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Editor's Letter

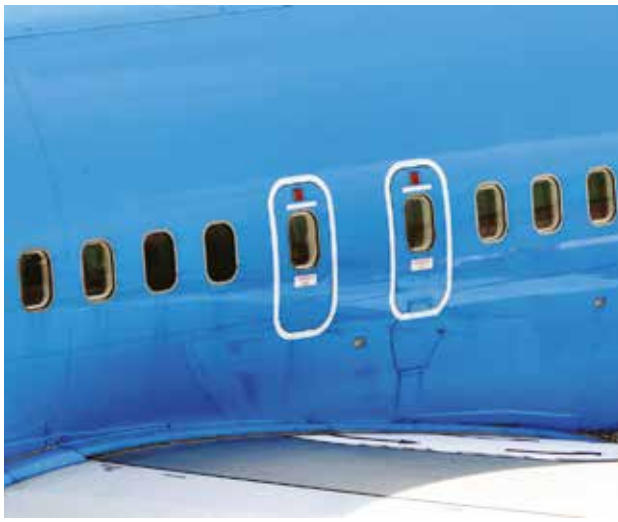
COMFORT BREAK

Airlines in today's ultra-competitive industry continuously look to reduce costs while also squeezing every possible bit of revenue out of their most valuable assets, the aircraft. Revenue generation can only be achieved through enhancing increasing load factor, increasing the yield per passenger, operating as many flights as possible, and by physically adding more seats to the aircraft.

The last element has been one area where airlines have endeavoured to maximise revenue generation – but it is also an area where the industry is willing to pay for the most advanced lightweight seating systems which optimise the passenger experience at the same time. It is also an area that is coming under scrutiny.

Over the summer, the Federal Aviation Administration said it was considering establishing minimum seat and seat spacing dimensions for aircraft that operate in the US and opened a public consultation initiative to garner opinion. There's no guarantee this process will result in any change, although the huge public response is evidence of dissatisfaction certainly with today's economy class experience.

Why now? US Congress already required the agency to consider establishing minimum seat size standards on the grounds of safety during an aircraft evacuation. This was a condition of its 2018 reauthorisation, although the requirement came with no penalties for inaction.



Admittedly, the agency has taken some steps to address the mandate as, in addition to soliciting public feedback, it also conducted limited live evacuation testing in 2019.

The agency's next reauthorisation bill could therefore be something to watch in 2023 especially since there are parallel efforts by a handful of US lawmakers who want future rules to reflect the realities of evacuating the elderly, children and people with disabilities.

Airlines will always provide safe seating that meets a range of budgets and special needs. There is no doubt that rules should best fit our time, but the FAA is charged with assessment on the grounds of safety, not comfort. Should critical minimum seat sizing decisions be based on anything other than safety, the immediate impact will be on airline profit which will simply translate into higher ticket prices – which is the last thing the industry needs as it exits such a difficult period in its history.

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AERENA

by AERQ

Unlock new revenue streams by kickstarting a global economy in the sky – all through enhanced engagement for a more memorable passenger experience.

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BUSINESS BRIEFING

CONNECTIVITY

EU allows airlines to offer 5G connectivity, US struggling to retrofit avionics for safety

European lawmakers are set to make it mandatory for airlines to equip their aircraft with free 5G connectivity. In late November, the European Commission updated the implementing decision on spectrum for mobile communications on board aircraft, designating certain frequencies for inflight 5G technology. Airlines will be obliged to install a 'pico-cell' on aircraft to amplify 5G coverage to passengers.

Passenger phones will connect to masts on the ground during low-altitude flights, and the pico-cell will be used to amplify the 5G signal at higher altitudes, allowing passengers to connect with their existing 5G data. EU Commissioner Thierry Breton said, "The sky is no longer a limit when it comes to possibilities offered by super-fast, high-capacity connectivity".

Airlines have been allowed to provide Wi-Fi to passengers since 2008 but usually charge extra for internet access and the service is usually only available on longer-haul flights.

Meanwhile the US aviation industry is warning that airlines will struggle to retrofit regional and cargo aircraft with critical avionics technology to avoid interference from wireless 5G by the prescribed deadlines.

It is now backing the FAA request to mandate an extension of mitigation by wireless carriers as airlines retrofit radio altimeters. "It is critical to extend these mitigations to allow airlines time to complete the retrofit," the letter said. Currently smaller regional aircraft have to meet the December 2022 deadline with larger aircraft scheduled for July 2023.

In a letter to the White House, the industry warns that 'inter-agency government progress appears to be at a stalemate, while stakeholders are doing their part to address these issues', warning that since January the FAA has documented more than 100 incidents of potential 5G interference.

100

Since the start of 2022, the FAA has documented more than 100 incidents of potential 5G interference

SEATING

Thompson Aero Seating to build dynamic test facility

Thompson Aero Seating plans to create a £7.5 million world-class Dynamic Test Facility (DTF) in Northern Ireland to help catapult the business into a new era of development and innovation.

Building works have already begun to extend the premises for the DTF at the Thompson brownfield site in Banbridge, County Down, and are planned to complete in spring 2023, with the test equipment to be installed in the summer and testing due to begin from autumn 2023.

The DTF will give Thompson enhanced capability to certify new products for airworthiness and to carry out R&D. Until now, Thompson has had to send products and team members to test facilities in Europe and North America.

Neil Taggart, Thompson chief executive, said: "Having our own Dynamic Test Facility will give us a huge opportunity to save on lead times in the development of our new seats and improve sustainability – which have to be positives for our airline customers."

The DTF's sled testing capabilities will reproduce the dynamic conditions of a full-scale crash event in a controlled environment. The reverse accelerator sled being installed will be able to produce up to 100g accelerations.

CABIN

Airline industry urged to implement cabin air standards

Airlines, manufacturers and the EU Aviation Safety Agency are being urged to immediately implement new cabin air quality standards to protect staff and passengers from chemical fumes.

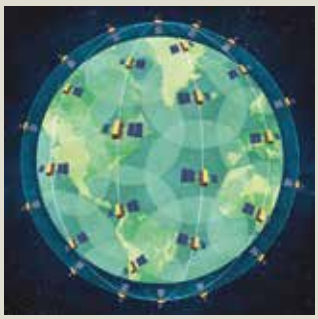
The European Committee on Standardisation (CEN) has finally published a technical report including recommendations on how to prevent exposure to fumes through improvements in the design, maintenance and operation of aircraft.

These measures could prove key to minimising the impact of 'fume events', when the ventilation supply of air on commercial aircraft gets contaminated with noticeable amounts of heated engine oil and hydraulic fluid fumes.

Its recommendations call for the installation of suitable filtration to remove fumes from the ventilation supply air, and chemical sensors to reduce onboard exposure to fumes and to prompt effective maintenance in addition to implementing best practice.

The European Transport Workers' Federation, the European Trade Union Confederation, the Global Cabin Air Quality Executive and the European Cabin Crew Association are calling for act on the recommendations right away.

BRIEFS



Cirium has developed a new satellite-based Ground Event maintenance tracking capability allowing maintenance, repair and overhaul service providers to monitor when and where an aircraft last had a maintenance event and predict its next visit.

It also helps to identify aircraft transitions and define strategies around how and where maintenance and aftermarket budgets are being allocated by operators or owners. The capability can show, for example, how Lufthansa returned five of their Airbus A340s which were due for retirement back into service due to aircraft delivery issues.

Qatar Airways selected Sport 24 to provide passengers with live coverage of 56 FIFA World Cup matches on their personal devices on flights equipped with the airline's Super Wi-Fi service.

Produced by IMG, and exclusively available inflight from Panasonic Avionics, the live TV service was streamed for the first time via Inmarsat's GX Aviation inflight broadband. The milestone coincides with the FIFA World Cup taking place in the Middle East for the first time.

Burrana has signed an agreement with Akkodis to provide its RISE Power system for installation on two Airbus A330 aircraft for PlusUltra Airlines. This award is part of the airline's recently announced fleet and cabin upgrade.

The system configuration selected by PlusUltra will provide two dual USB-A jacks per triple seat group – a total of four USB-A jacks per triple seat – and one dual USB-A jack per double seat group – a total of two USB-A jacks per double seat.

45

Each A350-900 cantilevered overhead locker is designed to carry a maximum of between 30kg and 45kg

7.7

Passengers now take on average 1.5 kg more carry-on luggage than 2008, on average 7.7 kg

5

Seating manufacturer Recaro's partnership with Lufthansa has spanned five decades

AIRCRAFT

Iberia must limit overhead bin luggage weight

A Spanish court has ordered Iberia to limit the weight of hand luggage taken on to its Airbus A350-900 aircraft to prevent cabin crew injuries.

Judges dismissed demands by flight attendant unions to not have to close the extra large overhead lockers or 'bins' but instead ordered Iberia to limit the weight of hand luggage on board.

Each cantilevered overhead locker is designed to carry a maximum of between 30kg and 45kg – the equivalent of five full-sized carry-on cases – and must be pushed upwards to close. As Iberia does not monitor carry-on weight, the actual weight of each locker can exceed the stated maximum.

The report states that Iberia cabin crew are expected to lift these lockers above their heads while simultaneously leaning over passengers due to the seating design. With 112 overhead lockers on a A350-900, a flight attendant could be expected to perform this action 14 times.

The ruling acknowledges that although Iberia carried out risk assessments it had failed to 'establish preventative measures'. While cabin crew want the bins replaced, the judge said this was not feasible although did order Iberia to start weighing hand luggage and adhering to weight allowances. Iberia must also ensure that a shorter employee (below 1.63 metres) can work with another crew member to minimise injury risk.

A recent European study by Lufthansa Consulting for the EU Aviation Safety Agency shows no significant change in standard passenger weight since 2008 although did find that passengers now take on average 1.5 kg more carry-on luggage, with the carry-on weight on average now 7.7 kg.

SEATING

Recaro cements relationship with Lufthansa

● Recaro's CL3710 and CL3810 seats have been selected by the Lufthansa Group to outfit its economy class cabins.

The order of 24,000 economy class seats will be equipped on nearly 100 Lufthansa and SWISS aircraft with delivery starting in the fourth quarter of 2023.

"We are looking back on 50 years of partnership with Lufthansa, and it's a tremendous honour to still be working alongside them to optimise the passenger journey," said Dr Mark Hiller, Recaro chief executive.

Dressed with Lufthansa's signature colours, the modular design of the CL3710 minimises maintenance and keeps total cost of ownership low. The six-way adjustable headrest with neck support enhances sleeping comfort for the passenger, and the seat's amenity flap is built to store personal smart devices for added convenience.

The CL3810 economy class seat will be retrofitted on both SWISS A330-300 and Lufthansa Boeing 747-8 aircraft which offer more space and premium comfort cushions with layered foam and innovative ergonomic technology and which is 15 per cent lighter in comparison to its predecessor.

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HAIL THE AGE OF DIGITALISATION

Aidan O'Leary, director of engineering – Ireland, Aerospace Engineering Solutions argues that it is time to go fully digital

"The aviation industry is keeping up with this digital trend but there is still a way to go with going fully digital"

Aidan O'Leary is director of engineering – Ireland, AES

Visit aesglobal.co.uk for more information on Aerospace Engineering Solutions

The use of digital computers in aircraft design was developed by large aerospace companies throughout the 1970s and included systems such as computer-aided design (CAD), a structural component stress analysis using aerodynamic modelling. The adoption of such digital techniques in aviation and its systems within the aircraft has grown steadily in sophistication and continues today.

Modus operandi is a term that describes a habitual way of operating, and in business it can be used to describe a company's preferred method of accomplishing its business and interacting with others in the same industry. This is the same in aviation – the OEM created the aircraft by its preferred means of accomplishing its business and the aircraft is delivered using hardcopy records. This continues today during aircraft transitions, and there is now an opportunity in today's digital age to deliver aircraft digitally during their transitions. Moving forward, it is now essential for all areas associated with an aircraft transition, including MROs, Part 21J engineering and CAMO organisations, to go digital.

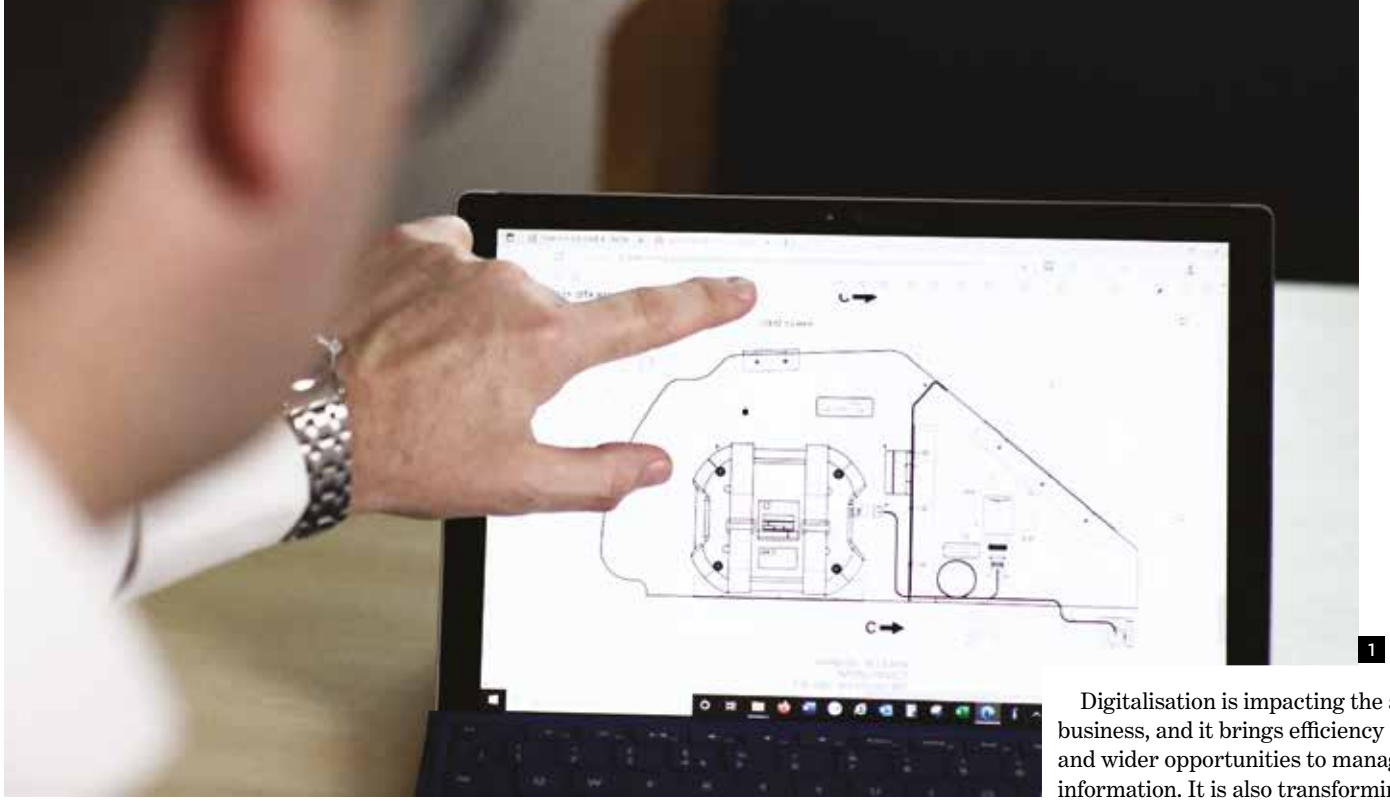
The aviation industry is said to be at the vanguard with its cutting-edge technology available to the aircraft cabin; that in turn is there to improve the passenger experience and make the journey more feasible. Wireless inflight entertainment systems are changing the game from the ground up by delivering the power of digital to aircraft all over the world. For example, you can now check menus on most airlines using a QR code on your phone, which means no paper menu brochures are needed.

Interestingly, the technical and MRO sideline are still managing paper, but more and more software is now available to mechanics and engineers to carry out their maintenance duties on tablets, and it's clear to see that MROs are adopting this today. People all over the world use digital products every day with their phones and applications to carry out their daily tasks, and the aviation industry is keeping up with this trend, but there is still a way to go with going fully digital. People and technology are designed to work well together, so more can be done for the future of this industry.

The use of digitalisation in aviation in 2022 and beyond is centred around

90%

Around 90% of all currently flying commercial aircraft have paper maintenance records. To put this in perspective, that paperwork would circle the Earth 25 times if laid end to end



1

Authorities have completed many surveys focusing on the digital transformation of the industry

why do we continue to use paper in the digital age. At Aerospace Engineering Solutions we do everything digitally with no printing paper for signing documents and only using digital signatures on our paperwork. Delivery to the customer is also by email, but a lot more is needed in the industry to stop printing paper.

Digitalisation has been a highly debated topic for years. Some believe it could lead to incomplete back-to-birth records while others argue they are easier to archive. On average, commercial aircraft usually pass through five or six owner/operators between delivery and retirement, making physical copies of paperwork easily lost or misplaced.

Although we incorporate digital technology as often as we can into our day-to-day lives, one could argue that the aviation industry is somewhat dated. Around 90% of all currently flying commercial aircraft have paper maintenance records. To put this in perspective, that paperwork would circle the Earth 25 times if laid end to end. So, it's not surprising that digitalisation is becoming an increasingly popular choice as digital records are far more portable and easier to back up. However, some believe that there are still concerns with the updated records, for instance, the security of online programmes within the Cloud.

2

Digitalisation is impacting the aviation business, and it brings efficiency and wider opportunities to manage information. It is also transforming traditional processes based on the exchange of paper documents.

Authorities have completed many surveys on the digital transformation of the aviation industry and have reflected on the challenges of the ideas and initiatives. During their surveys, they looked at data protection and cyber security, digitisation of paper, mobile applications and connectivity to name a few, and data protection and cyber security and digitisation lead the way for what trends were important.

Authorities are agreeing to digital records at the deliverance of aircraft during transitions. Many software companies are providing solutions and this software needs to be very advanced to provide confidence to aircraft owners.

The adoption of moving away from paper is supported, but confidence is needed. It is unclear where the lead will come from – is it lessors? Is it the airlines? Is it authorities? Who knows? The conversation has started, and it's going to be a long road, but it cannot take too long. Sustainable development in the aviation industry must meet the needs of current generations without compromising the ability of future generations.

So, if people are utilising the digital way, isn't it time to go fully digital? If we don't print paper then we save money, use less water, conserve energy and help preserve adult trees.

1. An AES engineer reviews a CAD drawing, a product of the 1970s digital development wave
2. Cabin technology is at the cutting edge with items such as USBC PD Power sockets

Light Touch

Zotefoams' collaboration with Technifab has created a pioneering partnership for lightweight aircraft interiors

James Bridges
Director of high-performance products, Zotefoams

Cody Kardokus
Director of business development, Technifab

Michael Kalamasz
Vice president of engineering, Technifab

Over the past decade or so, a slew of aircraft interiors components have been revolutionised thanks to the pairing of a disruptive foam material from Zotefoams with the vision and fabrication skills of Technifab.

As the commercial aviation sector commits to rigorous carbon reduction targets, *Aircraft Cabin Management* spoke to James Bridges, director of HPP products at Zotefoams and Michael Kalamasz, vice president of engineering, and Cody Kardokus, director of business development at Technifab to find out more about the role of foam in improving the sustainability of flight and what developments are in the pipeline.

Aircraft Cabin Management (ACM): With the ICAO announcing a commitment to achieving net zero carbon emissions for commercial flight by 2050, the aviation sector faces a tough time as it recovers post-pandemic and simultaneously works towards carbon reduction. What role can materials – in particular foam – play?

James Bridges (JB): It's a time of huge change for sure. Icons such as the Boeing 747 and the Airbus A380 have ceased production, making way for newer, more efficient platforms that reflect changing travel preferences. New propulsion technologies, such as hydrogen and electric, are nearing service, alongside the impending return of supersonic commercial flight.

In every case, though, weight reduction is key to both efficient operation and carbon reduction. Accordingly, we are seeing demand for foam to replace traditional materials across an increasing number of applications. Through our Azote polyolefin foams and Zotek F high-performance foams, Zotefoams materials can be found in seat cushioning, widow surrounds, galley insulation, decorative panels, armrests and ducting. The list goes on.

Cody Kardokus (CK): Fuel costs account for around 25 per cent of every dollar spent by airlines and of course weight impacts fuel consumption. Foam can be as much as 60 per cent lighter than traditional materials.

We've come a long way already: the first pressurised commercial passenger jet weighed almost 32 metric tonnes, while the nearest modern-day equivalent is a little over a third of that.

So now it's all about finding new areas of application. A great example is a project where we replaced traditional composite ducts with Zotek F in the environmental control system (ECS) of a wide-bodied jet, reducing the weight by over 90kg pounds. Assuming a fleet of 600 aircraft, that's a fuel saving of more than 4 million litres a year.

A further advantage is foam is self-insulating, eliminating the need for additional insulation and contributing to easier installation.

ACM: Aside from weight reduction, what are the key attributes that the aviation sector requires in a foam?

JB: Zotefoams has been making foams for the industry for over 80 years, initially using rubber, then polyolefins and more recently, engineering polymers, notably PVDF. Our materials are appealing for aviation due to our unique manufacturing process, which uses only temperature, pressure and inert nitrogen as the expansion medium.

This results in materials that are notably pure, consistent and durable. PVDF was selected as the raw material for Zotek F because it is inherently inert and UV-resistant – both of which are desirable qualities for aviation.

Michael Kalamasz (MK): Foam has excellent characteristics for comfort and, in the case of Zotek F, is also extremely safe. There is no outgassing typically associated with chemically blown foam; it is, purely and simply, PVDF. It is also highly customisable, so is an attractive proposition for airlines and aircraft manufacturers, as the same material can be used for multiple applications. As a fabricator, we appreciate that it can be bonded without the use of adhesive in many instances, so retaining that essential purity – or that it can be combined with

"Weight reduction is key to both efficient operation and carbon reduction"

1

2

3

different grades of foam and face fabrics in very easy processes.

For aircraft manufacturers there are additional advantages. Foam components are more flexible, allowing, for example, ducting to be 'woven' through the airframe, saving engineering time and enabling rate in production. Their lightweight nature has downstream benefits too, with the scale and weight of bracketry being reduced.

ACM: And beyond fuel savings, how do you consider sustainability in the context of foams for aviation?

JB: Sustainability is a complex topic with different requirements for different sectors that should be reflected in the design, use and end-of-life phases respectively. In aviation, the biggest environmental impact by far is the use phase, so the biggest impact we can make is to focus on weight reduction to deliver fuel savings. It's also worth noting that longevity is an important element of sustainability and that our materials are extremely durable, with a lifespan that easily matches that of the aircraft.

CK: We echo everything James says: the priority is always safety and performance in flight. Foam is often used as a mono-material to replace composite assemblies, which does make end-of-life processing more straightforward. We are also seeing reuse of foam increasing, in applications such as pet beds and artificial turf underlay, further increasing service life.

On that point, Technifab has a number of projects with current space programmes and it is noteworthy that the model there is shifting from 'single use' to reusable spacecraft, supported by the durability and robustness of Zotek F.

ACM: So what's next for foam in aviation?

CK: There are still many areas where foam can offer advantages. Insulation is a great example: traditional insulation blankets are prone to wick and absorb the condensation that is a by-product of flight, gradually becoming heavier and eventually needing replacement. Closed cell foams are resistant to moisture so the weight remains constant.

MK: Our dedication is to solutions that provide significant weight advantages, enhance product value and performance, improve installation times, simplify integration and condense the overall flow time into serial manufacturing. The inherent properties of the PVDF foam are the perfect complement here.

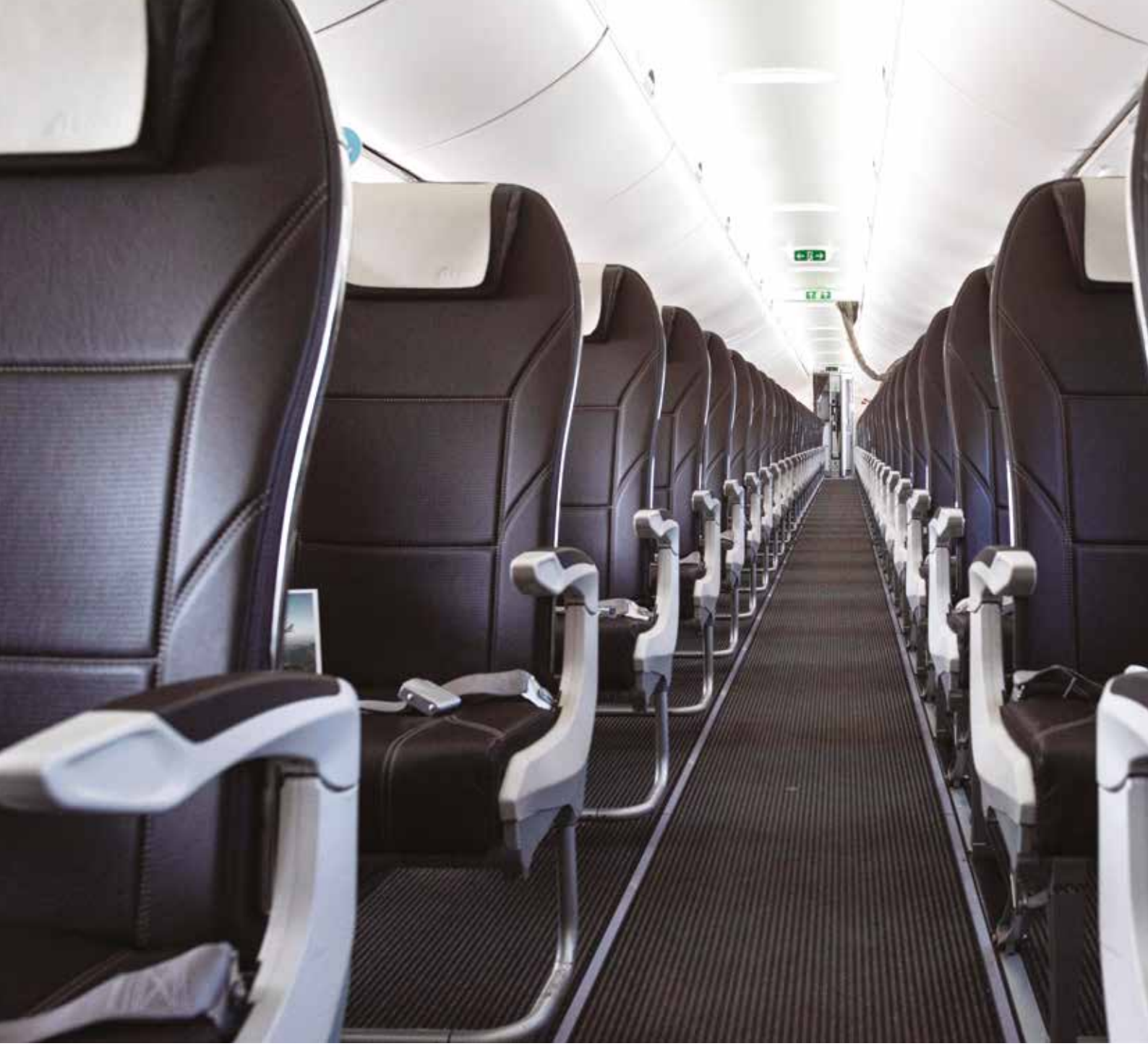
There are also significant advantages in how adaptable the PVDF foam is when considering the possibilities of products in the different areas of the aircraft that many times offer challenges due to limited spatial requirements and the confined work envelope. But innovation and invention are two of the core ingredients that motivate our teams to accept the broad range of challenges associated with custom product and process development, rapid prototyping and new product launches.

When coupled with the endless possibilities that the PVDF foam provides through its superiority in performance and versatility in converting, each new opportunity is received with a great deal of passion and interest, no matter its complexity or practicality. Even the most complicated and extraordinary of products is possible.

JB: The goal is always to produce a material that is lightest for purpose, while meeting all regulation requirements. Zotefoams already produces the world's lightest closed cell, crosslinked foam at just 15kg/m^3 and we're constantly looking to see if we can produce even lighter materials that still meet demanding performance requirements.

Conversely, the most recent addition to the Zotek F OSU range is an extra-rigid grade with densities up to 150kg/m^3. This has proven hugely successful, extending applications for foam to semi-structural elements such as seat backshells, while offering weight savings of up to 70 per cent compared with materials such as solid thermoplastics.

1. Due to its properties, Zotek F high-performance foam lends itself to the production of complex components for aviation
2. A novel solution from Technifab produced using Zotek F PVDF foam: a Moisture Trough and Gutter System used to channel the condensation generated when flying at high altitude to designated collection areas
3. A complex window housing for a passenger jet produced by Technifab using various grades of Zotefoams' Zotek F high-performance foam



SITTING PRETTY?

As US aviation authorities consider minimum seat sizes on safety grounds, airlines are working hard on getting the balance between the need for space and comfort right, reports ***Sandra Arnoult***

A bit of dustup is occurring now among airlines, passengers and the US Federal Aviation Administration over the prospect of a new rule that could require specific minimum sizes for seats on aircraft.

Over the years as the average passenger size has increased, airline seats have not kept pace with the increase of girth and height of customers. Now, the FAA is taking up the issue with an eye to making new rules that would set a standard minimum seat width for commercial carriers.

Standard seat sizes for US carriers currently range from a 17 inch width and a 30-32 inch pitch. This however coincides with a push by some airlines for 'cabin densification' to increase capacity and revenue through cabin designs and materials that reduce seat size and personal space.

As expected, all the interested parties – including airlines and passengers – had a lot to say to the agency that oversees both aviation safety and standards.

When the FAA's 90-day comment period ended in November, it had received more than 26,000 comments. Passengers ticked off a litany of complaints ranging from cramped, uncomfortable seating, ease of access and fears of the ability to make a quick evacuation in the event of an emergency. Airlines however contend that there is no need to create a minimum seat width requirement as passengers are free to choose the carrier that meets their needs and expectations.

The FAA determines the maximum number of seats that can be installed on commercial aircraft based primarily on the number of exits available for an emergency evacuation and the time it would take to safely evacuate.

But there is currently no mandate on the width and pitch for aircraft seating. Airlines have consistently tried to balance load factor with the needs for passenger comfort and safety, while remaining FAA-compliant.

Still, the FAA appears to be in no hurry despite the flurry of interest. "We will review all applicable comments," FAA spokesman Steven Kulm tells Aircraft Cabin Management. "Our review has no set timeframe."

Seating and capacity standards are not a new issue for the FAA. But critics say that times have changed and so have passenger needs. Capacity requirements are based on the size and body type of the aircraft, the emergency exits and the ability to evacuate an aircraft within 90 seconds.

"Since 2018, the FAA has continued to actively study the relationship between safety and seat dimensions, finding no basis to move forward in the past with new or updated regulations," says Robert Ireland, vice president, Airlines for America, in his statement to the FAA. He was joined in his comments by Douglas Lavin, vice president, member and external relations, IATA North America. Further, the FAA's own comprehensive studies have revealed there is 'no evidence that current seat sizes are a factor in evacuation speed, nor that current seat sizes create a safety issue necessitating rulemaking'. The group represents US carriers, including American, Delta, Southwest, United airlines and other majors.

"Passengers have complained about lack of legroom and tight seating, yet everyday thousands of passengers consciously choose flights with less comfortable seating to save money," says US-based aviation analyst Henry Harteveldt. "That said, there is a legitimate need to ensure that a high-density configuration can meet require evacuation standards."

↑ As passenger sizes increase, airlines are under pressure to reconsider cabin design

"THE FAA WILL PROBABLY SEE ROBUST PUSHBACK REGARDING SEAT SIZE FROM BUDGET CARRIERS"

The current average seat widths accommodate only 50 per cent of the population, according to a group called FlyersRights.org, which submitted lengthy comments to the FAA. While passenger sizes have increased, airline seats have decreased in size and pitch, according to their research.

"While passenger safety should be the FAA's primary focus, the detractors of the minimum seat standard rule may criticise such a rule as unfeasible," FlyersRights contended in formal comments to the FAA, adding 'a reasonable and proper phase-in of the rule would make it both economically practical and much safer for customers'.

Another passenger rights group, Travelers United, has called for a five-year moratorium on any new ruling so that more studies and research can be conducted. "This focus on seat size dooms this FAA examination of passenger safety with a narrow focus," says Travelers United president Charles Leocha. "Safety and comfort are not the same thing. And the narrow issue of seat size and aircraft evacuation does not take other safety factors into consideration."

Testing should take into account passenger size as well as the true length of time taken to evacuate a cabin and the impact of new materials and design, says Leocha. The focus on seat size is only part of the overall considerations for safety and an overall reconsideration will serve passengers far better, he adds.

Harteveldt suggests that the FAA will probably see robust pushback regarding seat sizes from ultra low cost or budget airlines.

"They believe it will impede on their ability to compete, arguing that if they are forced to increase legroom and thus remove seats that they will be forced to charge higher fares," Harteveldt explains. "ULCCs may also position their high-density seating as a 'green strategy' since a plane with more passengers can be considered more fuel-efficient than one with a less dense configuration."

The National Air Carriers Association that represents low-cost carriers including Breeze Airways, Spirit Airlines, Frontier, Allegiant and others urged the FAA to focus on its primary mission of safety.

"Ensuring passenger comfort is not within the FAA's regulatory mandate," says NACA Jodi Baker, deputy administrator for aviation safety. "Passenger comfort is left to the airlines and a result of the choices passengers make when booking flights."

↑ Airbus's new Airspace cabin has built-in flexibility so a 3-3-3 section can upgrade to a 10-abreast layout

50%

The current average seat widths accommodate only 50 per cent of the population, according to FlyersRights.org

Airlines have tried to take into account passenger needs, aiming to provide safety as well a modicum of comfort while offering customer a seat selection that fits their budget or special needs, based on size or physical ability.

Relatively new to the US market, Breeze Airways began flying in 2021. It describes itself as a budget carrier and makes a point in offering a range of services and seating. It operates a fleet of Airbus A220s and Embraer E-jet 190-195s. Standard economy seat is 17.6 inches, and the seat pitch ranges from 30 to 31 inches. The carrier's 'Nicest' seats, similar to a first class product, have a 20.5 inch seat width with a 39 inch pitch.

Founder David Neeleman is no stranger to the airline industry. He helped launch charter carrier Morris Air and WestJet of Canada. In 1998, he created JetBlue and in 2008 he launched Brazilian carrier Azul. He appears to have found a niche for providing reliable, passenger-focused service while maintaining a range of price points.

"Like always, we wanted to create a company where people want choice," says Breeze chief commercial officer Lukas Johnson. "Certain carriers aim to serve customers seeking the lowest possible price. We take a lot of pride in how we design the product and we think people like that. We'd love to carry everybody." However, he adds, there will always be some who just want the cheapest flight.

"Unless the FAA concludes from any new evacuation testing that high-density seating may pose a risk to passenger safety, I don't believe the FAA will enact any meaningful changes," says Harteveldt. "The FAA may be sympathetic to the plight of the travelling public, but it isn't charged with ensuring passenger comfort, only passenger safety."

DESIGNING WITH AN EYE TO THE FUTURE

While airlines try to strike the balance between the most efficient use of aircraft cabin space with passenger comfort, manufacturers are working to fill the gap that addresses both.

"Our focus has always been on lightweight design and comfort," says Dr Mark Hiller, chief executive of Recaro Aircraft Seating.

"Innovations such as the high literature pocket and the ergonomically contoured seat bottom, in tandem with significant investment in weight saving materials, is how Recaro remains a pioneer in driving innovative seat solutions."

Hiller says that airlines and suppliers continue to be focused on developing sustainable solutions given the cost of fuel and the shared goal of achieving better carbon neutral performance.

A hybrid cabin layout that incorporates premium and economy is one way to maximise comfort and flexibility.

As an example, Hiller points to KLM Cityhopper which features the company's BL3710 seats at the front and SL3710 seats at the back of the cabin.

Mirus's Kestrel seat design weighs in at 7.5kg 'fully dressed'

It's hard to forecast the future however and it can take up to two years to bring a new product to market. Then it could take another eight months or more to customise the seat for an individual customer programme.

Recaro's newest addition to the economy class portfolio is the CL3810, which features ergonomic technology, premium comfort cushions, lightweight engineering and an additional inch in living space. "Leaders in the industry must be bold in developing these innovations to make this a reality is the way forward," says Hiller.

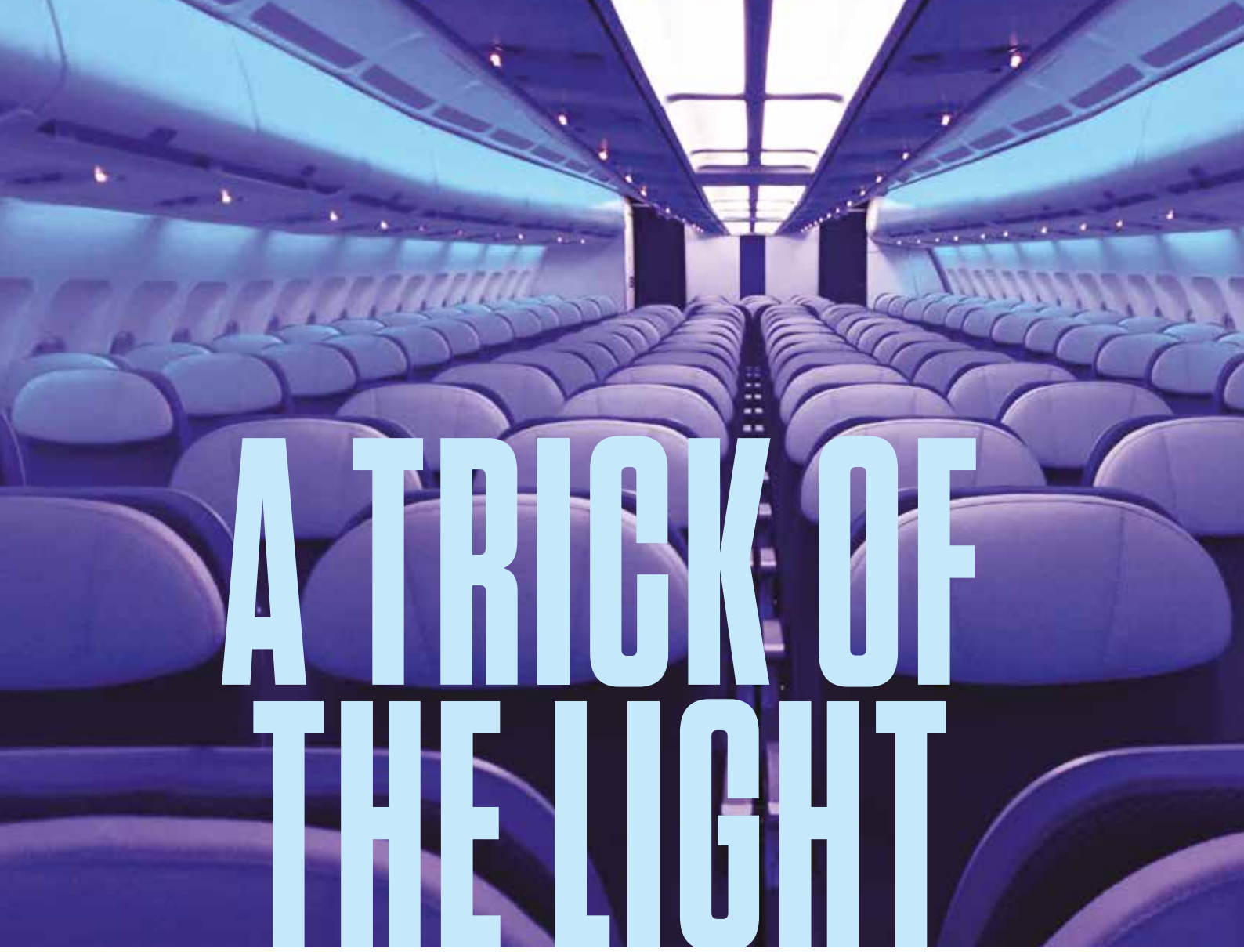
The industry faces the challenge of creating new designs and products that will reduce overall weight on the aircraft without sacrificing passenger comfort.

"In today's climate, where cabin densification is a priority for airlines and passengers are also seeking more space and privacy, it is important for seating manufacturers to bridge the gap and balance these demands through innovative and cutting-edge products," says Ben McGuire, chief executive and co-founder of Mirus Aircraft Seating.

"At Mirus, we are responding and improving the lives of the 95 per cent of passengers who fly in this ever-constricting section of the aircraft by giving them increased levels of comfort and space through clever seating solutions."

McGuire points to the Mirus Kestrel seat design, a fixed back economy seat with a 28-inch pitch weighing in at 7.5 g 'fully dressed'. He says the Kestrel blends unequalled levels of passenger living space and comfort in an ultra-lightweight, slimline, fixed back economy seat, ensuring ample fuel-saving opportunities for airlines, offsetting emissions and reducing costs.

Optimum passenger comfort is guaranteed while incorporating the Mirus design philosophy of 'finesse and style to enhance the appearance of the cabin', McGuire notes.



A TRICK OF THE LIGHT

Alexander Preston examines how lighting manufacturers are innovating solutions to bring the widebody experience to single aisle long-haul aircraft

In October 2020, Air Transat flew an Airbus A321LR from Montreal, Canada to Athens, Greece: a nine-hour journey usually the preserve of a Boeing 787 or A350, and the latest example of narrowbody long-haul.

While seating manufacturers have made moves to adapt widebody seats to long-haul single aisle aircraft to enhance passenger comfort, there's one key element of the cabin design that hasn't yet received the same level of attention. Or has it?

"As more aircraft move from widebody to narrowbody and become smaller, the work a lighting system does for the cabin interior in giving the impression of space and freedom is more important than ever," says Dan Rust, co-founder and director at Cobalt Aerospace.

Schott's vice president, aviation, Philip Fischer agrees, adding that as the trend is being adapted to aircraft types not in focus before, the number of light concepts are increasing and they have to be adapted to these new environments.

Fischer points to two areas of focus: realising a sense of space, generosity and well-being within the smaller cabin, and achieving a sense of privacy and personal space within the narrower cabin. Consequently, as airplanes become smaller, the challenge becomes larger," asserts Fischer.

Meeting this challenge, Schott offers mood lights (HelioCurve LED strip), accent lights/divider lights (HelioLine side light) and its star ceiling as well as sophisticated reading lights such as its Jade model that convey both ambience and privacy at the same time.

For Brian Schmalz, vice president, sales & marketing, Collins Aerospace, the conversation can be further broken down into four main categories that ultimately all focus on providing an enhanced cabin experience around comfort and well-being for the passenger and cabin crew, namely passenger psychology, passenger physiology, architectural/immersive effects and cleanliness.

According to Schmalz, passenger perception of the cabin environment can be altered by modifying the light colour, the spectral composition (various wavelengths of light) and intensity.

He points to the example of boarding, where a cool bright white light can provide passengers with the feeling of a spacious cabin; whereas heading towards an evening sleep cycle, dimmer but warmer lights in the cabin will elicit a sense of comfort and relaxation that is the initial trigger for sleeping.

Brain chemistry

Lighting also has a major influence on our brain chemistry. Our lives are lived according to patterns set by our natural daylight cycles. For instance, morning light contains a higher content of blue and cyan lighting that triggers us to wake up and start our day; during our working day, the sun is at its peak and provides a natural white lighting; and at the end of the day we seek a warmer relaxing lighting that simulates sunsets or the warm glow of a fire. Low levels of warm-colour light helps melatonin levels to rise and support a sleep cycle, while the opposite (higher levels of cool light) physiologically support awakening.

Collins Aerospace's new Hypergamut wash lighting – which was a Crystal Cabin Award finalist at Aircraft Interiors Expo 2022 – not only provides the highest CRI (colour rendering index, which is a measure of light colour quality in terms of how well colours are seen by the eye) available today, but it allows the spectral content of the light to be weighted.

For example, the spectral content can be adjusted for meal-time where red and green content could be increased to provide an enhanced look of the meal while still retaining the base cabin lighting colour, or it can be used to combat jet lag using the circadian rhythm algorithms, providing the correct spectral content to initiate that wakefulness period to start resetting the body clock.

Jan Petersohn, business development cabin systems, at Diehl Aerospace agrees that a mature lighting concept is one of the key factors for a pleasant atmosphere on long-haul flights. "As we all know from experience, the human body is stressed by long-distance flights and travelling across multiple time zones," he says. "Thus, any support is helpful to relieve the [body] and help it to adapt to the circadian rhythm in a new time zone."

To achieve this, the cabin lighting system mimics the sunlight and provides harmonised lighting scenarios.

Single-aisle aircraft, stresses Schmalz, need to make the most of the limited space available, and this means that common spaces like galleys or entry ways benefit from architectural lighting to enhance those spaces to create a more spacious look and feel. This is also true for business class seats, he explains, where integrated lighting concepts can be employed to highlight the zone and emphasise the space.

ARCHITECTURAL LIGHTING ENHANCES SPACES SUCH AS GALLEYS OR ENTRY WAYS

Additional lighting features can also be considered to maximise the look and feel of the cabin space, such as bulkhead artwork to direct passenger focus, using artwork in cabin architecture the same way that it is used in interior building architecture, or fully immersive cabin lighting environments, using lighting to change the depth perception of the ceiling or cabin width.

It's a consideration well known to STG Aerospace director Pierre Michard. "More and more, our lighting scenes are designed to spark interest from the passenger. It can be a sunrise scene to match their waking-up cycle or a carefully designed brand panel lit in an unexpected way, similar to an art installation."

The company is now seeing a growing appetite from cabin integrators to introduce dynamic lighting to narrowbodies in order to give an impression of space. "We have already modified our first narrowbody for long haul operations," says Michard.

1 & 2. Cobalt Aerospace's Cobalt Spectrum lets airlines easily alter the cabin lighting for passenger wellbeing as well as aesthetics

2

"A NEW GENERATION OF DYNAMIC LIGHTING SCENARIOS MIMICS NATURAL LANDSCAPES"

"A new generation of dynamic lighting scenarios mimics natural landscapes, giving the passenger a great preview of the flight destination." he says.

Passenger wellbeing

For the Airbus A321XLR, Diehl has used the latest LED technology for the entrance area, the entire cabin and the lavatories. This makes the areas appear significantly larger, more modern and brighter. In addition to the main lighting and the flexible light strips along the contour of the overhead compartments, the highlight, says Petersohn, is the Hero Light which runs in the middle. The 40-centimetre-wide strip light can be customised for each airline customer. Comfort colours and dimmable lighting ensure maximum wellbeing for passengers on board. "We can illuminate any desired edge or niche by using our flex lights and still keep costs and weight low," claims Petersohn.

And then there's the single aisle lavatories and galleys which don't have the same space or layout flexibility that are possible with widebody aircraft. During longer flights the single aisle lavatories go a longer time with more usage cycles between full-service cleaning cycles than they would when cleaned on the ground between shorter flight segments. To help offset this, Schmalz says that 222nm Far Ultraviolet ("Far UV") lighting has demonstrated in certain studies that, when properly applied, it can be used to reduce viruses and bacteria on targeted surfaces – with no action from cabin crew.

The company's own Lilac 222nm lighting system is planned to be autonomous and will cycle on/off continually during the flight, interrupting the cleaning cycle if a passenger enters the lavatory. This technology has recently been undergoing on-aircraft testing on the 2022 Boeing 777 ecoDemonstrator aircraft.

"There are significant opportunities to continue to enhance the passenger experience through lighting and provide that Instagrammable wow moment," believes STG's Michard.

Rust agrees. "The opportunities are fantastic: arguably better for narrowbody aircraft. There is a symmetry across a long-haul single aisle aircraft that doesn't exist on a widebody, where the view is wildly different for passengers seated in outboard seats to centre seats.

"Essentially, a narrowbody provides a single ceiling canvas for sky effects and additional symmetrical canvases to the sides for horizon effects. Where there exists more of a challenge is in the appetite and ability of narrowbody operators to change routes and uses for their aircraft, leading to a requirement for either a large number of pre-defined scenes to choose from, or the ability to change scenes quickly and easily."

The challenge could be overcome by adopting single standards to accelerate innovation adoption. Databus is a prime example. "Despite Arinc partners' efforts to come up with a great unified Arinc 825 protocol, we still must create specific variants to accommodate multiple communication standards including Arinc 825/CanBus, CIDS, CSS and multiple flavours of RS485," says Michard.

STG Aerospace has developed the Universal Lighting product family that suits all sectors of the market, giving a more personalised experience to passengers with a full integration of the latest databus standards.

For its part, Cobalt's Cobalt Spectrum features thermal and age correction technology as well as 2.4GHz wireless real-time control. The latter provides opportunities to easily integrate wire-free control panels to define all the scenes an operator could want, change them at will, and to try out new scenes under real-time control in the hanger.

Summing up Collin's approach, Schmalz reveals that the company is working with customers to explore many opportunities to use its systems collectively with a focus on creating comprehensive lighting solutions to curate an experience that is greater than the sum of the individual parts.

It's a mission shared by all those working on bringing a real light upgrade to the single aisle long-haul experience.

↑

STG Aerospace's Universal Lighting allows a more personalised passenger experience

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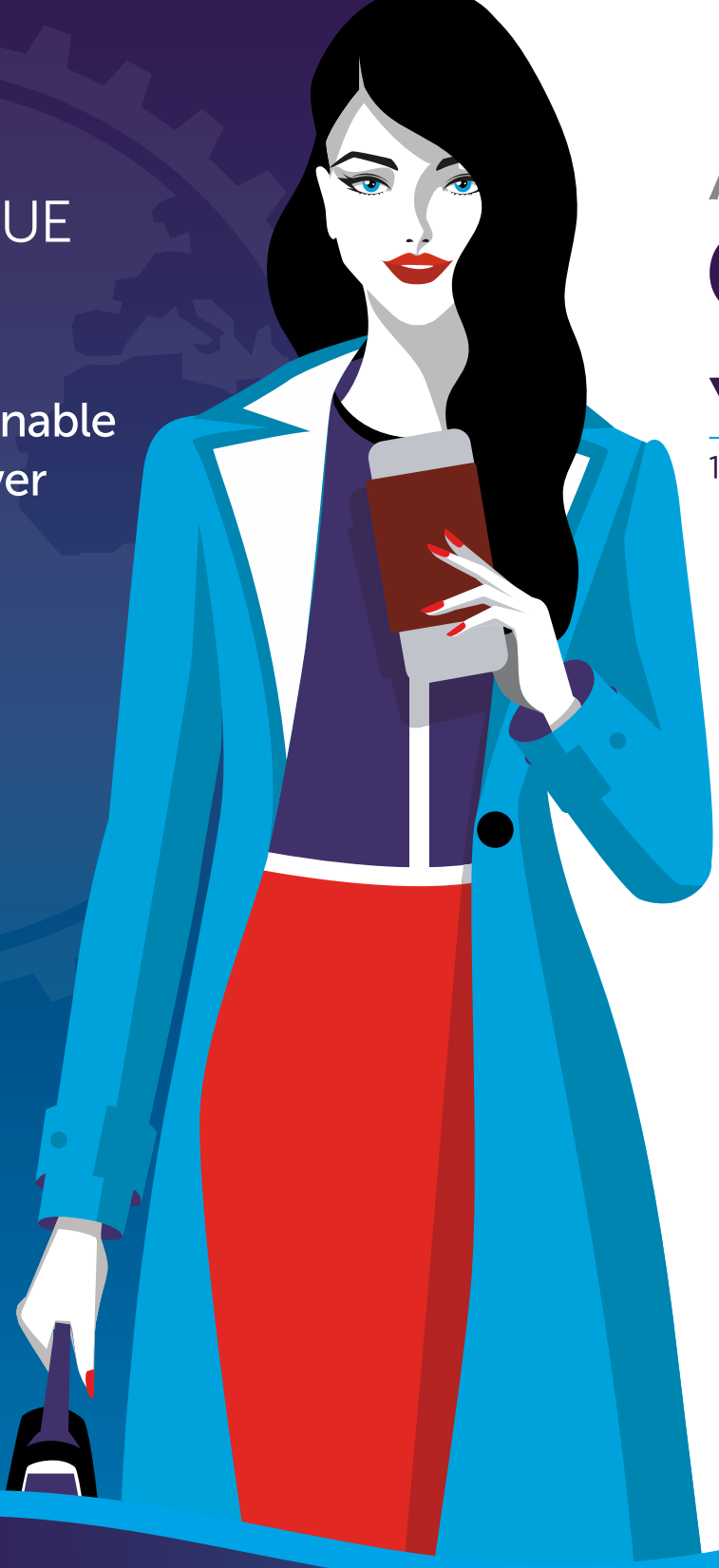

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1

The Air We Breathe

Paul E Eden discusses the state of the art technology in cabin environmental control systems

When the Boeing Model 307 Stratoliner entered service in 1940, it opened a new era in which airliners could potentially fly above terrain and weather, improving safety, efficiency and passenger comfort – the key enabling technology was cabin pressurisation.

Pressurisation and cabin air quality are managed by the environmental control system (ECS). At its most basic, the ECS receives engine bleed air and conditions it to maintain cabin pressure and sustain a comfortable, breathable atmosphere for passengers and crew. Boeing's 787 is the exception, its ECS drawing air from ram air inlets, not the engines.

The industry has become very good at cabin pressurisation but has struggled with the occasional entry of contaminants into cabin air on the ground. These 'fume events' may have long-term health consequences for crew and they are sufficiently common that frequent flyers will almost certainly have experienced them and know how unpleasant they can be.

A recent European Committee on Standardisation (CEN) technical report detailed recommendations for preventing fume events, including installing filters to prevent fumes from entering the cabin or to mitigate their effect. The report has caused pressure on EASA to address the issue properly, while some ECS suppliers are already ahead of the game.

David Conrad, vice president, business development at Oxnard, California-based PTI Technologies, explains the challenge of fume events and how PTI is working to prevent them.

50%

The cabin air on commercial aircraft is typically supplied by two sources – 50% from recirculated air and 50% bleed air taken from the compressor section of the engines or APU

"The cabin air on commercial aircraft is typically supplied by two sources – 50 per cent recirculated air and 50 per cent bleed air taken from the compressor section of the engines or APU. The 50 per cent from bleed air contains contamination that may include hydraulic fluids, engine oils, pyrolysis products, multiple types of volatile organic compound – VOCs – and particulates, as well as ozone."

In response, PTI Technologies has developed integrated filter technology, initially applied to fuel tank inerting systems and now to bleed air filtration for ECS. "We've tested these filters at temperatures up to 250°C [500°F] and challenged the filter with contaminants including toluene, engine oils, valeric acid, ozone and propylene glycol. Our test results are very positive, and we are working to deliver integrated bleed air filters to airframe OEMs for testing."

The company is also developing filter systems for recirculated cabin air. Standard HEPA (high-efficiency particulate absorbing) filters remove impurities but are unable to capture gases. Conrad reports market-leading performance in trials with HEPA filters with activated charcoal imbedded into their weave for gas removal.

Other 'fume removal' options on the market include BASF's dual-mode Deoxo convertor, which uses catalyst technology to break down ozone and VOCs into oxygen, carbon dioxide and water. Interestingly, David Yokota, Senior Director, Air Management Systems, Honeywell Aerospace, also reveals: "We are actively working on solutions to fume events, but we are not yet in a position to provide details."

2

HEPA filter

Air filtration in aircraft ECS drew particular attention in the wake of Covid-19, with a focus on the ability of HEPA filters to remove microscopic airborne particles – including viruses – from recirculated cabin air. PTI's Conrad explains: "It is vital to minimise the quantity of harmful particles circulating through the cabin and cockpit. Viruses, pollen, bacteria and microscopic dust can contaminate cabin air and trigger responses in humans, including runny nose, watery eyes and sneezing.

"For this reason, recirculated air flows through HEPA filters, which are otherwise used in medical environments. These trap more than 99.9% of airborne particles and bio-contaminants, down to 0.3mm. A well-maintained, high-performance HEPA air filtration system is important for the creation of a healthy and comfortable atmosphere for passengers and crew."

Covid-19 particles tend to be between 0.1mm and 0.5mm in size, suggesting that a sizeable proportion should pass through a HEPA filter. But the virus enters cabin air in respiratory particles released from passengers and crew as they breathe, speak and cough, and these are usually between 0.9mm and 1.0mm in size. Meanwhile, it is accepted that an N95 mask will protect medical personnel against Covid-19 and these masks trap 95% of particles that are 0.3mm or greater in size. A HEPA filter is equivalent to an N100 mask, trapping 100 per cent of similarly sized particles.

There is also a strong argument for cabin air humidification, especially in less densely occupied premium sections, both for passenger wellbeing and its potential to cause 'clumping' of virus particles. Peter Landquist, VP senior advisor sales at CTT Systems, says: "It is proven that humidity plays an important role in reducing the risk of viral infection. When humidity is low, our mucus membranes dry, weakening our first line of defence against viruses. I believe filtration and humidity are very important and that both are required." Cabin air is otherwise very dry, since little water vapour occurs naturally at altitude.

"AIR FILTRATION IN AIRCRAFT ECS DREW PARTICULAR ATTENTION IN THE WAKE OF COVID-19"

3

More densely loaded cabin areas have higher humidity levels, typically around 12 per cent, because more people are breathing out water vapour, but first class may be as low as 5 per cent; levels below 20 per cent in the built environment are considered suboptimal.

Landquist describes how CTT's system combats these effects: "The cabin humidifier is installed in the air supply ducts for the cabin zone to be treated. Two or three units are usually sufficient to cover first and business class. The humidifiers automatically activate at cruise altitude, increasing cabin humidity to 22 per cent, and deactivate as descent begins. Thanks to air recirculation, the added humidity 'spreads' to the economy cabin, typically increasing humidity there to around 18 per cent."

Increased cabin humidity also means condensation, which may cause corrosion, electrical failures and add weight through pooling. For this reason, CTT's cabin humidification system includes zonal dryers.

4

Sound and weight

Diehl Aviation produces a range of ECS components and its VP corporate communications, Guido van Geenen, expands on two specifics – noise and sustainability. Cabin sound levels are an important factor in passenger comfort and air conditioning systems create a significant element of cabin noise. Van Geenen explains: "Airliners must meet very high acoustics requirements and delivering very good sound insulation without negatively affecting airflow is a major challenge for air conditioning system design." The key is in the careful choice of materials, including noise attenuating composites.

Those same materials have a role in sustainability. "Virtually every gram counts on board an aircraft," van Geenen says. "Saving weight means saving fuel, and Diehl Aviation has inevitably applied its high standards for lightweight component technology to air conditioning ducting. Our Particle Foam Air Outlet, for example, combines novel materials and a jointing method developed in-house to ensure new levels of efficiency and weight reduction.

"Air outlets made from granulated foam plastic and air ducts in thermoplastics offer many benefits in lightweight construction and manufacturing processes. Once testing of this new, automated technology is complete, our customers will be able to profit from its benefits."

More than eight decades since the Stratoliner introduced pressurised commercial air travel, the industry is still evolving technologies that have made ECS an important component in the passenger experience. New challenges such as Covid-19, our expanding understanding of passenger physiology and sustainability are continuing to drive innovation in systems as essential as they are taken for granted.

1 & 3. Diehl Aviation's air mixer unit and air distribution piping are made with efficiency and weight reduction in mind. Photos: Diehl Aviation.
2 & 4. CTT Systems' zonal dryers work to reduce problematic condensation, while its cabin humidifiers maintain optimal levels for passenger wellbeing and comfort. Photos: CTT Systems.

GROWING PAINS

Gary Weissel and *Jeff Luedeke* of Tronos Aviation Consulting mull the return of open borders for the aircraft interiors industry

December marks the three-year anniversary since the first human cases of Covid-19 were identified in China. Some may argue we are still in the pandemic. However, borders began to open roughly a year ago, which has spurred a recovery in air travel.

With international travel beginning to open at the end of 2021, 2022 started with optimism that airline travel demand would follow, and interior product demands would resurge. We know from historical data that airlines typically will limit spending to essential needs, until operating profits are realised in consecutive quarters, and a near-term outlook indicating continued financial stability.

2022 Passenger Volumes at a Glance

IATA's Quarterly Chartbook Q3 2022 indicates that global passenger traffic Origin-Destination ("O-D") in March 2020 was tracking close to 50 per cent of March 2019 volume. Global passenger traffic O-D has continued to climb and by September 2022 was at 81 per cent of the pre-pandemic level. The upward trends were expected to continue for the remainder of the year. However, recent concerns over a potential recession and skyrocketing inflation may have some impact on Q4 volume expectations. In late November, Bloomberg Intelligence's analysis reported that both corporate and leisure bookings were down, 'possibly signaling that consumers were responding to pressured budgets'.

IATA predicts that regional passenger recovery will be fully realised in North America in 2023; Europe, Latin America & Caribbean, and the Middle East in 2024; followed by Africa and Asia Pacific in 2025, with net total overall regional passenger recovery in the world in 2024.

2022 Financial Performance at a Glance

The end of Q1 resulted in some airlines reaching profitability again, and this continued with strong travel in Q2 resulting in others reaching profitability as well. Some airlines are seeing record revenues in Q3 with profitability. A few of the more prevalent earnings reports are as follows:

• July 29, Singapore Airlines reported a net profit of US $370 million April-June, a recovery from a US $409 million loss in the same period a year ago.
• October 13, Delta Air Lines announced their September quarter 2022 profit indicating record quarterly revenue and second consecutive quarter of double-digit operating margin. It was noted that demand improvement in corporate and international travel contributed.
• October 20, American Airlines reports the third quarter load factors were 85.3 per cent, quarterly revenue record of US $13.5 billion, a 13 per cent increase versus 2019. It was noted that demand for domestic and short haul international travel remained very strong, with expected demand improvement for long-haul international travel as travel restrictions and testing requirements are lifted around the globe.
• November 7, Ryanair posted its largest ever post-tax profit for the six months to September at €1.37 billion. However, it noted that regional developments make the sector fragile for the coming winter.

2022 Passenger Volume and Financial Performance Summary

The optimism for airline travel and financial recovery was realised through Q3 with overall passenger traffic (O-D) at roughly 81 per cent of 2019 levels, and total industry revenues expected to recover to 93 per cent of 2019 levels. Some markets such as Asia Pacific are not recovering as quickly due in part to travel restrictions remaining in place longer than other markets.

2022 Commercial Aircraft Interiors Market at a Glance

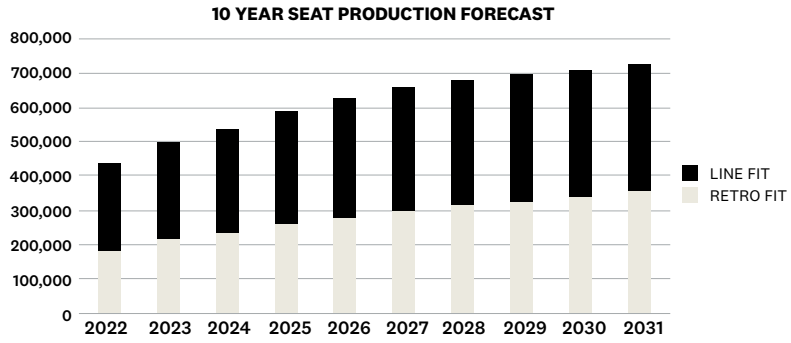
TAC and Real Response Media independently performed surveys with a handful of interior product suppliers to get an understanding of business recovery, supply chain issues and staffing levels.

Interior product suppliers are reporting business has rebounded to 60-80 per cent of 2019 volumes. Of the current reported business, 20-30 per cent is new business, while the balance is effectively restarting of 2019 projects put on hold when the pandemic hit. Requests for quotation for new business have steadily been increasing over the previous six months.

Supply chain issues remain relevant, mainly related to raw materials and microprocessors, with added pressures from rising energy costs and logistics. Suppliers have tried to manage these

"Concerns over a potential recession and skyrocketing inflation may have some impact"

→ Business has rebounded 60-80 per cent of 2019 volumes



challenges with restructuring, investing in stock based on forecasting, and investments in tooling/capabilities allowing sourced items to be made in house providing greater controls. Most that we talked to believe we are through the worst of the supply chain challenges and slowly climbing out of the hole.

Staffing levels have recovered back to 60-80 per cent of 2019 levels. Every supplier we contacted is looking for new staff members. The biggest challenge was stated in degree technical positions, such as engineering.

However, continued difficulties in fulfilling entry level manufacturing positions are evident as well. Suppliers have either enhanced their efforts or developed partnerships in their local communities, as well as applicable universities, to help create and improve the supply of new staff members.

Aircraft Interiors Market Outlook

The Aircraft Interiors Market Outlook is driven by fleet sizes, cabin age, new product trends and new product introductions. TAC, in partnership with Aerodynamic Advisory, annually produces a 10-year interiors market forecast covering line and retrofit interiors production.

The 10-year fleet growth is forecast to include approximately 17,600 new deliveries. Including fleet retirements, this predicts a 2031 fleet size over 33,000 aircraft.

To support this projected fleet growth and fleet retrofits, TAC forecasts the need for 6.2 million new pax places, 2.8 million for retrofit of existing fleets and 3.4 million for new production line fit aircraft. This equates to approximately US $31 billion in seat production value. This is down about 25 per cent from pre-pandemic forecasts over the same 10-year period, driven by reduced pandemic demand and slower fleet growth from pre-pandemic forecasts.

The total aftermarket spend on interiors is estimated at US $80 billion over the next 10 years. This is made up of approximately US$22 billion in maintenance, repair and overhaul (MRO) of existing interiors and US$58 billion on installation of new replacement interiors – aka retrofit.

The total 10-year interiors production forecast in major product categories (including seats, galleys, bins and IFE) is forecast to be US $121 billion, split approximately 50/50 between retrofit and new line fit production. This is down about 12 per cent from our pre-pandemic forecasts.

Aircraft Interior Market Trends

As much of the current business in the interiors supplier market consists of restarting programmes that were in the works pre-pandemic, there are limited areas of innovation evident. One of the results of the global lockdowns is more demand for Personal Electronic Device (PED) connectivity while airborne. Passengers feel the need to maintain connectivity while in the air to stay in touch with family, friends, social media and breaking news.

With connectivity there is a need to make charging available on board

"The total aftermarket spend on interiors is estimated at US $80 billion over the next 10 years"

for PEDs. USB-C technology has continued to evolve in PEDs and will become the standard within the near future. A recent detailed assignment we performed indicated In-Seat Power Systems (ISPS) are playing catch up to a baseline USB-C with 60watt output capability. We anticipate technology advancements overall in ISPS as the system architecture and components are due for updates.

Business class cabins on international routes are still an area to monitor. With this market segment still trailing domestic demands, it may be too early to determine if the seat counts are sized appropriately for the post-pandemic demand. There has been plenty of speculation that reductions may be needed as virtual meetings became the norm during the lockdowns.

However, we have recently seen the introduction of the 'business plus' first row, offering enhanced products and personal space. Several airlines have also announced the impending halt of international first class cabins as the level of business class services and seat offerings have closed the gap between the two classes.

The resurgence and continued growth in domestic and regional travel keeps the pressure on production volumes of narrowbody aircraft. Both Boeing and Airbus are still struggling with supply chain issues in their attempts to meet their own robust forecast production rates.

The introduction of newly delivered narrowbody aircraft to increase existing fleets has spawned interior refresh demands on these existing fleets. We are seeing passenger seating replacements ahead of traditional trends, and the new oversized overhead stowage bins on the A320 airframe series provides an opportunity to retrofit the existing fleets.

The airlines are once again making money, and travel demand is still evident, typically resulting in new business opportunities to come for suppliers.

Gary Weissel, managing officer, and **Jeff Luedeke,** managing director, Tronos Aviation Consulting Inc. (TAC)

VIEWPOINT

Sohaib Ahmed

Programme manager interiors, AJW

The industry continues to experience challenges within the supply chain, which has led companies to reorganise themselves for the prospect of fluctuating aviation-related volumes. AJW Technique Interiors faces sourcing challenges for products such as backing materials, fire blockers and adhesives for cabin interiors.

These materials are in huge demand; subsequently, this is delaying the aftermarket and service delivery for all involved, from OEMs to airlines and third parties. Many forces are acting together and disrupting logistics. We are making strategic decisions about a simpler and more nimble supply chain so that we can continue to offer our customers the service and efficiency they expect. AJW Batteries however has seen an upturn in productivity due to units coming in for routine inspection and this is only going to increase as airlines focus on their winter maintenance schedules.

During the pandemic, airlines pushed their limited resources into maintaining the airworthiness of their aircraft. They are now, however, focusing on cabin interior upgrades. The travel industry is on the road to recovery and passenger comfort and experience are now getting attention. As such, AJW Technique Interiors is seeing an increased demand for its various interior products as the industry smartens up its aircraft.

Within all sectors of our business, AJW is driving toward recovery and is optimistic that we will reach pre-pandemic levels as we learn to adapt to the changing industry. We remain committed to offering service excellence and our MRO division has adopted various digital transformation strategies to not only strengthen our service delivery but to move toward a more sustainable way of operating.

Businesses within the aerospace industry need to move with the times and adopt innovative technology if they want to survive. We have gone back to first principles in many respects, to gain perspective and to focus on what it is that drives the business, but we also need to work within the framework of a changing world.

Seeing a need in the market, AJW has launched its aircraft remarketing services. The team of specialists is meeting the challenging needs of aircraft operators, investors, owners and insolvency practitioners by offering solutions to maximise their assets' potential value. The leasing team also offers high quality engines with practical leasing solutions and support to minimise disruption and downtime for client aircraft. We are excited to see these programmes grow as we remain focused on transforming aviation efficiency through our agile approach to business.

After two years of travel restrictions, competition among airlines is tangible. People are travel hungry, but they are also facing the looming economic recession, which means they are looking at cheaper options when booking their holidays. This means airlines need to impress their passenger base, but must still consider their bottom line. Many of these airlines are still recovering and replacing their fleet is not an option, so cabin refurbishment is the cheaper option. So yes, operators are keen to catch up on their interior maintenance and AJW Interiors is eagerly accepting all proposal requests.

1

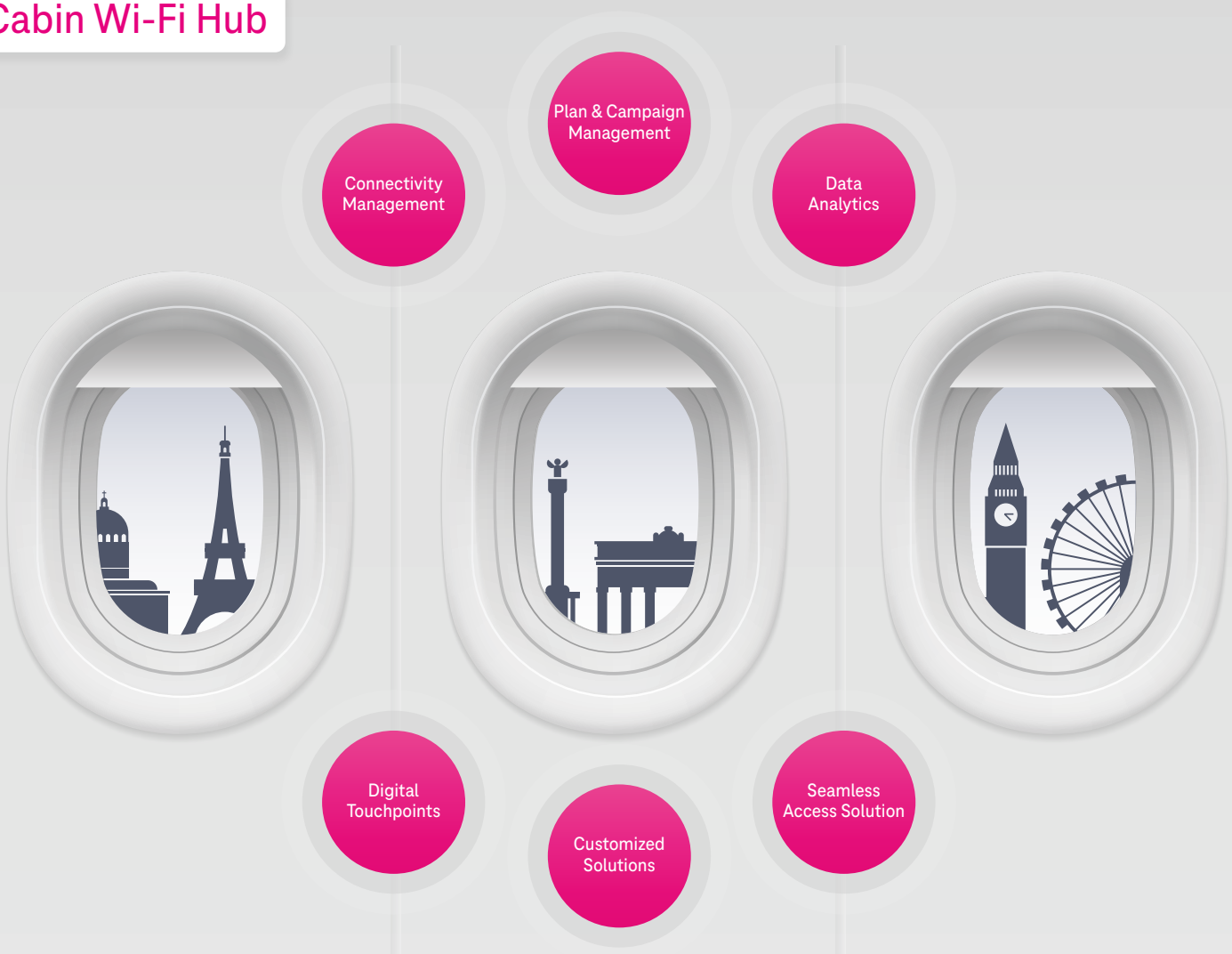
2

AJW is optimistic that it will reach pre-pandemic levels as it learns to adapt to change

1. AJW is aiming for a simpler, more nimble supply chain
2. AJW's SkyLeather seat coverings

One Connectivity Experience

Cabin Wi-Fi Hub



ONE Connectivity Experience

Harmonized Wi-Fi Service: Across fleet with simple handling through ONE interface for airlines

We now offer an easier way to manage the many IFC providers and satellite or air-to-ground solutions you use. With our single Wi-Fi platform you benefit from streamlined processes, reduced complexity, insights into customer needs, and a consistent passenger experience. This one-of-a-kind solution is made possible with centralized management via our Cabin Wi-Fi Hub. Take advantage of our unique service to uncover new monetization opportunities while enhancing brand loyalty.

Contact us today for further details!

inflight.telekom.net/one-connectivity

Ben McGuire

Chief executive and co-founder, Mirus Aircraft Seating

Although the pandemic made the last couple of years hugely challenging for the entire aviation industry, it gave us time to understand and reflect on what we had achieved since our inception in 2015.

We reviewed our processes and used that understanding to improve on operational aspects, to ensure that when air travel returned, we were 100 per cent ready to service our customers to our best ability.

Today, single aisle aircraft carriers are experiencing record numbers of bookings, putting them back on the upward growth trend that we were seeing prior to the pandemic. Mirus is now in the hugely positive position of being able to commit to deliver seats quickly, reliably and to the highest quality.

The pandemic sadly meant that we had to reduce our headcount by around 50 per cent. However, over the past 12 to 18 months we have actively been recruiting and are now back up to 80 per cent of our pre-Covid headcount.

Mirus is currently experiencing a period of rapid growth and for that reason we have a number of positions we need to fill across all areas of the business. The headcount would grow faster (as the demand is there), but finding the right people to fill those positions, as in all industries at the moment, is proving challenging.

Dr Joe Leader, chief executive of APEX & IFSA, has very eloquently explained the current climate by saying 'demand for travel continues to outpace economic headwinds'.

Neil McGregor

Chief operating officer, IFPL Group

There's no doubt the industry is making an impressive recovery, which we are seeing behind the scenes with plenty of new business opportunities and enthusiastic resumption of programmes that were paused during the pandemic. We have recovered to around 60 per cent of our pre-pandemic business levels, and this is growing quickly.

We worked hard to maintain a connection with customers during the pandemic, offering support where we could. Fortunately, the relationships we have with many of our established customers have ensured they've returned to restart programmes that were planned pre-pandemic, and to kick off exciting new projects. We estimate around 70 per cent of our current business is continuing projects that began before the pandemic.

Since the industry started to come back online, we are finding operators are responding really positively to our retrofit power, lighting and audio products as a way to revamp aircraft currently in their fleet and win passengers back to air travel.

It's incredible just how different an aircraft interior can look with refreshed lighting, and operators are buying into the positive press which can be generated from such a quick, cost-effective transformation. Similarly, operators are realising that passengers now expect more from their journeys, and that installing modern comforts like in-seat power can make a huge difference to the passenger experience.

Our team have worked incredibly hard over the past few years, and we're so grateful for their dedication. We had to make some difficult staffing decisions during Covid-19, but as the business continues to grow so too will our workforce. One of our biggest staffing challenges has been planning around the global disruption to the supply chain. Any manufacturer that deals in electronics will be all too aware of the problems that 'chipaggedon' – the worldwide shortage of microprocessors – has caused.

"We worked hard to stay connected with customers during the pandemic"

1

Our buying team have worked extremely hard to source the components needed to create our products, but the scarcity of some of these items has meant delays to production schedules and extra costs. We've all had to adapt to these changes; communication across all departments has been absolutely key to making this work and delivering on schedule for our customers. These challenges have definitely kept things interesting! To help our team further, we encourage and facilitate flexible working, incentivise training,

2

and have ensured staff retain all benefits they had access to prior to the pandemic.

Our sales and business development team have also been kept very busy over the past few months responding to the significant increase in requests for proposals. Awareness of our products and services has been boosted by exhibiting at events like Aircraft Interiors Expo and MRO Europe, which have been busier than ever.

Visitors to these events seem engaged and focused, enjoying not only the new ideas and products, but the chance to meet contacts in person again. We have seen particular interest in our in-seat power system, which allows operators to build a bespoke package and bring power to one row of seats or an entire fleet.

1. Refreshed lighting schemes quickly transform spaces
2. In-seat power systems are essential

Henrik Höjer

Chief executive, CTT Systems

The pandemic hit the aviation industry hard and certainly also CTT Systems. During 2022 we started to recover and, partly due to the pandemic, we have seen an increasing interest for our humidification systems, improving the relative humidity level in an aircraft for the crew and passengers.

This is due to the acknowledged and proven correlation between extreme dry air and increased risk of infection. With improved humidity, the crew and passengers will avoid effects like tiredness, jetlag and a reduced immune system.

We have also seen that the continued high focus on sustainability has increased the interest in our anti-condensation system which reduces weight and thereby fuel, in turn helping airlines to reach their sustainability targets and lower the cost of jet fuel.

During the pandemic, CTT worked hard to protect our supply chains and to manage shortage of components and long lead times; we have managed to protect our customers from shortages and delays partly by increasing our stock levels.

CTT has also managed challenges like shortage of components, increased costs and so on for our suppliers by transferring production from suppliers to CTT. The supply chain is slowly stabilising, but lead times and cost increases continue to require our full attention to protect our customers from shortfalls in deliveries.

From a net sales perspective, CTT has recovered during 2022 and we are now at roughly two thirds of pre-pandemic net sales level. We are benefiting in our aftermarket sales from the recovery in passenger air traffic. We're still below pre-pandemic levels when it comes to deliveries to new aircraft production, which we forecast to gradually return in 2023.

CTT is seeing an increased interest in our products as airlines start to be profitable again and want to restart projects to increase the wellbeing of passengers and crew (humidification systems) as well as sustainability projects reducing weight and thus fuel burn and CO_2-emission (anti-condensation).

CTT had to reduce staff during the pandemic by roughly 35 per cent. We have now started to hire again but we are below 2019 levels. In engineering,

"CTT is seeing an increased interest in our products as airlines start to be profitable again"

we have demand but have difficulty finding enough experienced engineers. We are also recruiting in production and maintenance and repair, and here it is easier to fill open positions.

To overcome our staffing challenges, we have reactivated all our partners from before the pandemic and are using different models to attract, hire and contract staff. We are also reactivating our cooperation with schools and universities.

↓
CTT is experiencing more demand for its humidification systems

VIEWPOINT

Jon Page

President, Pexco Aerospace

Supply chain constraints continue to impact the aviation industry, with a shortage of parts and labour slowing aircraft delivery and delaying interior reconfiguration programmes.

Our focus is primarily on polymer extrusion for cabin structures, lighting and flooring, so we have had to work hard to overcome difficulties with sourcing certain raw materials, logistics and rising energy costs. We appear to be through the worst now. We know there will be bottlenecks ahead, but we expect them to ease as we move deeper into 2023.

Fortunately, having invested heavily in the last decade in state-of-the-art equipment and machinery to elevate our in-house capabilities, we have much greater control of our supply chain. Our planning has been an enormous advantage for us and our aerospace customers, who reap the benefits of the certainty we can provide in delivery times for aircraft parts.

As commercial air travel has rebounded to around 80 per cent of pre-pandemic levels, we have certainly seen a restarting of aircraft interior programmes to a similar level. With more passengers, the need for replacement cabin parts also continues to increase.

Given the considerable demand from airlines for more narrowbody aircraft in their global fleets, airframers are focusing on ramping up production significantly. This ramp-up will help support continued recovery and increase demand for our core products that are fitted in new aircraft, such as stow bin structures, wire management systems and seat track covers.

There is a lot of positive interest from airlines in our newest blue-sky innovation, AirShield. With many airlines waiting for narrowbody aircraft to be delivered, they are using the downtime to invest in ways to elevate passenger well-being and the inflight experience – something AirShield has been engineered to do. We will translate this interest into new manufacturing programmes in the first quarter of 2023.

At Pexco, we have always adopted a sustainable approach to our workforce. But despite this, we experienced severe effects of the pandemic on our workforce. However, we are recovering nicely and anticipate returning to pre-Covid levels by the end of 2024. We currently have approximately 125 employees at our manufacturing facility in Washington, as well as customer service representatives and business unit managers across the US and Europe.

Demand for highly skilled labour – especially in aviation – is a significant challenge. Given our unique location in the Yakima Valley, only a couple of hours from Seattle, we are well-positioned to tap into the hive of aerospace activity in the northwest US while offering employees an attractive work-life balance.

We take a two-pronged approach to attracting and retaining the talent we need. Firstly, we invest heavily in local people and develop them for long careers in manufacturing. We partner with local schools to educate young people in our region about the career opportunities we can offer. Where we need to, we supplement that with highly experienced aerospace engineering specialists from the US who help lead our R&D and business development arms.

We are proud to say our employees are like family, and that personal approach is a crucial reason why many of them stay with Pexco for many years – and even decades in some cases.

"Many airlines are using the downtime to invest in ways to elevate the passenger experience"

↑ Pexco's blue-sky innovation AirShield creates air barriers around passengers

INFLIGHT CONNECTIVITY

BEATING THE CAPACITY CRUNCH

What does 2023 hold for providers of inflight connectivity? Euroconsult's ***Vishal Patil*** attempts to predict how the industry will shape up in the future

Inflight entertainment and connectivity (IFEC) has been at stake for many airlines in the world. The Covid-19 pandemic has forced some of the airlines to rethink their IFEC strategies. We assume that it may have delayed their plans, but certainly the plans have not been taken off the table.

Airlines around the globe have gone through unprecedented times recently and nobody would have imagined the extent of the difficulties caused by the pandemic. The pandemic also impacted different parts of the world in different ways – or rather different countries reacted to the pandemic differently.

Consequently, today, after two years, some regions are back to normal whereas others are still struggling. The same is true of the airline industry. North American airlines have seen passenger traffic surpassing pre-Covid levels at least domestically, whereas some of the Asian countries have yet to catch up with a resumption in passenger traffic. Overall, domestic traffic returned comparatively quickly to normalcy compared to long haul international traffic.

The growth in passenger traffic and increasing demand for inflight connectivity (IFC) is making airlines rethink their IFC strategies. Euroconsult assumes that the pandemic acted as a catalyst. Passengers are increasingly looking for means to stay connected with their loved ones even in midair. As a result, airlines focused on bringing back their IFC-equipped fleet online, leading to the number of IFC-active aircraft jumping 10 per cent to around 9,900 by the end of 2021 after a slump the previous year.

To ride on this demand tide and to cater to passenger expectations, airlines providing a 'free chat' option as a part of their IFC offer, if not 'free for all Wi-Fi', is on the rise. Euroconsult expects that the trend towards free IFC, either complete or partial, will continue as more airlines follow the suit. The reasons to offer free internet – complete or partial – are numerous. Some airlines may offer it for free to protect brand image while others may offer it due to sheer peer pressure.

Apart from passenger demand, another deciding factor for the increased IFC adoption by airlines is the decreasing capacity costs. The development of newer technologies such as HTS, VHTS and flexible satellites, along with the entry of multiple non-geostationary orbit (NGSO) satellite constellations catering to the IFC market, is expected to increase capacity tremendously in the near term.

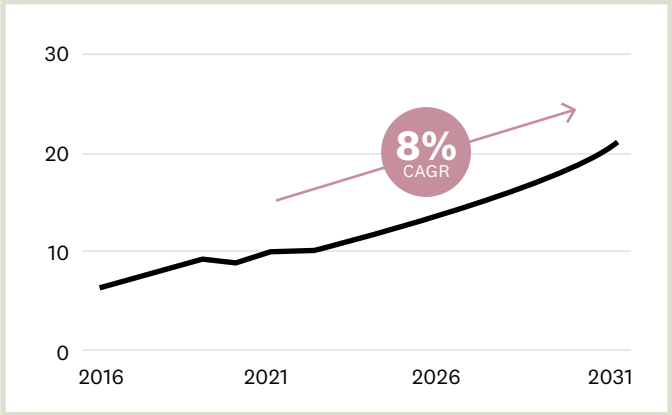
The scheduled launch of the Viasat-3 constellation in 2023 will provide an unprecedented 1 Tbps per satellite, while a few other geostationary orbit (GEO) satellites launched or in the pipeline that can provide hundreds of Gbps per satellite are expected to increase the capacity supply.

On the NGSO side, OneWeb and Starlink have already started offering capacity for land-based applications and have shown interest in serving the IFC market. Their entry into the market is still uncertain though as both the forerunner NGSO operators must deal with many technological and regulatory hurdles before they can serve the IFC market commercially.

The aviation industry is highly regulated. It is difficult to enter as a new entrant. The service provider must obtain a Supplementary Type Certificate

"The growth in passenger traffic and increasing demand is making airlines rethink their IFC strategies"

Total number of connected aircraft (thousands)



"Newer technologies such as HTS, VHTS and flexible satellites will increase capacity tremendously"

(STC) for each aircraft type they are planning to serve. Being also highly fragmented, in terms of aircraft types, the service provider needs to obtain multiple STCs depending on the airline, aircraft type, aircraft configuration and region in which the airline operates.

Both these NGSO operators have been dealing with this situation differently. OneWeb seems to have chosen to partner with service providers whereas Starlink has chosen to go directly with the airlines. On the equipment side as well, OneWeb is working with equipment manufacturers to develop the new IFC terminal whereas Starlink is developing an antenna in-house.

Once commercially available, Starlink will be the most vertically integrated player in the IFC industry on the NGSO side. On the GEO side, Viasat is the most vertically integrated company present in the IFC market. Many other existing service providers are actively partnering with OneWeb or upcoming Telesat Lightspeed constellations to enhance their service offers. Euroconsult expects to see many more such partnerships happening in the IFC market.

Volatile

The Covid-19 pandemic has once again highlighted the volatility of the IFC service market. Many service providers went through financial restructuring to align their focus. Eutelsat's investment in OneWeb, Anuvu partnering with Telesat and, more recently, Panasonic's partnership agreement with OneWeb are a few examples that indicate the direction of the IFC industry. Viasat has also entered the procedure to acquire its competitor Inmarsat, but the process has now been halted by the UK government under the pretext of studying the impact of this deal on the competition.

Viasat and Inmarsat have expressed their interest in NGSO constellations on individual levels. It denotes that the IFC ecosystem is welcoming every business model from the most vertically integrated GEO and NGSO players to non-vertically integrated and multi-orbit service provisions through the partnerships.

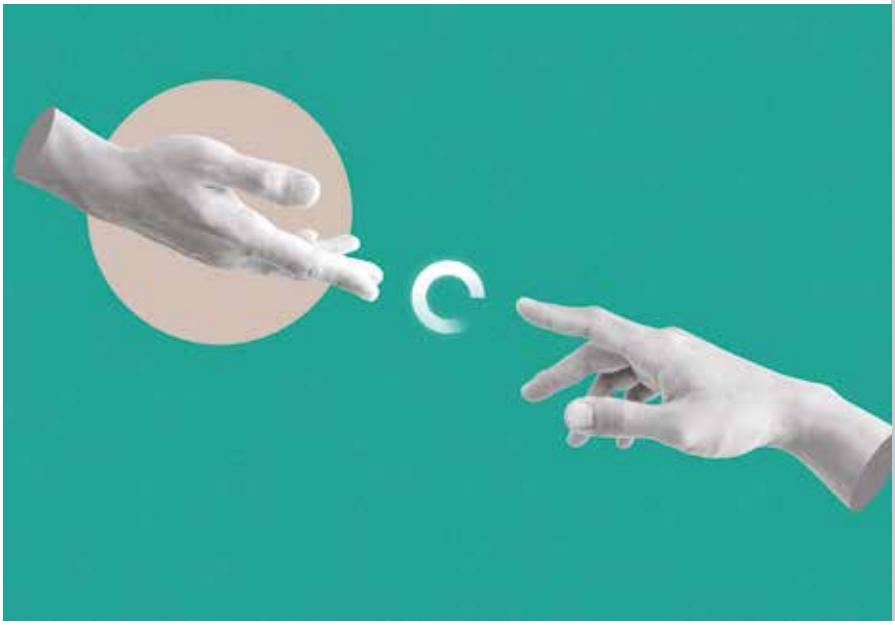
Even though the direction taken by the industry is yet unclear, some of the service providers are betting high on the multi-orbit solution for the future. It involves complications on the equipment side where the antenna system must be able to scan multiple satellites at the same time and manage seamless beam switching frequently while ensuring the minimum power consumption and form factor with efficient heat dissipation.

Euroconsult estimates that more than a dozen antenna manufacturers are heavily invested in developing such systems. ThinKom has managed to successfully test the multi-orbit capabilities of its existing antenna solution. Some others have been testing multi-orbit and multi-frequency solution that will provide airlines the required freedom to choose the IFC solution and the provider.

Airbus has stepped into it with its HBC+ programme, where the aircraft manufacturer is working with different solution providers to include their offers as a standard line-fit option. Inmarsat is the first service provider chosen by Airbus for the HBC+ programme.

The IFC industry is highly dynamic and advancing on different fronts. There are developments throughout the entire ecosystem to make IFC a standard service. It will be interesting to see how the industry shapes up in the future.

Vishal Patil has expertise in the satellite communications sector related to the mobility market, with particular focus on aero and maritime connectivity. He has been actively involved in a variety of research and market assessment projects and due diligence missions for various clients from the entire satcom mobility value chain.



VIEWPOINT

William Huot-Marchand

Senior vice president of inflight, Inmarsat Aviation

How do you see the IFC market dynamics changing in a multi-orbit environment?
With the launch of Inmarsat Orchestra last year, we became one of the world's first satellite providers to announce plans for a multi-layered, multi-orbit network. We're pleased that others have now followed this with their own multi-orbit offerings.

Strong competition has always been a hallmark of the IFC market, and multi-orbit offerings are only showcasing this further. Airlines continue to demand the strongest services and latest innovations to ensure they can be at the forefront of what their passengers demand – and more IFC providers moving to multi-orbit models will only help us all achieve this.

The biggest benefit to the market of a multi-orbit environment is enhancing passenger experience. Multi-orbit networks, at least from Inmarsat's point of view as we develop Orchestra, are focused on user experience above all else, to ensure the best possible connectivity experience for every passenger, on every flight. This will certainly be welcomed by airlines, as we see the IFC market become much more customer-focused.

What we are starting to see within the new multi-orbit environment, however, is some operators making claims about speed without the necessary commitments. We offer committed information rates for our GX Aviation inflight broadband service, backed by solid service level agreements. All of this gives airlines the confidence and assurance that we can deliver consistent performance no matter the route or aircraft.

How soon do you think will airlines be able to select technology-ready multi-orbit solutions?
We can't speak for others' progress, but we're making great headway with our Orchestra network. We launched our first LEO test payload in late 2021, and have since completed several technical proofs of concept, including mesh network trials, all of which have seen great success in testing.

That said, Orchestra is Inmarsat's vision for multi-orbit connectivity, not a technology programme with a 'once and done' launch date or a simple aggregation of technologies. It will seamlessly integrate the proven capabilities of our backbone GEO networks, adding in transformative HEO, LEO, dynamic beamforming and 5G terrestrial networks.

This enables new capabilities for the aviation industry, offering a trusted platform to continuously integrate powerful new technologies as and when they are proven. This will give airlines all the freedom and flexibility they need to deliver exactly the connected services they want to offer – for every passenger, no matter the location, number of users, devices and applications used.

As soon as 2024 we'll see innovations like dynamic beamforming enter service offering a seamless extension for our GX Aviation customers, with many more innovations to follow as and when they are proven in testing.

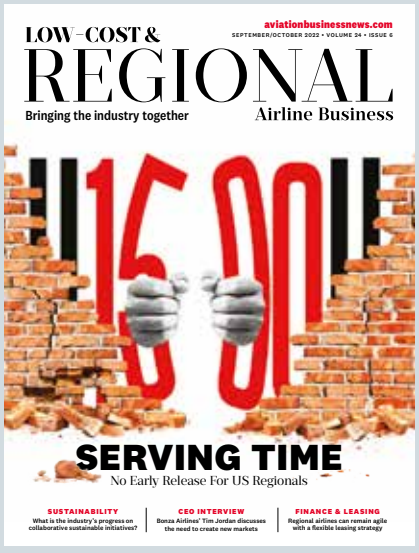
How do you think those solutions will guarantee a passenger experience which is both low cost for the airline and seamless for the passenger?
The consistent innovation offered by multi-orbit networks like Orchestra will ensure the best possible connectivity services to airlines, and the best possible connectivity experience to passengers. At Inmarsat, we are developing our multi-orbit network to deliver the widest range of new capabilities that the aviation industry could need, offering distinct benefits to both airlines and their passengers.

One such example is dynamic beamforming, part of Inmarsat's Orchestra roadmap, which is a seamless extension for existing our GX customers, and will be backward compatible with existing hardware. This innovation will ensure capacity can be delivered to high-demand hotspots when it's needed most – even to individual customer aircraft – thanks to thousands of simultaneous, independent beams with laser-like precision. These beams can be reconfigured and repositioned to deliver capacity across the world in real-time, ensuring passengers get the consistently high-quality connectivity they crave.

Above all, we are committed to providing high-quality, seamless inflight connectivity experiences for passengers around the world – millions of whom already enjoy the benefits of GX Aviation every year. Orchestra and the shift to multi-orbit IFC will only enhance this further, by offering greater capacity, many more capabilities for airlines, and the certainty of service that airlines demand.

"The consistent innovation offered by multi-orbit networks will ensure the best possible connectivity services"

AVIATION
Business News



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Mike Pigott

Executive vice president, connectivity, Anuvu

How do you see the IFC market dynamics changing in a multi-orbit environment?
In a multi-orbit environment, it will be key for airline customers to work with partners to balance consistent, great service to customers today and maintaining that over time with rapidly changing customer expectations.

We at Anuvu see the market moving more towards an integrator model where service providers compete, whether on a managed service or other basis, where airlines look to integrator experience and expertise to enable airlines to have access to multiple networks in multiple orbits at competitive economics.

How soon do you think airlines will be able to select technology-ready multi-orbit solutions?
It is hard to pick a specific time beyond "soon" because of all the moving pieces in space with new constellations and on the ground with the newest software solutions needed to make a multi-orbit solution seamless. We are working hard at Anuvu to deliver the best service in the industry today and prepare for a much more dynamic market in future.

How do you think those solutions will guarantee a passenger experience which is both low cost for the airline and seamless for the passenger?
A key aspect of the future of IFC is going to be greater transparency of all participants in the market. Service level commitments are one part of that puzzle, but the market will also require transparency of each type of connection and each type of service – including not just satellite performance, but also on aircraft and terrestrial network performance.

Floris Reimbold

Senior manager business development, inflight, AERQ

How do you see the IFC market dynamics changing in a multi-orbit environment?
The inflight connectivity (IFC) value chain of the past is about to change significantly. The reason is not the multi-orbit environment directly, but several causes: the market entry of new players; the transition to new business models; the revolution through new technologies; the decreasing value of middlemen; the increasing market consolidation; and on top of all, the implementation of industry standards and interoperability between different ecosystems.

So, we'll see more flexibility and choice for the airlines through the availability of standard platforms: future IFC products will not lock-in an airline to a specific provider anymore, but enable the airline to switch from one network service provider to another using the same compatible hardware platform – like you would exchange the SIM card in your phone at the end of your contract term.

This will empower airlines to create competition on the service side on the long run. Airlines will not accept proprietary systems in the future any more that force them to scrap their existing hardware installations on the aircraft before being able to switch to a new satcom provider.

One key piece of technology of course is the antenna terminal. Electronically steerable antennas (ESA) are crucial to unlock the full potential of LEO satellites. As handovers from one satellite to the next will happen every few minutes in LEO networks, a quick hand-over in all circumstances is critical for an uninterrupted service and good passenger experience. Only multi-beam capable ESAs can ensure make-before-break connections.

Despite announcements that a switch to the next satellite would only be a matter of milliseconds and re-positioning and pointing of legacy antennas would be fast, we will see how the whole handshake process will turn out in practice – on flying aircraft with non-ESA terminals in break-before-make setups on LEO satellites.

At the end of the day, we'll see a different provider landscape and new ways of cooperation between existing and new players, and this will affect all market participants – satellite operators, antenna terminal manufacturers, value added resellers and solution providers, Internet Service Providers, MROs and airframe OEMs as well as the airlines themselves.

The increasing number of members of the Seamless Air Alliance, covering the complete IFC value chain and most of the big brand names, is a good indicator for this trend.

How do you think those solutions will guarantee a passenger experience which is both low cost

for the airline and seamless for the passenger?
Up to now, the industry failed to fulfil passenger expectations and has not provided a seamless experience at all. Passengers not only expect a reliable and stable connection with good performance, but also expect it to be cheap (or free) and easy to use, without any hassle or a lengthy log-in and payment process.

The LEO and MEO constellations, as well as electronically steerable antennas, will bring several advantages: higher bandwidths, lower latency, more redundancy and reliability, better polar coverage and, last but not least, less data costs.

"Only multi-beam-capable ESAs ensure make-before-break connections"

However, all those advantages will not automatically lead to a seamless passenger experience; the multi-orbit solutions alone don't guarantee seamlessness at all – quite the contrary, as complexity increases. It requires a joint effort of the IFC industry to hide its complexity from the users.

It is an important task of the industry to ensure ease-of-use of an IFC product, and it's a fine line for airlines between offering hassle-free access and not losing the IFC touchpoint by completely removing the IFC portal. Standards like Hotspot 2.0 are going in the right direction, but require careful balancing with the need to keep passengers in an airline's ecosystem and not giving up this important touchpoint.

In the end, the next generation IFC solutions will increase passenger satisfaction, not only because of better IFC products but also by enabling connected inflight entertainment systems.

Those and IFC will increasingly merge into fully integrated IFEC ecosystems: AERQ's open digital platform Aerena shows how both airlines and passengers benefit from connected IFE platforms, which enable new digital services and make best use of the latest connectivity solutions.

John Wade

Vice president, inflight connectivity business unit, Panasonic Avionics

How do you see the IFC market dynamics changing in a multi-orbit environment?
The connectivity landscape is very active right now with pretty much every airline in the world seeing passengers demand connectivity, and they expect to have it on their aircraft.

The combination of our LEO network coupled with GEO, all tied to a new aviation terminal, will allow us to compete very effectively against the other IFC companies. I'm definitely excited about what this means for Panasonic Avionics' product portfolio.

Our multi-orbit network, with lower latency, high-capacity coverage and high uplink and downlink, will position airlines to meet the rapidly growing and dynamic demand from passengers for these applications and service.

Combined with the right passenger price points and easier steps to get connected, we think that take-up rates will grow substantially in the years ahead.

How soon do you think will airlines be able to select technology-ready multi-orbit solutions?
Initially, we expect that multi-orbit connectivity solutions will be hitting the market by the end of 2023 and Panasonic Avionics will certainly be one of these players.

The combination of LEO and GEO will ensure that the airline has a future-proof solution that will scale to provide the optimal products to their passengers.

Later, we'll introduce both LEO and GEO, whereby the aircraft can roam between the two networks. We look forward to delivering this service in the second half of 2023.

The network will be managed to meet airline requirements and to optimise the passenger experience based on the market and the airline's commercial and competitive needs.

How do you think those solutions will guarantee a passenger experience which is both low cost for the airline and seamless for the passenger?
The passenger demands services that work and enable him/her to do what they need to for pleasure or business, and more.

Optimising the passenger experience will drive an airline's returns from IFC that the airline needs to generate. By adding LEO into a multi-orbit solution, the

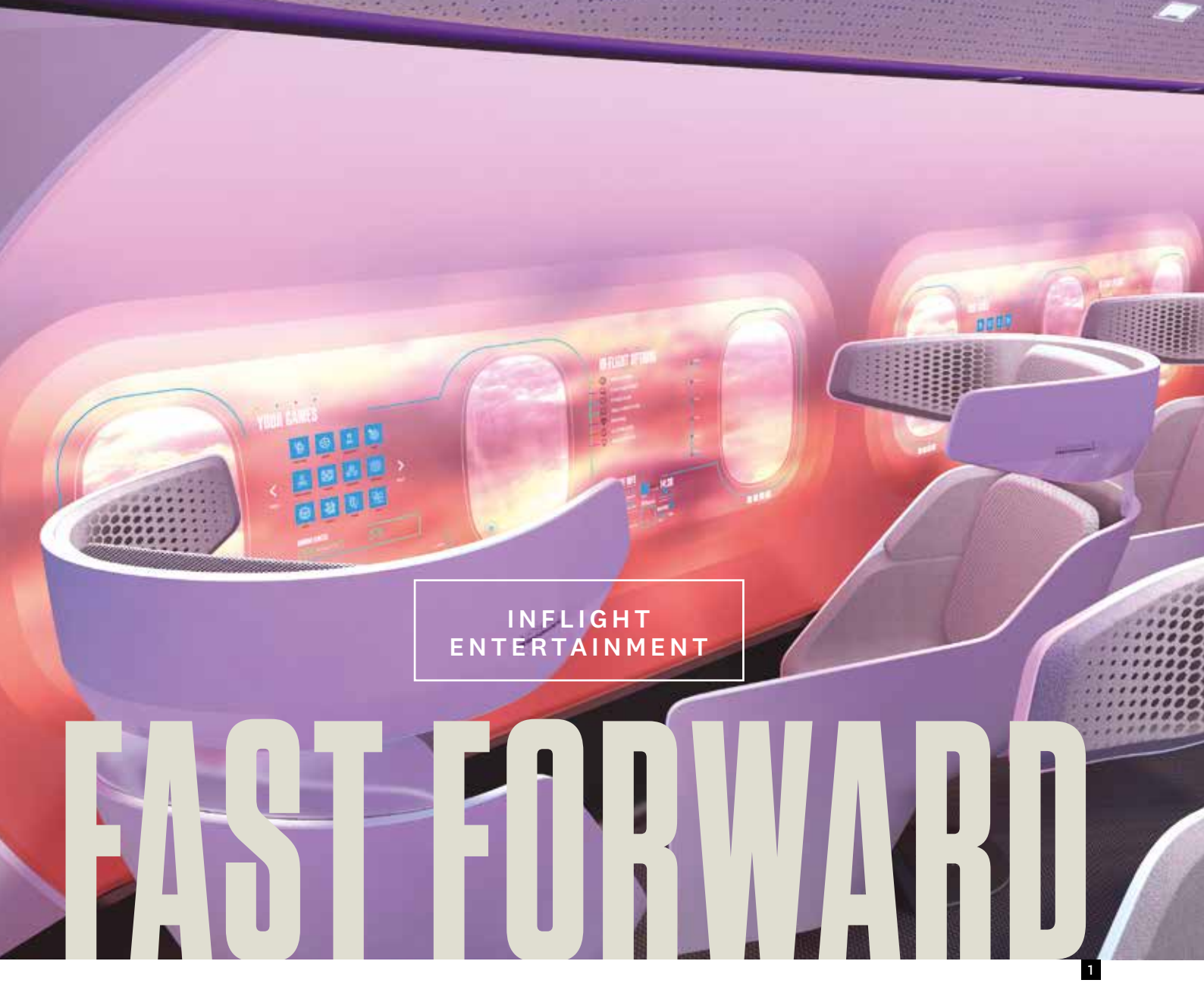
"The landscape is very active right now with every airline seeing passengers demand connectivity"

airline's IFC solution will not only be scalable and future proof in terms of capacity, but it will also provide true global coverage.

Also, through its high throughput, in terms of both download and upload, as well as much lower latencies, that IFC solution will be providing the passenger with a truly excellent connected experience.

Finally, to ensure airlines deliver the best experience whilst staying within budget, our QoE platform provides state of the art diagnostics, reporting and service control.

The data generated through robust QoE monitoring empowers airlines to find the sweet spot between throughput investment, customer satisfaction, and data usage.



INFLIGHT ENTERTAINMENT

FAST FORWARD

1

David Whelan at Valour Consultancy outlines what trends will shape the IFEC market in 2023

As we approach the end of 2022, the aviation industry finds itself in a much stronger position than it did a year ago. Passengers have returned to the skies with great enthusiasm, for both business and leisure travel, writes David Whelan at Valour Consultancy.

According to IATA, global air travel in September 2022 rose 57 per cent compared to September 2021. Globally, traffic is now at 73.8 per cent of September 2019 levels. The rebound has been particularly noticeable in APAC which has seen a 464.8 per cent increase for international traffic compared to this time last year. The only region which hasn't posted encouraging growth has been China, where traffic is still struggling with Covid restrictions.

There are still challenges ahead, but 2023 is likely to be another year of encouraging recovery with global air travel set to return to pre-Covid levels by 2024. Moreover, we are seeing more solid aircraft delivery numbers this year and expect this recovery to continue next year. Deliveries for 2022 are likely to land around 1,000 across the year, a marked improvement from 2021.

Valour Consultancy expects the number of aircraft deliveries in 2023 to reach approximately 1,200. The widebody market (vital to seatback IFE vendors) has struggled the most since Covid hit, but we can expect to see widebody deliveries reach around 200 for 2023; with the vast majority of these linefit with seatback IFE. There will also be an increasing number of widebody retrofit opportunities, as well as linefits on new long-haul narrowbody aircraft during this period.

So, the future looks bright for IFEC in 2023, but which specific trends should we be on the lookout for and how is the market adapting to the new state of play? Let's take a look.

1 & 2. As aircraft design continues to evolve, Airbus is reimagining the cabin, with game-changing seat layouts and IFE technology

"DIGITAL TRANSFORMATION OF THE AIRCRAFT WAS INEVITABLE AND HAD BEGUN PRE-COVID"

57%

According to IATA, global air travel in September 2022 rose 57% compared to September 2021

Airspace Link paves way for more linefit W-IFE

Unlike the seatback IFE market, the vast majority of W-IFE installations are retrofits – mainly because there remains a huge, untapped pool of candidate narrowbody aircraft to be equipped with the technology. Typically, only around 10-15 per cent of annual W-IFE installations are linefit. For that reason, ensuring the installation process is as smooth as possible and that downtime is minimised has been a major point of competition among W-IFE providers, particularly for portable vendors where speed of installation is a major USP.

Retrofit installations may have typically been the main route for W-IFE providers to get their respective solutions onboard aircraft and, while this will remain the case, Valour Consultancy expects there to be substantial growth in W-IFE solutions being fitted at the factory. With an increasing number of airlines seeing W-IFE as a major component in the urgent digitalisation of the cabin, the technology is increasingly likely to be part of the initial delivery.

Airbus's Airspace Link, formerly known as OSP, could have a major impact on linefit W-IFE installation rates in the coming years. Airspace Link will come to encompass much more than just W-IFE, with IoT a key component of the long term plan, but for now the W-IFE digital platform is the first out of the blocks.

Airspace Link is a 'Wireless IFE App' that provides a foundational platform which can then be integrated to an airline's needs by one of three software partners: Bluebox, Display Interactive and Inflight Dublin. This sits on Airbus's server – from Kid-Systeme – and is available for linefit and retrofit installations on Airbus aircraft.

We can certainly expect the Airspace Link W-IFE app to be increasingly common for new deliveries in the coming years. Retrofits are also possible on non-Airbus aircraft via GeniusLINK.

W-IFE Vendors Transition to Digital Service Providers

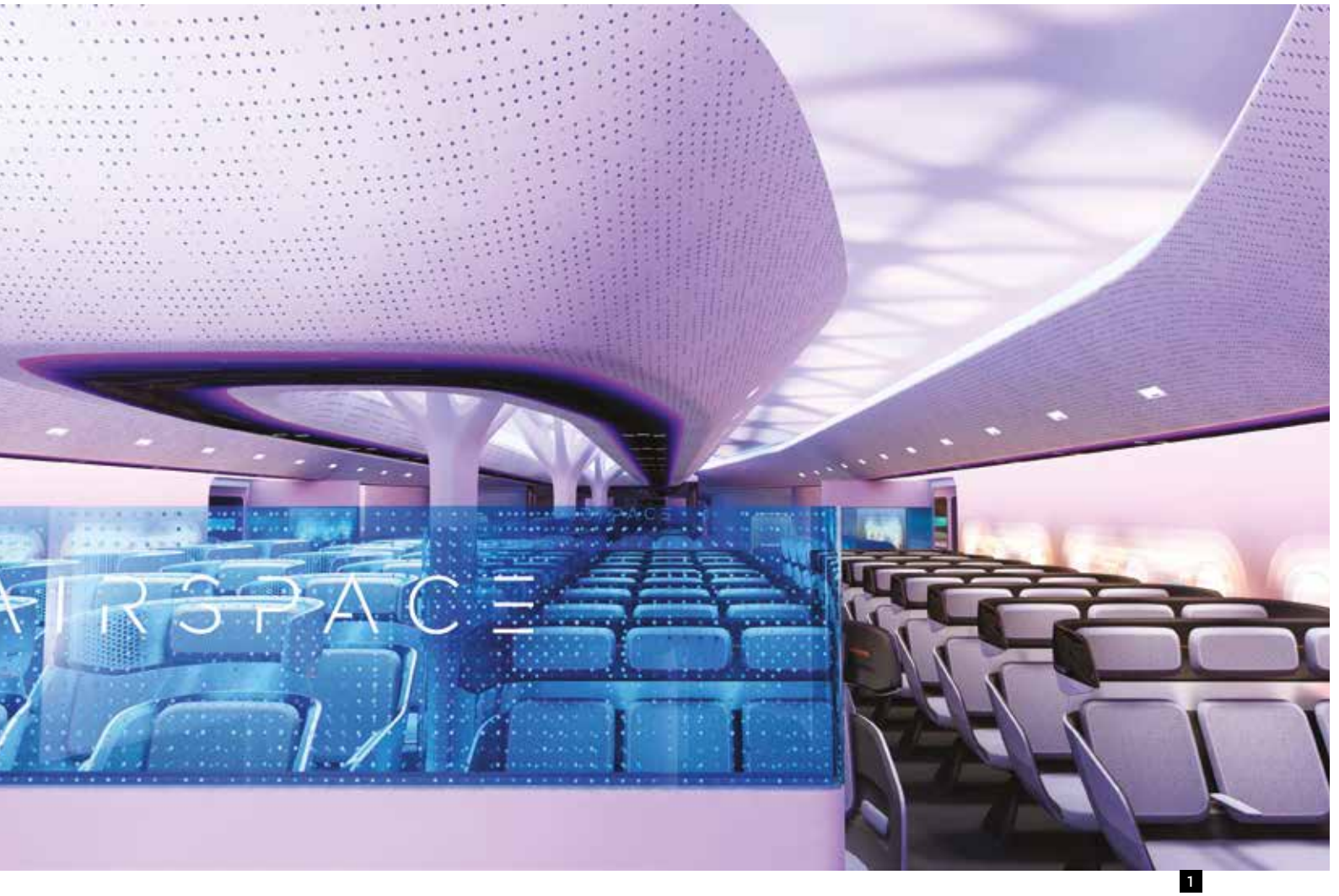
Traditional AVOD will remain a vital part of a comprehensive IFE solution, but companies are gradually diversifying their solutions and going further than ever before with what is expected of IFE. Vendors and airlines are increasingly looking at IFE as a means of managing the whole in-flight experience of the passenger. The pandemic has only accelerated this trend, and the industry is now beginning to transition into a more holistic in-flight engagement strategy.

Digital transformation of the aircraft was inevitable and had already begun pre-Covid, and there were two main purposes to this: firstly, to enhance the in-flight experience of the passenger by providing more choice and less friction; and, secondly, related to this, to help the crew manage the cabin in increasingly efficient ways.

IFE providers are increasingly focused on providing a wide range of solutions including the following:

- digital seat pockets
- in-flight catering
- destination content
- ecommerce platforms
- in-flight advertising

2



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"IN 2023, EXPECT MORE DISCUSSION AROUND PERSONALISING THE IFE EXPERIENCE FOR PASSENGERS"

This trend can be seen most notably in W-IFE vendors, many of which are now repositioning their focus away from in-flight entertainment and towards broader digital services platforms.

This can be seen in the launch of Bluebox's Blueview which is described as a 'digital passenger experience platform'. The introduction of Airspace Link also means that, in future, W-IFE vendors could be software-only partners – with Airbus providing the hardware.

Greater Personalisation

Personalising the digital experience is at the forefront of the consumer technology market, and aviation is now beginning to follow this trend with airlines looking at how they can best enhance the passenger experience.

In 2023, expect to see more discussion around personalising the IFE experience for passengers. Vendors and airlines are becoming increasingly proficient at tailoring their IFE offering. Millennials and Gen Z travellers are making up an increasingly higher proportion of air passengers and their experience growing up in a digital environment means the number of flyers who see the trade-off between providing information about themselves and getting a more personalised experience is increasing.

Connected IFE allows airlines to create much more bespoke experiences. This involves leveraging big data in flight and having supplement data stored in customer relationship management (CRM) systems. This wealth of information is then crunched in such a way that passengers are presented with personalised content on board. IFEC systems are therefore being designed to be tightly integrated into an airline's CRM system containing not just viewing history but information on things like past purchases, routes travelled, food preferences, allergies and so on.

The Recovery Begins...

So, 2023 looks like another strong recovery year for the IFEC ecosystem thanks to the broader recovery of the aviation industry as a whole and the growing need for airlines to digitalise and connect passengers.

↑

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Lukas Kaestner is co-founder of the Sustainable Aero Lab and president of the Crystal Cabin Award Association

IN THE WINGS

Lukas Kaestner, co-founder of the Sustainable Aero Lab and president of the Crystal Cabin Award Association mulls the future from the 'Green Room'

Speakers of a panel discussion will often gather in a Green Room prior to going on stage, making themselves familiar with other panelists, and outlining their individual points in the upcoming discussion. I recently joined such a Green Room at the Sustainable Design Summit in London.

Sitting in that room, it came to my mind that the situation was a little metaphoric to aviation's journey on becoming a 'green' industry. Everybody is eager to go on stage, but we're still in that room.

Covid has been an important eye-opener in that we will have to brace for further 'black swan events', with number one being global warming. When I helped co-found the Sustainable Aero Lab in late 2020, it felt like we were still operating in a distinct niche. This has changed since then, as Airbus' ZeroE strategy and IATA's pledge for net-zero aviation by 2050 show – just to give two examples.

"We must move from a supply chain mindset into a supply circle one"

Aviation has figured out its 'flight plan', but we haven't really taken off. Or, actually, upped the game. Aviation has been painted as the villain for many years, especially in European discussions. However, with new engine generations like the GTFs, and lightweight structures in the fuselages and cabins, it's fair to say we have already progressed.

Yet these innovations were not due to care for the environment. Fuel has always been a most significant cost driver, with airlines keen to keep spending low. But now, we see the dawn of another cost factor in aviation – a direct cost for emissions. Pricing this has already started with the CORSIA roadmap, and will only gain in relevance and height. On the other side, funding opportunities for sustainable R&D in aviation have never been better, and budgets keep growing.

Gen Z

Action will be needed also in terms of passengers. In the next 15 years, the 'baby boomers' will retire from their jobs. This was the generation most interested in status programmes, lounge access and amenities such as onboard newspapers. The future traveller will be from Gen Z, a group that has already put the fight against global warming as their top priority today. They will demand new answers from our industry for passenger experience.

But Gen Z will also create new business opportunities. While the 2000s saw the rise of low-cost airlines in many parts of the world, we might see the rise of sustainable carriers in the next decades – where people will actively pay a premium to use an eco-efficient product.

Especially in the cabin, there is still great potential to be tapped in this regard. Roughly three quarters of an aircraft cabin currently goes straight to landfill upon end of life. It also has to do with existing regulations: cabin surfaces have to be fire-retardant, which counters recycling efforts. Together with regulators, we will have to find a middle way where we keep safety records, but move from a supply chain mindset into a supply circle one.

It becomes apparent that for this next step, we will need everybody to join the stage at once. Aviation needs to leave the prep room and bring new ideas into the spotlight. This is the main incentive behind both the Sustainable Aero Lab and the Crystal Cabin Awards. With entries for the latter still open for submission until February 2023, including the Sustainable Cabin category, I highly encourage you to make your way to the stage and share your ideas. The time has never been better!

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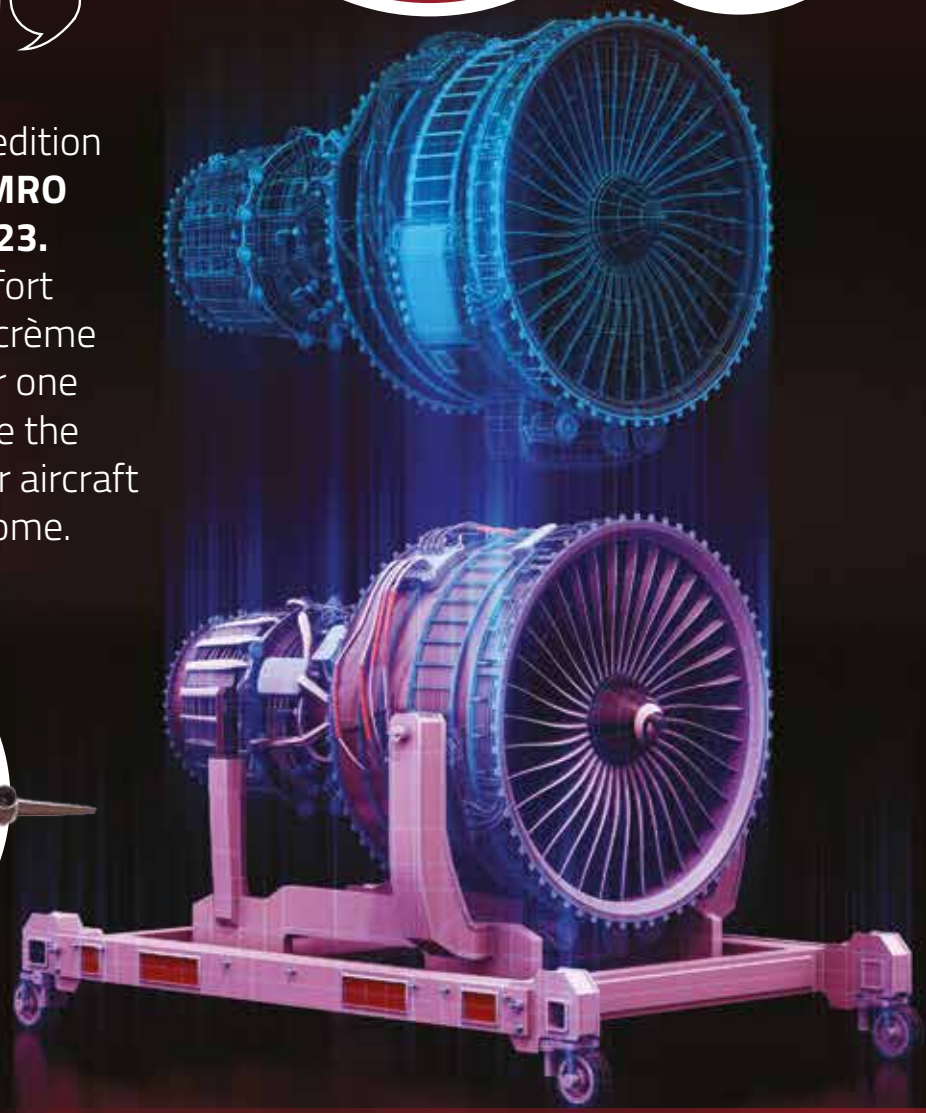

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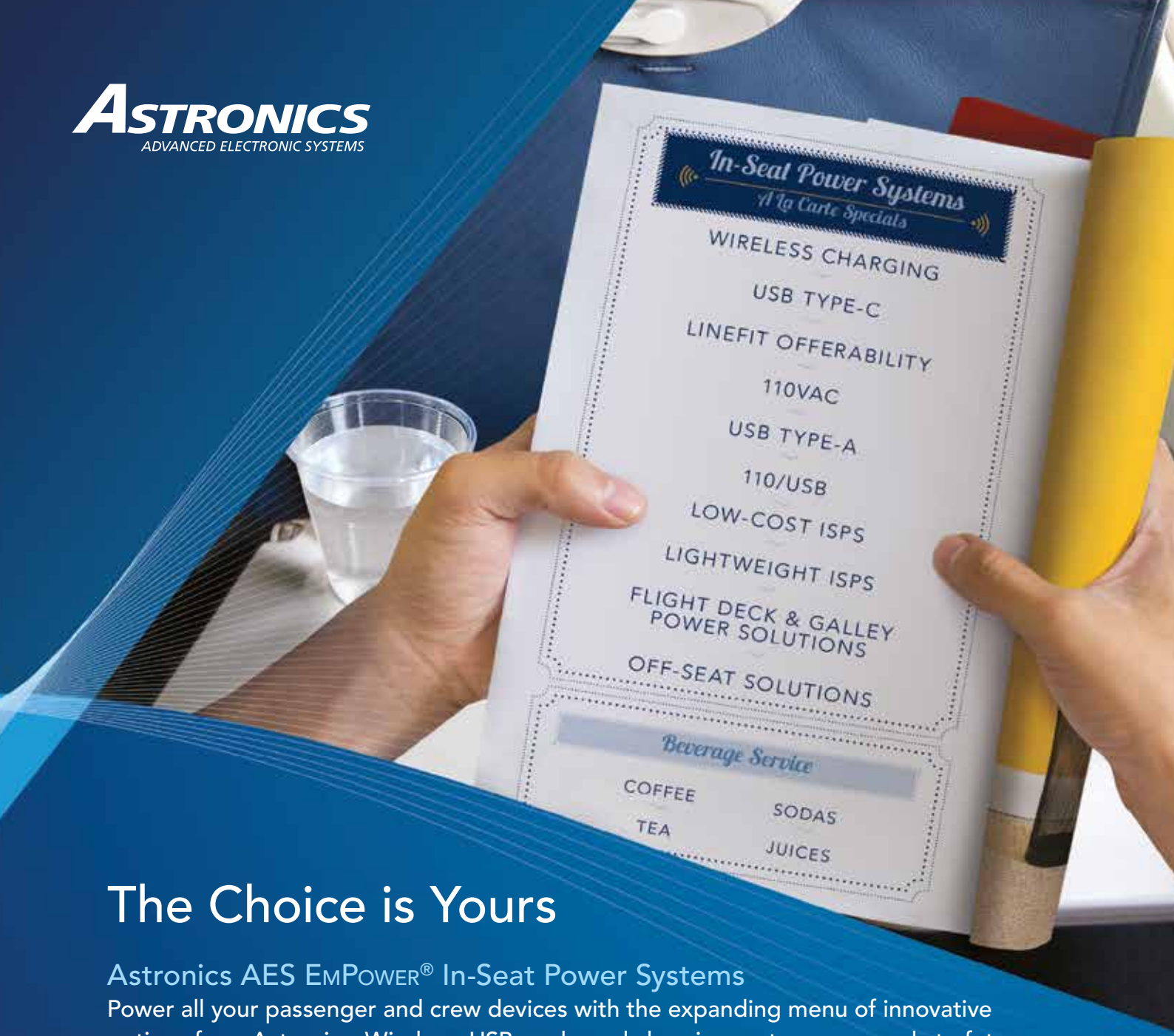

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