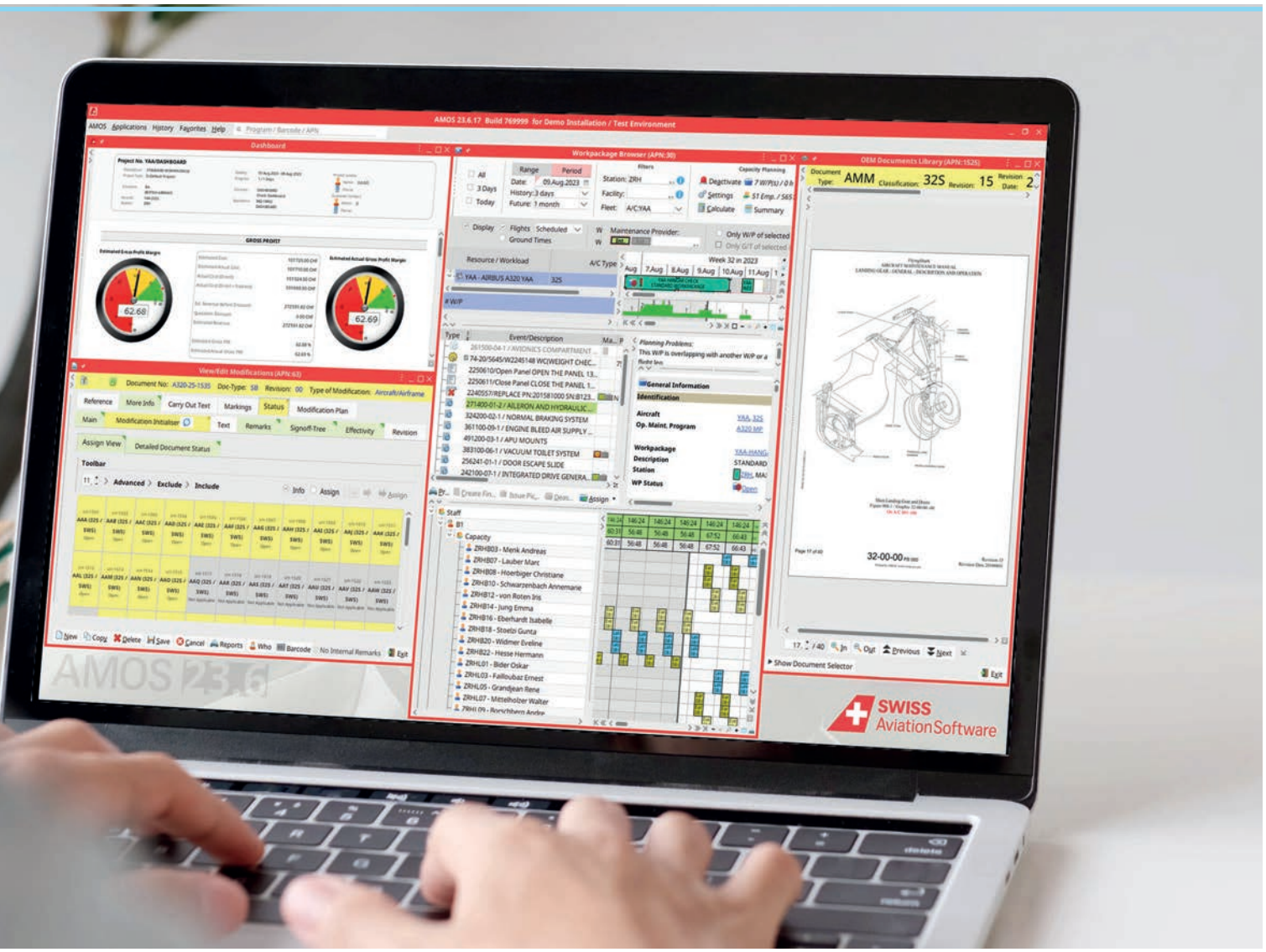
The Advantages of Paperless Management Systems

There are a range of advantages associated with MROs moving to paperless management systems as much as they can.

A case in point: "A fully paperless system allows the software to be used on mobile devices for work accomplishment instead of using paper task cards," said John Stone, Vice President of Product Management with Ultramain Systems, whose ULTRAMAIN M&E/MRO software addresses a broad spectrum of aviation maintenance needs. "It enforces desired MRO operational practices with employees in compliance with your procedures and regulations, where the use of paper does not," he said. "As well, paperless software ensures uniformity of job execution and automates recordkeeping, and makes sure that the individuals assigned to specific tasks are fully qualified and current to perform them."

Using paperless systems on mobile devices also allows an MRO's electronic task forms to be fully structured, uniform, and understandable, Stone observed. "Gone are the days of data entry clerks interpreting hand scribbled entries, as well."

Andrew O'Connor is Head of Products with OASES, whose OASES management software



supports national carriers, large third-party maintenance providers, and independent operators across more than 50 countries. "Today, in many cases, engineers are noting down their aircraft inspection and maintenance activities on paper, then returning to an office to key it in," said O'Connor. "Making this both electronic and mobile improves accuracy and saves time. [In addition], accessing manufacturers' handbooks electronically from anywhere saves time and adds to efficiency. It also ensures that users are always consulting the latest versions versus inadvertently consulting an out of date, paper-based version."

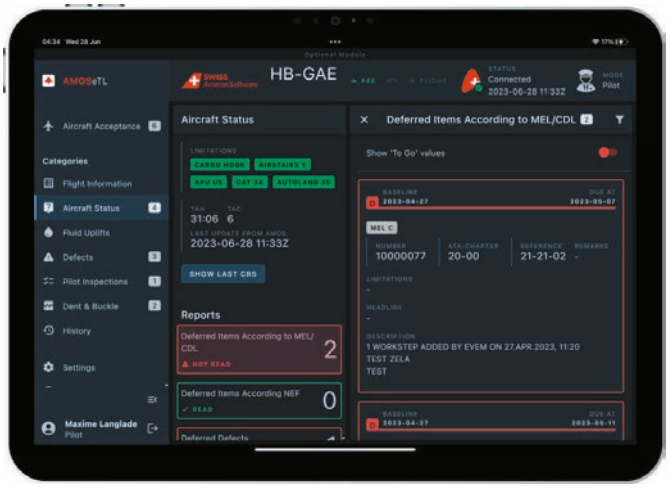
Besides enabling the use of mobile devices in MRO management, the digital infrastructure associated with paperless systems drives the centralization and universal access of all OEM documentation associated with the aircraft being repaired. The same is true for the data generated during the repair jobs, plus the tracking of technician hours, materials used, problems encountered and remedied, and the information required to build this work back to the client.

"Maintenance activities heavily rely on information from various data sources, such as OEMs' technical documentation and customers' work scope documents," Rajarajan said. "MRO management software can seamlessly ingest these documents and prepare for the downstream process of sequencing tasks, planning resources, parts, and tools, and finally rendering to the shop floor in mobile applications. This increases operational efficiencies by reducing the time and effort required to process the technical contents."

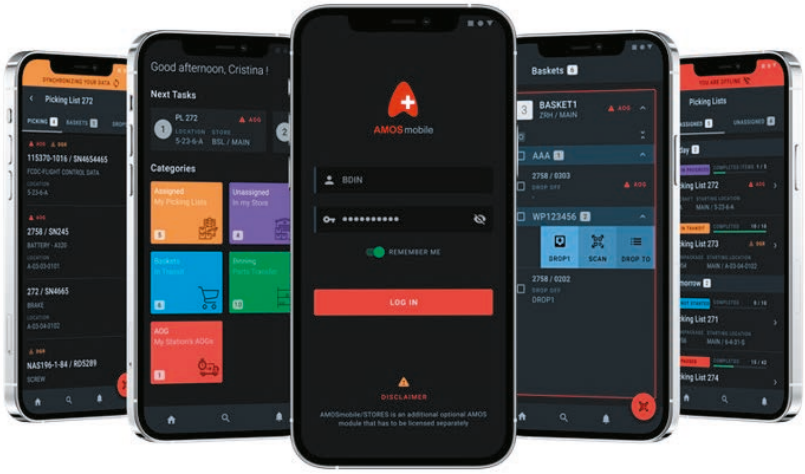
Hangar-level work execution is another area of increased digital adoption, he added. "Ramco's Mechanic Anywhere mobile app enables mechanics to access technical documentation, book

"Any decent MRO software solutions on the market should be capable of enabling paperless processes and generally are."

Chris Clements, Swiss AviationSoftware's Senior Sales Representative



AMOSeTL: Real-time aircraft status and defect management for seamless digital workflows. (Credit: Swiss-AS)



Right: AMOSmobile/ EXEC: Empowering technicians with mobile tools for efficient, paperless maintenance execution. (Credit: Swiss-AS)

time, report findings, record measurements, and request parts and tools from the place of work. With the required regulatory approvals, task cards can be closed and signed off digitally. This considerably decreases the nonproduction hours, thereby increasing productivity."

So far, we've seen that paperless systems make it possible to add mobile devices to the documentation chain, while improving the quality of overall data and knowledge management throughout the MRO itself. In contrast, paper-based systems are disconnected, inefficient, harder to keep up to date, and far less accessible.

Then there's the fact that paper is just, well, paper! In other words, paper is a physical medium that has weight and takes up space. Electronic data does not, while the machines that manage and store it are far less demanding of physical space than filing cabinets and folders full of paper.

"Going paperless is great for the sole reason of removing the need to manage paper," said Rob Mather. (He is Vice President of Aerospace and Defense with IFS, a maker of enterprise software that specializes in aerospace and defense, as well as several other sectors.) "When you migrate to a paperless environment, you no longer need warehouses, you no longer need to buy paper, and you no longer need to buy printers. As a result, you're reducing total costs just by virtue of going paperless."

"When you consider the time saved by paperless technicians who no longer have to congregate around the docs office to collect their assigned taskcards or queue at a kiosk to start booking their time, you can expect productivity improvements from Day One," Clements said. "Additionally, thanks to direct data entry being done by technicians, less time is required to correct text or request entries that have been transcribed incorrectly. All of these 'small' reductions translate into more hands-on time on the aircraft with the same working shift without any reduction in quality and safety — in fact, quite the opposite."

The Result: A Better-Run MRO

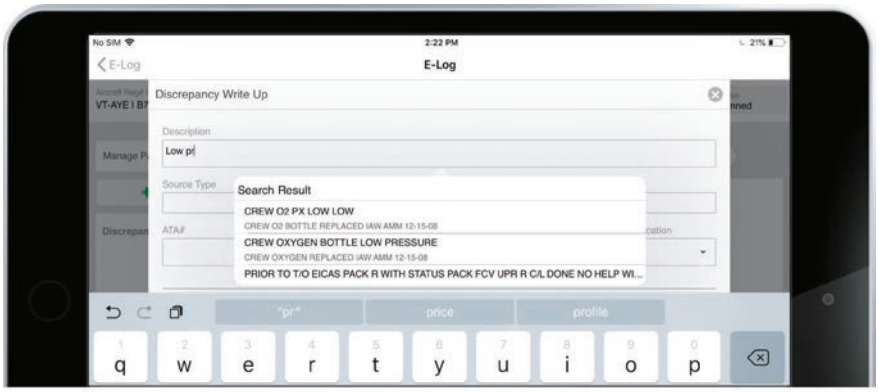
Individually, the benefits of going paperless are impressive in themselves. But when you put them all together, the cumulative benefit is a better-run MRO.

"If you organize your company around paperlessness and mobility, you can actually completely change the way you do business in order to be far, far more efficient — because you're doing all of the records in real time," said Mather. "For instance, you can maximize the technician's productive time by moving a bunch of processes off their plate into supporting roles. So for example, if a technician is writing the record of the fault and they say, 'I need this part', or 'this part was removed', you can integrate that process into a parts request. By just filling in that form, they've already requested the material."

That's not all: "The enablement of digitized management of OEM documents, customer work packages, and automated planning of task sequencing, tools, and resources will reduce indirect man hours by eliminating the manual-intensive process," Rajarajan said. "Meanwhile, the adoption of mobile tools on the shop floor considerably reduces non-production time by cutting down the time spent moving around to access technical documentation, and checking stocks."

"Once implemented, paperless processes will bring immediate benefits for all affected users with regards to real-time data and the removal of the paper report generation, which in itself is time consuming and has a cost associated," Clements agreed. "The back-office

Ramco Aviation Software Decision assists mechanics by leveraging machine learning. (Credit: Ramco)



Decision Assist for Mechanics by Leveraging Machine Learning

staff in Production Planning, Procurement, and Commercial all stand to benefit when their processes and exchanges are digitized and integrated into their primary tool, which in Swiss-AS' case is AMOS."

"As well, MROs can be more efficient as they are reducing their basic data entry efforts as well as reducing the need to rework such data," said O'Connor.

All told, a paperless management system will make an MRO function better than it did before. But it isn't just the company that benefits from this Improvement: it's the MRO's customers. A better-run company repairs their planes and engines faster, commits fewer errors due to an enhanced information flow, and can answer customers' questions intelligently and usefully when they call up to find out what is happening with their repairs.

"If you have access to real-time information coming off the aircraft, you know exactly how far it is in the work package, how much has been accomplished, and what problems have been found," said Mather. "As a result, you have greater predictability, and that increases customer satisfaction. It also increases the capability of the MRO organization to plan through an online portal where they can interact with customers. This speeds up approvals and keeps matters clarified with customers, because it's all there on the screen in black and white. So there isn't a battle with customers at the end of the day: They've got information about everything that's happening with the aircraft and they can see exactly all the records."


(Credit: Ramco)

Ramco Aviation Software has the necessary capabilities to make the process entirely paperless"

Saravanan Rajarajan, Associate Vice President of Aviation Solution Consulting at Ramco Systems

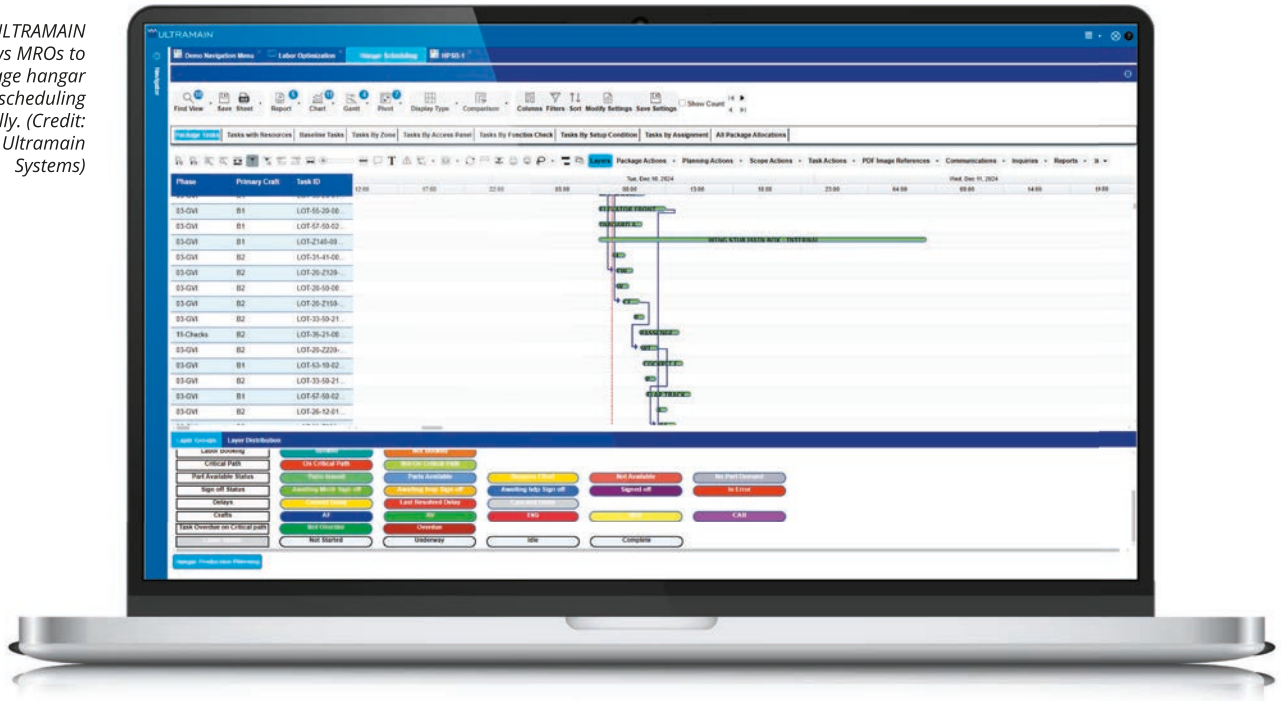
What It Takes to Move to Paperless

So far in this article, we have outlined the many benefits associated with MROs going paperless. Now's the time to splash a little cold water on the process: Even for the best organized companies, moving from paper to digital documentation requires organizational changes, process adjustments, and even some regulatory approvals. So it's not just about implementing software and tossing paper into the recycling bin. To make the transition to paperless in a successful and enduring manner, MROs need to adapt their workflows —- and sometimes their organizational structure!

So where to begin? Well, before an MRO starts asking for bids from ERP software vendors, senior management needs to decide what they want to achieve from the process. Are they just trying to get rid of paper, or are they looking for a more fundamental transformation to improve how their company does business and better integrate it with the digital world beyond their doors? These are questions that need to be asked and answered first, because it is difficult to successfully navigate a journey if you don't know what your final destination is.

"It's very important to create a vision around what you're trying to accomplish and what the benefits are going to be because certainly in some ways you're adding complexity," said Justin Daugherty, Maxa's Senior Director of Aerospace Solutions. (Maxa provides Data Analytics Automation and AI/ML solutions to support many industries, including aerospace.) "As well, you might slow down some phases of executing your maintenance by doing digital, but then in other ways you're going to speed it up and you're going to make people's lives significantly easier and better and faster. This is why calling attention to that broader vision and setting those expectations right out front is really important. At the end of the day, you need to get buy-in from the people who are going to be executing maintenance while using these systems."

"There are not many barriers to transitioning to paperless systems," noted O'Connor. "The most important thing is that the MRO



ULTRAMAIN allows MROs to manage hangar scheduling digitally. (Credit: Ultramain Systems)

organisation buys into the project and accepts the principle that paper-based solutions are going away."

After the vision has been spelled out, it's time to talk to the vendors. Then, once the right software system is being selected for the company, it will need to work closely with the successful vendor to analyze the process of moving from paper to paperless, to develop an end-to-end plan for doing so, work out the schedule for the implementation and to buy hardware, install and debug the system and ready it for deployment, and finally to train the staff to be able to use it.

There will be lots of little details that will have to be addressed during this process. For example, "to fully embrace paperless and, in turn, mobility, electronic signatures have to be adopted," Clements said. "This is a challenge in itself, and requires that an MRO management system such as AMOS is capable of supporting the necessary processes."

In particular, "you need to be able to prove rather that the signed digital record is the record and it hasn't been altered," said Mather. "In order to do that, you need a certain degree of security process control and encryption. With encryption, you actually need to have a digital signature file that is irrefutable to prove the validity of that document, in order to truly be paperless in this scenario. Not every system has that capability: That's a key differentiator."

As for AI

As advanced as they are now, there's no doubt that paperless MRO management systems can always be improved. This is why the makers of these systems are constantly pursuing advances and updating their products.

Not surprisingly, artificial intelligence (AI) is on their radar. But not everyone thinks AI is a Magic Bullet.

On the positive side, "we do see technologies like AI having a very significant role to play in MRO offerings," said O'Connor. "As such, OASES is currently exploring such technology for areas such as predictive maintenance, such as using AI to look at historic trends in component replacement to align parts ordering with when replacements are actually needed."

On the negative side, an MRO needs to have its data in a centralized storage area that an AI can access and analyze. If not, the AI will not have sufficient information to make accurate recommendations. In the computer industry, the direct relationship between input quality and output quality is described by the old adage, 'Garbage In/Garbage Out'.

"AI and machine learning (ML) can only be effectively leveraged when built on a trusted, unified data source — one that integrates multiple systems of record, applies pre-calculated insights, and incorporates business logic and context," Daugherty said. "Even then, just bringing your data together into a single data lake isn't good enough for AI and ML if the data is not accurate, complete and always kept current. If you just apply an AI or ML against a flawed data lake, it's going to hallucinate."

That's right, artificial intelligence systems can hallucinate. To quote IBM.com, "AI hallucination is a phenomenon wherein a large language model (LLM) — often a generative AI chatbot or computer vision tool — perceives patterns or objects that are nonexistent or imperceptible to human observers, creating outputs that are nonsensical or altogether inaccurate."

In reality, AI hallucinations are just super-charged versions of Garbage In/Garbage Out. But they are still something that every MRO wants to avoid. This is why the makers of paperless MRO management

AMOS.
AGAIN.

"This collaboration reflects our commitment to adopting advanced technology solutions and solidifying Avia Solutions Group's position as a leading company in the aviation industry. It marks a significant step towards enhanced fleet management and operational excellence."

says Aviation Systems Architect & Project Manager at Avia Solutions Group.

Avion Express and SmartLynx of the Avia Solutions Group (ASG) take off with AMOS.

AMOS represents a transformational leap in operational effectiveness and fleet optimisation.

This strategic integration fosters data transparency, group-wide collaboration, and sets a new benchmark in digital transformation for ASG.

The integration not only streamlines processes but also unlocks significant cost savings and efficiency gains.

SWISS AviationSoftware

SWISS-AS.COM

Ultramain Solutions

Ultramain Systems delivers true paperless MRO solutions for airlines, third-party base and line maintenance providers, and component overhaul shops. Going paperless isn't just about enabling an airline's Continuing Airworthiness Management Organization (CAMO) or allowing third-party MROs to interact with an airline's maintenance system—it's about ensuring that MROs themselves can operate independently and seamlessly in a fully digital environment. For over a decade, Ultramain Systems has been at the forefront of this transformation, offering a system that **eliminates** paper. Not just in task cards, non-routines, and supporting forms, but across the entire MRO workflow. ULTRAMAIN enables true digital merging of airline and OEM work cards, ensuring MROs can generate and complete work packages entirely in a digital format—one that aligns with customer and regulatory expectations. With ULTRAMAIN, airlines and MROs achieve a truly digital, streamlined, and compliant maintenance environment.

systems are being very careful about implementing AI in their products.

"Actually, AI isn't necessary for paperless processes," said Mather. "Our MRO management systems already have all the tools they need without AI."

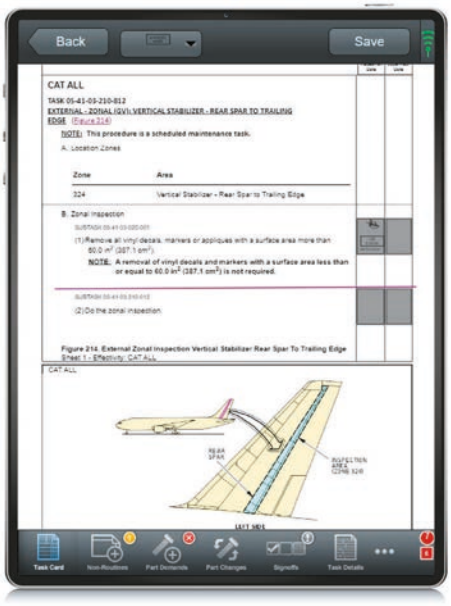
Will There be a Truly Paperless Future?

"Do you foresee a future when paper will be entirely banished from MROs?" That's the last question that Aerospace Innovations posed to our experts for this article. On this point, their opinions varied

"For sure, the paperless hangar is not only coming, but in some cases it is virtually here," Clements said. "Of course, MRO customers, in the form of airlines and leasing companies, have a part to play to realise a complete digital flow of data. But MROs themselves can already reap the benefits of the paperless process and tighten up their shop floor data collection, commercial offerings and ultimately deliver ever better products in the form of 'on time' and 'on budget' results for their clients."

"Yes, I certainly see that digitalisation of the MRO industry is very doable, is efficient as a timesaver and even enhances

(Copyright: 2019 Gorodenkoff/Shutterstock)



Above: ULTRAMAIN Mobile Mechanic brings an MRO's ERP system directly to the shop floor. (Credit: Ultramain Systems)

accuracy," added O'Connor.

John Stone is a bit more conservative in his assessment, but no less optimistic. "Paper part tags, bin labels and the like will still be used, but beyond that MROs who use ULTRAMAIN can operate paperlessly today," he said. "For instance, industry adoption of Spec 2000 Ch. 18 (Work Packages) is not required to go paperless, because ULTRAMAIN automatically transforms customer-provided paper-based work packages into digital work packages/task cards that allows an MRO to operate paperlessly."

Meanwhile, Saravanan Rajarajan admits to a bit of scepticism when it comes to MROs becoming completely paperless. "It is difficult to foresee this due to multiple factors, including regulatory requirements, customer-specific requirements, regional variances, and organizational adoption of paperless processes," he said. "However, MRO management system adoption rates are increasing due to competitive pressures, cost efficiencies, and younger workforces."

The moral to this story: Although paperless MRO management systems may not erase every shred of paper fiber from the enterprise, they will likely eliminate paper-based systems as a viable form of management going forward.There's just too many benefits associated with going paperless and too few linked to staying with the old ways.

By James Careless

Better Batteries by Design

A look at how battery technology is advancing to deliver the performance attributes required by eVTOL aircraft

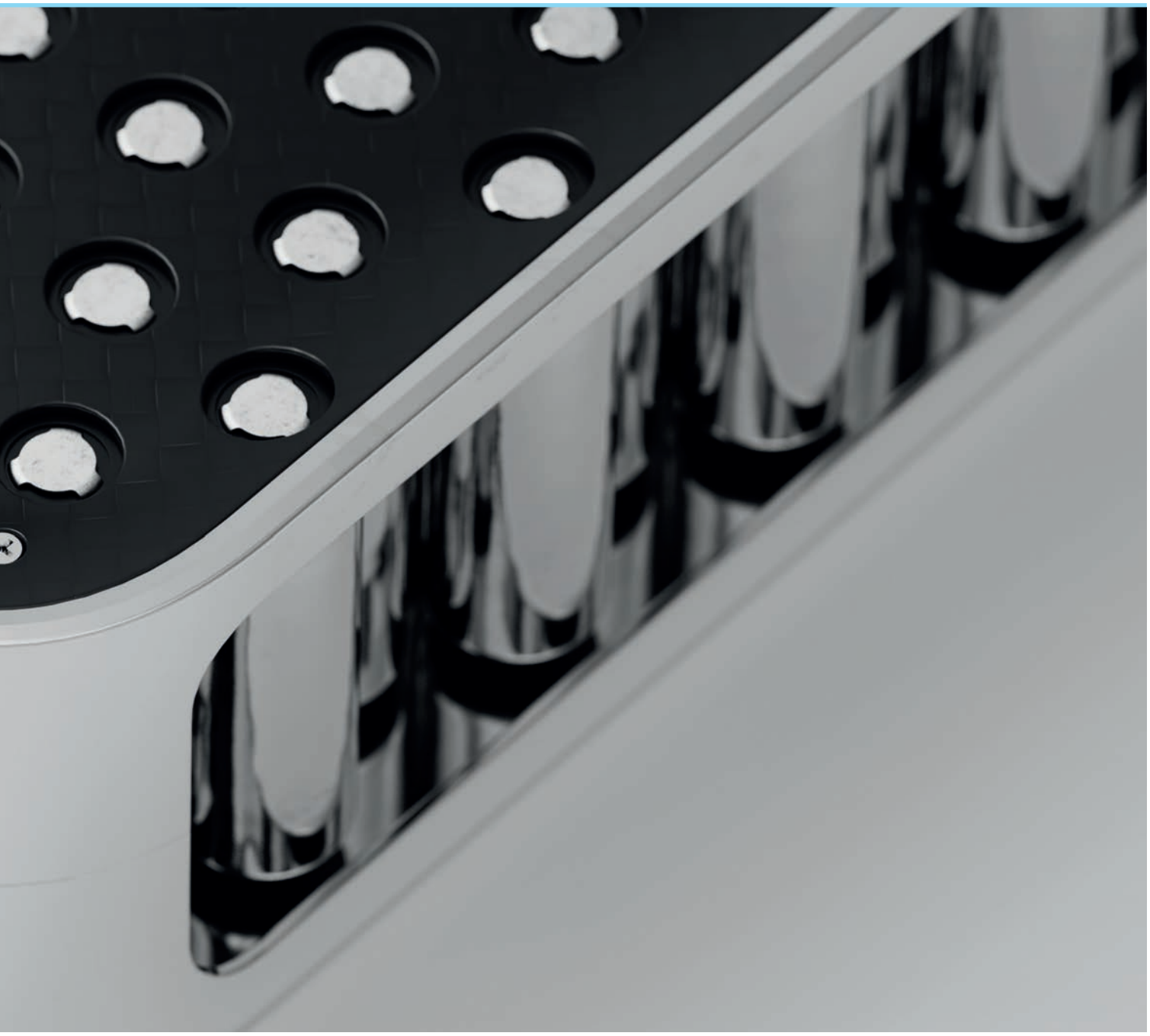
'Fast', 'quiet', 'convenient'. Three virtues that manufacturers of all-electric, vertical take-off and landing (eVTOL) aircraft cite as advantages over traditional ride-sharing options such as Uber, Lyft, the India-based Ola and China's Didi. For example, Joby Aviation expects to deliver journeys that are up to 10 times faster than driving with its electric taxi, which is designed to carry a pilot and a maximum of four passengers at speeds of up to 200mph.

Quantifying how much potential there is for eVTOLs is difficult. Analyst forecasts differ widely, but Joby is betting that the global market will be 'large'. However, it concedes that the market remains undeveloped and there is no guarantee of future demand.

Such uncertainties have led to a scarcity of investment from which many manufacturers have been left bruised and battered. Notably, Germany's Volocopter and Lilium find themselves in insolvency proceedings as they seek an injection of finance and restructuring, although Lilium has announced an asset purchase agreement with Mobile Uplift Corp, a company set up by a consortium of investors from Europe and North America. The deal was expected to close in January ahead of a business re-start, but no further details have been released.

eVTOL success is also largely dependent upon the utilisation rate of the aircraft - the amount of time the aircraft spends in the air carrying passengers or cargo. High daily aircraft utilisation is achieved in part by reducing turnaround times at skyports and by having the right battery technology.

Speaking in 2023, Daniel Wiegand, co-founder and Chief Engineer for Innovation & Future Programs and Executive Director at Lilium, said he believed from a technology point of view that by 2050, around 50% of all flown passenger kilometres could be



done in a battery electric aircraft. In addition, over the next ten-20 years, he expected 75% of electric aircraft performance improvements to come from the battery.

Fast forward two years, and comments from Bruno Even, CEO of Airbus Helicopters, seems to have poured cold water on such optimism. Speaking to journalists during a media briefing at the end of January 2025, Even confirmed the company is pausing the development of its CityAirbus NextGen eVTOL aircraft. The reason? Concerns over the maturity of battery technology, which the company doesn't feel reliably meet the requirements for range, performance and cost-effectiveness currently.

"The launch of a new program depends on many factors, the maturity of the business model, and the maturity of the technology … some of them need to evolve in order to be in a position to launch a new program," he said.

CityAibus NextGEn was designed to transport up to four people - three passengers and a pilot - over 80km, with a cruising speed of around 120kmph.

Could do better

A sanguine Tine Tomažič, Director of Engineering & Programs at Pipistrel admits that "When we consider the battery challenges facing eVTOLs, we recognise that battery technology must continue to evolve to increase performance as well as developments with charging and charging stations."

Nonetheless, he deems that, "We are witnessing progress, as this is ever evolving as we continue to learn, develop and innovate."

Pipistrel is behind the Nuuva V300 – a long-range, large-capacity hybrid-electric VTOL unmanned aircraft – successfully completed its first flight on 31 January 2025. Equipped with a zero-emission electric vertical take-off powertrain and a separate dedicated cruise propulsion system, Tomažič says the Nuuva V300 will

provide unparalleled flexibility and runway independence. The aircraft is powered by in-house developed proprietary battery systems, ensuring efficient, sustainable and cost-effective performance. This unique combination of technologies will enable the Nuuva V300 to operate in a wide range of environments.

Researchers at Oak Ridge National Laboratory (ORNL) are one team that is pushing our understanding of eVTOL battery performance. Led by Illias Belharouak, an ORNL Corporate Fellow, the researchers have concluded that eVTOL batteries can't just be adapted from electric car batteries, which they claim has been the dominant approach to the technology.

The conclusion and other takeaways are the results of efforts from early 2024, which saw Belharouak and his team evaluating how lithium-ion batteries fare under extremely high-power draw, linking actual flight profiles to real-time physical battery operation.

Under the now-closed programme, lithium-ion batteries were created by the ORNL team at the DOE Battery Manufacturing Facility located at ORNL and run through simulated climb stages of eVTOL aircrafts. What happened inside the battery during cycling, including how much energy was rapidly accessible during the demanding take-off phase, was studied, while afterward, the battery materials were tested for corrosion and other chemical or structural changes.

One of the immediate findings was that the power and performance demands for eVTOL batteries can significantly reduce their longevity and durability.

Unlike electric vehicle batteries, which typically drain at a steady rate, there is a significant difference in eVTOL power requirements between take-off and cruise flight in. Take-off requires a high burst of power, while cruise flight operates at a medium-to-low power level relative to the take-off phase. Similarly, landing also demands high power, and the vehicle often transitions directly into charging mode, meaning the battery never gets a chance to rest electrically or thermally.

Another limitation is cycle life. eVTOLs are used in urban air transportation, where they will need to be recharged multiple times a day. Therefore, eVTOL batteries must be able to withstand multiple charge/discharge cycles and maintain a certain SOC (State of Charge).

"Now we know more about what is required of the eVTOL battery, we'll need to engineer systems differently to achieve that," said ORNL lead researcher Marm Dixit. "Our focus is fundamental: What happens to the materials under these specific loads and operating conditions? We are trying to figure out the limitations of the battery chemistry we have now and then tune the battery to bridge that gap."

As part of the study, the ORNL researchers developed a new electrolyte and tested it against the current state-of-the art version used in lithium-ion batteries. As the ORNL explained, using the eVTOL mission profiles, its electrolyte performed better, retaining more capacity during the most power-demanding flight phases, calling into question the current measurement of battery performance.

As Dixit testifies, "Your battery is not just capacity at the end of 1,000 cycles. It's what's happening within a cycle that tells you whether your system is going to work or crash. And the stakes are much higher here because you're asking how safe it is to go up in the air. This is a question we don't know the answer to — yet."

Designing for density

For Pei Feng, President of Greater Bay Technology (GBT), the battery system is the 'base station' in the clean energy network, and its speed of energy flow affects the efficiency of industrial innovation and user experience.

GBT Battery entered the eVOTL field for the first time in 2024 when it entered into a strategic

cooperation with Ehang Intelligence to jointly develop the world's first eVTOL eXtreme fast charging battery solution for low-altitude aircraft for short-distance flights and frequent take-offs and landings.

Battery cell technology, as Tomažič told Aerospace Innovations, is constantly evolving. "The current state of battery cell technology for eVTOLs involves a complex balancing act between several critical factors: energy density, power output, battery lifetime and cost."

For its part, GBT characterises current traction battery technology in terms of performance improvement, technological innovation and

Airbus has paused development of its CityAirbus eVTOL citing the immaturity of battery technology. (Copyright: Airbus Helicopters)

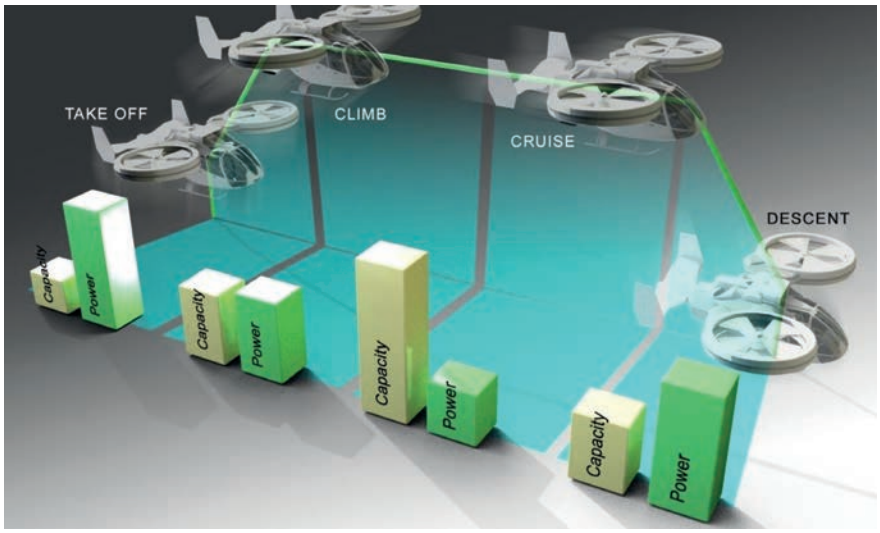
industrial intelligence.

As a company spokesperson expounded, performance enhancement is mainly reflected in the energy density which continues to climb. They asserted that at present, the energy density of lithium-ion batteries has been raised from the initial 100Wh/kg to more than 200Wh/kg, about 3-5 times that of lead-acid batteries. This means that in the same volume or weight, lithium-ion batteries are able to store more energy, which significantly improves the range of new energy vehicles and meets consumer demand for long range. In the field of cutting-edge solid-state battery technology, this indicator has reached 400wh/kg, and the energy density improvement has a greater effect on alleviating mileage anxiety. This is due to high fault tolerance of the solid state's positive and negative electrode materials.

EHang has a strategic investment in Shenzhen Inx Technology Co., Ltd. (Inx), a solid-state lithium metal battery technology company in China. Inx's solid-state lithium metal battery differs from existing traditional lithium-ion batteries by using lithium metal instead of graphite as the negative electrode and solid-state electrolyte instead of liquid electrolyte separators.

Dr. Lin Chen, Chairman and Head of Research & Development of Inx, has stated that after over a decade experience of dedicated research and technological development, Inx's solid-state lithium metal batteries have an energy density of 450Wh/kg based on 6Ah-50Ah cells. Equipped with this solid-state battery, EH216-S has already completed a continuous 48 minutes and 10 seconds flight test, which is applicable to different flight requirements and significantly improves the flight endurance by 60%-90%.

A method of realising high energy density, is through optimising the battery structure design. "By



The operating phases of an eVTOL need varying amounts of power; some require the battery to discharge high amounts of current rapidly, reducing the distance the vehicle can travel before its battery must be recharged. (Copyright: Andy Sproles, ORNL, US Dept. of Energy)

optimising the structural design of the battery, the space utilisation of the battery can be improved, so as to enhance the energy density," the GBT spokesperson states.

GBT has made the battery cell, module and system board a lightweight design.

"For the battery cell, under the premise of meeting the performance of eXtreme fast charging [Compared with the existing aircraft batteries, GBT claims the eXtreme fast charging battery system for low-altitude aircraft released this time has ≥25% increase in energy density, 35% increase in battery capacity, ≥2,000 cycles, and 30% - 80% charging in 5 to 10 minutes], we chose high-capacity anode and cathode materials, increased the proportion of active substances in the pole piece, and reduced the quality of auxiliary materials in the battery cell, so that the battery cell has the energy density that is not inferior to the conventional ternary cells," the spokesperson said.

In terms of the module, GBT has adopted an integrated large module design, with more than 60 pieces of battery cells integrated in a single module, and adopted the platformised structure design, using the ultra-thin shell to integrate the module. The lower shell uses aluminium extrusion and stamping brazing and an integrated liquid cooling plate structure, which saves space in the Z-direction and reduces weight. The upper case adopts an MSC high-tech composite material top cover, which ensures mechanical strength while the density is only 1.3~2.0g/cm³.

According to Pipistrel's Tomažič, every project the company engages in employs a custom battery architecture, which intrinsically optimises different parameters, including size, weight, power, cost, cycle life, shelf life, environmental durability, serviceability, various degrees of system redundancy, and power distribution.

Whatever the approach, there is a need to increase energy density without increasing battery size, and to minimise battery weight, as the weight of an airplane directly affects its flight performance and safety, and an overweight battery increases energy consumption and reduces range and flight efficiency. Additionally, a reasonable battery layout can optimise the aircraft's centre of gravity distribution and improve flight stability and safety.

Overcoming cell degradation

The degradation of traction batteries has always been a key factor limiting their performance and life. In recent years, battery technology has made significant progress in material chemistry, providing a variety of solutions to solve this problem. Through the efforts of electrolyte optimisation, cathode and anode material improvement, battery structure design optimisation and battery management system application, the degradation problem of traction battery is gradually being solved.

Pipistrel is balancing and managing performance metrics with the needs of the operator by simplifying any complex battery details for operators, who receive easy-to-understand information. This includes State of Charge (SoC) which shows the battery's current charge level as a percentage; State of Health (SoH) which indicates the battery's condition and how much it has aged; and Operating Temperatures which provides real-time temperature data to ensure safe operation.

"This user-friendly approach helps operators manage the battery efficiently and safely. We've successfully implemented this with the Velis Electro, and operators have found it very useful," says Tomažič.

The company is also addressing cell degradation through multiple approaches. As Tomažič explains, they are exploring advanced chemistries, including silicon-anode and solid-state lithium technologies, through various research programs. They are also optimising the integration of batteries into the aircraft structure, including the development of structural batteries, as well as enhancing thermodynamic efficiency with liquid and hybrid cooling systems to better manage battery temperatures.

"Additionally, we conduct extensive testing to identify optimal operating conditions, temperature ranges, power loads, and charging cycles that can slow down degradation for each cell type. There is no one-size-fits-all solution, as different chemistries require tailored approaches," he asserts.

Safe discharge

While designed to maximise reliability, such battery systems must also endure aggressive duty cycles

The Lilium team testing cells against its mission profile at its HQ near Munich. (Copyright: Lilium)

with discharge demands of up to 6C, putting great pressure on their design. Additionally, these batteries must operate under challenging environmental conditions, such as temperature extremes, vibration, and mechanical shock experienced during landings.

At Pipistrel, safety has been a top priority throughout its journey of lithium battery development, which began over 15 years ago with commercial off-the-shelf (COTS) cells. "We have consistently adhered to the highest safety standards during our research and development processes.

"Our batteries are designed to meet rigorous safety criteria, ensuring that our products are reliable and meet highest performance standards," confirms Tomažič.

In order to satisfy the safety requirements of aviation batteries, GBT has designed a dual-branch system for the battery pack, added a closed backup system isolated from the main system, and designed a dual-branch system for the battery pack, in the event of a failure of the primary system, there are still two backup systems that can continue to work instead of the primary system to ensure the safety of the vehicle. Space-grade nano-insulation material is used between the main system and the backup system to realise effective fire prevention and heat insulation.

In order to promote the commercialisation and popularisation of eVTOL batteries, in 2023, GBT opened its 189,000m2 specialised factory for eXtreme fast charging traction battery in Nansha, Guangzhou. The factory includes cell production workshop, battery safety experiment workshop, test workshop, pilot plant, PACK workshop capabilities amongst other activities.

That same year, Vertical Aerospace opened its Vertical Energy Centre (VEC), believed to be the UK's most advanced aerospace battery facility, based in Bristol. The 15,000ft2 facility, is one of the only dedicated aerospace battery facilities in the UK, and home to Vertical's battery team which is developing proprietary battery technology combined with cell technology from its strategic partner, Molicel.

The first in-house developed prototype battery modules have already been assembled in the facility which gas also seen the battery systems undergo a wide range of testing, including temperature, conducted emissions, vibration, thermal durability and characterisation, propagation and drop testing at the VEC. Vertical has previously had significant progress with battery tests, having carried out crash and thermal runaway testing under European Union Aviation Safety Agency and the UK's Civil Aviation Authority supervision.

According to the company, it has developed significant intellectual property around battery design including cell packaging, cooling and electronic battery management systems to deliver high-power, high-performance battery packs capable of powering eVTOL aircraft. Vertical is aiming for entry into service with a 220Wh/kg battery system. This will enable Vertical's VX4 eVTOL to conduct back-to-back missions, with fast-charging cycles in-between, and minimised impact on the packs' cycle life.

A second chance

Extending the serviceable life of the battery is one thing, but what of repurposing these batteries after their eVTOL service. The teams at Pipistrel and EHang among others, are exploring second-life batteries.

The common ways to reuse eVTOL batteries are recycling, after station utilisation, technology upgrading and reuse.

Professional battery recycling organisations or those companies with advanced battery dismantling technology and environmentally friendly equipment can safely and efficiently recycle valuable materials in the batteries, such as lithium, cobalt, nickel etc. The recovered metal materials can be used to produce new batteries, reducing the need for new raw materials, but also reducing production costs and environmental pollution.

GBT says another opportunity is the use of eVTOL batteries in energy storage systems, such as home energy storage, industrial energy storage or grid energy storage, or even in other non-mobile devices, such as streetlights and signal base stations. These devices have relatively low energy density and power requirements for batteries, so the performance of eVTOL batteries can be fully utilised, the spokesperson said.

There may be consensus on the approach to repurposing still-functional components, but opinions are split on whether the relevant legislation is aligned with the realities of eVTOL battery technology.

"Current legislation regarding eVTOL batteries does not need to be reframed to take into account advances in the eVTOL market," believes Tomažič. "The regulatory landscape is becoming increasingly clear, and from an infrastructure standpoint, an eVTOL should be capable of landing at any vertiport, airport, or heliport. We are closely monitoring the standardisation of charging infrastructure to ensure compatibility and safety."

A different perspective comes from China. "Legislation on eVTOL batteries can no longer adapt to the rapid development of eVTOL battery technology. For example, the existing battery safety standards, performance test methods, and airworthiness validation processes cannot adequately cover the special requirements of eVTOL batteries," says the GBT spokesperson. "In addition, with the continuous innovation of battery technology, new battery materials and structures may bring new safety risks, which also require timely assessment and updating by the legislative bodies."

By Alexander Preston

Pipistrel's Nuuva V300 zero-emission powertrain is entirely liquid-cooled, including the batteries, and has demonstrated the ability to withstand faults, battery thermal runaway events, and crash loads as part of the EASA certification process. (Copyright: Pipistrel)

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