SESAR INNOVATION PIPELINE 2021

Air traffic management research and innovation

sesar
JOINT UNDERTAKING

All the projects outlined in this publication are co-funded by the European Union.

About the SESAR 3 Joint Undertaking

The SESAR 3 Joint Undertaking is an institutionalised European partnership between private and public sector partners set up to accelerate through research and innovation the delivery of the Digital European Sky. To do so, it is harnessing, developing and accelerating the take-up of the most cutting-edge technological solutions to manage conventional aircraft, drones, air taxis and vehicles flying at higher altitudes.

The SESAR 3 JU partnership brings together the EU, Eurocontrol, and more than 50 organisations covering the entire aviation value chain, from airports, airspace users of all categories, air navigation service providers, drone operators and service providers, the manufacturing industry and scientific community.

The partnership also works closely with the regulatory and standardisation bodies, notably EASA and Eurocae, as well as key stakeholders, such professional staff organisations, the space and military communities and global partners.
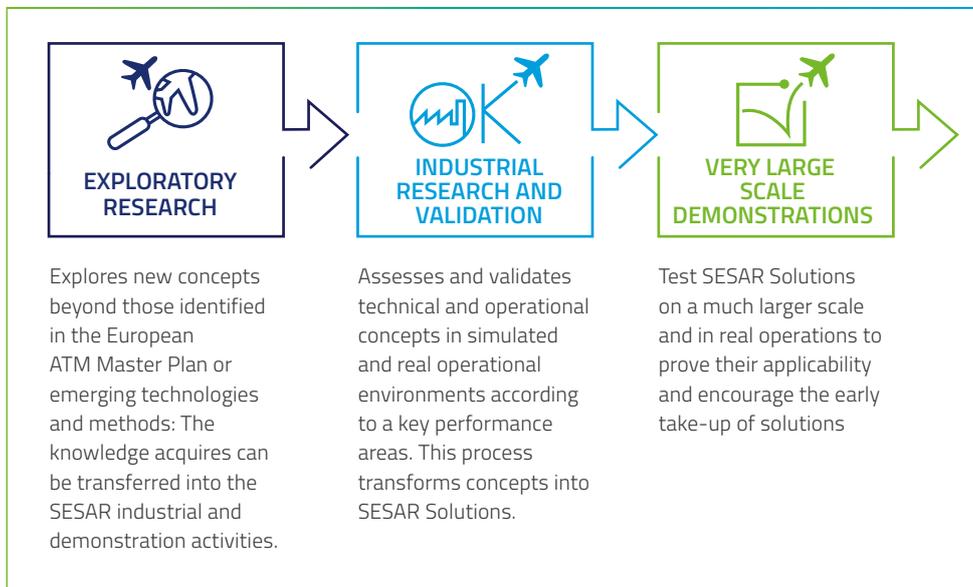
TABLE OF CONTENTS

2021 HIGHLIGHTS

The SESAR research and innovation programme is designed as an innovation pipeline, made up of exploratory research, industrial research and validation and very large-scale demonstrations/demonstrators, where ideas are transformed into tangible solutions.

The research takes place across 70 projects and in over 50 test beds all around Europe (simulation platforms, on-board commercial flights, dedicated airport testbeds and air traffic control centres), which validate concepts and candidate solutions. The testing is not limited to a specific location, but can be used to test multiple environments irrespective of the location where the physical validation is held.

In 2021, the JU were successful in advancing new technologies and procedures through the SESAR innovation pipeline, in accordance with the timeline set by the European ATM Master Plan – Europe's roadmap for the digital transformation of ATM. This brochure provides highlights of progress made over the course of 2021.

EXPLORATORY RESEARCH

Explores new concepts beyond those identified in the European ATM Master Plan or emerging technologies and methods: The knowledge acquires can be transferred into the SESAR industrial and demonstration activities.

INDUSTRIAL RESEARCH AND VALIDATION

Assesses and validates technical and operational concepts in simulated and real operational environments according to a key performance areas. This process transforms concepts into SESAR Solutions.

VERY LARGE SCALE DEMONSTRATIONS

Test SESAR Solutions on a much larger scale and in real operations to prove their applicability and encourage the early take-up of solutions

High-performing airport operations, including total airport management, remote towers, runway throughput capabilities, navigation and routing tools, airport safety alerts for controllers and pilots

Advanced air traffic services, including time-based separation and European wake vortex re-categorisation (RECAT-EU), better sequencing of traffic, automation support tools, integration of all vehicles

Optimised network operations, including dynamic collaborative tools to manage ATC airspace configuration (sectors), and civil-military collaboration for greater predictability and management of operations and airspace use

Enabling infrastructure, including CNS integration to facilitate economies of scale and seamless service delivery; and system-wide information management governance, architecture and technology solutions and services for information exchange

Drone integration, covering technologies and service solutions to support complex drone operations with a high degree of automation in all types of airspace, including urban areas

SESAR 2020 at a glance

EXPLORATORY RESEARCH

INDUSTRIAL RESEARCH & VALIDATION

VERY LARGE SCALE DEMONSTRATIONS

Fundamental	Applied

High-performing airport operations

AEON | IMHOTEP
ASPRID

AART (PJ.02 W2) | TAM (PJ.04 W2) | DTT (PJ.05 W2)

STAIRS (VLD02 W2)
SORT (VLD03 W2)
ITARO (PJ37 W3)

Optimised ATM network services

ECHO | ISOBAR
CADENZA | START
SlotMachine

OAUO (PJ.07 W2) | DNMS (PJ.09 W2)

Advanced air traffic services

HAAWAII | SAFELAND
INVIRCAT | URClearED

EAD – PJ.01 W2 | PROSA (PJ.10 W2)
ERICA (PJ.13 W2) | 4D skyways - (PJ.18 W2)
Virtual Centre (PJ.32 W3) | FALCO (PJ.33 W3)

Enabling aviation infrastructure

FACT

I-CNSS (PJ.14 W2)

DREAMS (VLD01 W2) | ALBATROSS (VLD02)
ADSCENSIO (PJ.38 W3) | VOICE (VLD02)

U-space

BUBBLES | ICARUS
DACUS | USEPE
Metropolis 2

PJ34 W3 – ATM ⬚U-space Interface

AMU-LED | SAFIR-MED
CORUS-XUAM | TINDAIR
GOF 2.0 | Uspace4UAM
(VLD02)

Fundamental list:

- AICHAIN
- AISA
- ALARM
- ARTIMATION
- BEACON
- CREATE
- DYNCAT
- FARO
- FlyATM4E
- FMPMet
- ITACA
- MAHALO
- MODUS
- NEWSENSE
- SAFEOPS
- SIMBAD
- SINAPSE
- SINOPTICA
- SYN AIR
- TAPAS
- TRANSIT
- X-TEAM D2D

Transversal activities

- Engage knowledge transfer network
- NOSTROMO
- Master Plan – PJ20
- Content integration – PJ19

Timeframe 31 December 2021

Changes in leadership

© SESAR 3 JU

In July 2021, Florian Guillermet, stepped down from his role as Executive Director of the JU to take up a new position as CEO of DSNA (Direction des Services de la Navigation Aérienne), France's air navigation services provider.

Guillermet joined the SESAR Joint Undertaking in 2008, first as Chief Programme Officer and then as Deputy Executive Director, before taking up the leadership of the organisation in 2014. Guillermet oversaw the successful completion of the first SESAR research and innovation programme, as well as the roll-out of a second programme, winning industry-wide support and recognition for his strong and successful management of the partnership.

"On behalf of the Board, I would like to thank Florian for all that he has done to mobilise the aviation industry and to effectively drive forward the research and innovation agenda for modernising our skies. It is thanks to his commitment and outstanding leadership that the SESAR JU has been able to deliver so successfully on its mandate, accelerating the pace of innovation and delivering high quality solutions for industrialisation. I wish him the very best

for the next leg of his aviation journey," says Henrik Hololei, Chair of the SESAR JU Administrative Board and Director General for the European Commission's Directorate General for Mobility and Transport (DG MOVE).

The departure of Florian Guillermet led to a decision taken by the Administrative Board of the JU to appoint of Richard Frizon as its interim Executive Director, to ensure the smooth and effective continuation of the work of the JU, until the appointment of a new Executive Director is made in early 2022.

Frizon brings to the interim role over 20 years of expertise in finance and public administration both at national and European levels. Prior to joining the SESAR JU in 2019, Frizon spent 10 years at the European Research Council Executive Agency, leading the sector responsible for the agency's budget (2.2 billion EUR). As interim Executive Director, Frizon is tasked with managing the operations of the SESAR JU in accordance with its work plan, as well as ensuring the successful launch of the SESAR 3 JU at the end of the year.

© SESAR 3 JU

© Shutterstock

New SESAR 3 Joint Undertaking promises to be bigger, bolder, better

In December, the SESAR 3 Joint Undertaking (SESAR 3 JU) was officially launched, marking a new chapter in modernising European air traffic management (ATM).

Bringing together the EU, Eurocontrol, and more than 50 organisations covering the entire aviation value chain, including drones, this new European partnership will invest more than EUR 1.6 billion between now and 2030 to accelerate, through research and innovation, the delivery of an inclusive, resilient and sustainable Digital European Sky. Building on the achievements of its predecessor, the SESAR 3 JU will drive an ambitious programme to make Europe's aviation infrastructure fit for the digital age, while offering quick wins to contribute towards the sector's net zero ambitions.

Drawing upon a wide pool of multidisciplinary expertise spanning the length and breadth of Europe, the SESAR 3 JU will develop and deliver innovative solutions across nine flagship areas of research and innovation (R&I), accommodating a diverse array of air traffic, from air taxis and delivery drones to commercial airliners and military aircraft. The portfolio of R&I activities will be structured according to an innovation pipeline, composed of exploratory and industrial research, large-scale demonstrators and a fast-track mechanism, to accelerate market uptake of the most promising and competitive solutions.

The new partnership will also act as catalyst for speeding up the transition towards climate neutral aviation, focusing on solutions that can be implemented rapidly and that can bring environmental benefits in the short to medium term, ahead of a ramp-up in use of sustainable aviation fuels. It will also aim to introduce solutions that allow for a more flexible and resilient infrastructure that is capable of withstanding unpredictable shocks like COVID-19.

Key to the success of the SESAR 3 JU will be close cooperation with regulatory and standardisation bodies, notably the European Union Aviation Safety Agency (EASA) and EUROCAE, in order to accelerate solutions into implementation, while working closely with the SESAR Deployment Manager. Also critical will be creating synergies between research and innovation activities at European and national level, which will be facilitated with the establishment of a States' Representative Group to monitor

the progress of the JU in line with the Horizon Europe and the Commission's top priorities, including the "Sustainable and Smart Mobility Strategy", "European Green Deal" and a "Europe fit for the digital age".

Speaking on the occasion of the first meeting of the SESAR 3 JU Governing Board on 14 December, Director General of Directorate-General for Mobility and Transport (DG MOVE) and Chair of the SESAR 3 JU Governing Board, Henrik Hololei said:

"*The aviation sector has to accelerate its transition to a sustainable and digital future. But I have no doubt that working together with this goal in mind, we will make it. Air traffic is recovering steadily following the pandemic, there is a rapid rise in new entrants like drones, and the aviation network is under increasing pressure to reduce emissions and address the issue of lack of scalable capacity. The public-private partnership has shown that it serves as a catalyst to speed up this transition towards a green, climate neutral and digital Europe, and to make our European industry more competitive and more resilient.*"

SESAR Solutions Catalogue charts progress towards the Digital European Sky

In September, the JU published the fourth edition of the SESAR Solutions Catalogue, charting progress in developing the technological and procedural solutions needed for delivering the Digital European Sky. The solutions captured in this latest edition offer a pathway towards recovery, and a smarter and more sustainable air transport system in Europe.

The publication contains 101 delivered solutions (reaching required level of maturity for industrialisation) addressing key areas of the air traffic management value chain, notably airport operations, air traffic services, network operations and the enabling infrastructure. As much as two thirds of the delivered solutions are now part of deployment plans at local and European levels, meeting the business needs and resulting tangible benefits in terms of performance.

The Catalogue also presents details of the ongoing research and innovation on 80 candidate solutions in SESAR 2020, and progress towards the vision of the digital European sky. Finally, the publication gives a flavour of what's on the horizon thanks to promising innovations underway in all three strands of research (exploratory, industrial and demonstrations).

The combination of the climate and COVID crises has accelerated a societal shift towards more sustainable air transport and renewing momentum among airports, airlines and ANSPs to rethink their business models and operations. The dual crisis also means that collaboration and the pooling of resources is more critical than ever, since industry-wide challenges can only be overcome together.

Although developed prior to the pandemic, the solutions captured in this fourth edition of the SESAR Solutions Catalogue offer a pathway to recovery in the short term, while also laying the foundations for a more far-reaching transformation of ATM.

Considering the urgency of the climate situation, the Catalogue also shows that many of the solutions delivered so far offer direct and indirect gains for the environment, whether it is lowering fuel consumption or minimising noise. In doing so the Catalogue illustrates the role air traffic management can play in making aviation and air transport more sustainable, in line with Europe's Grean Deal ambitions.

SESAR SOLUTIONS CATALOGUE **2021**

Fourth edition
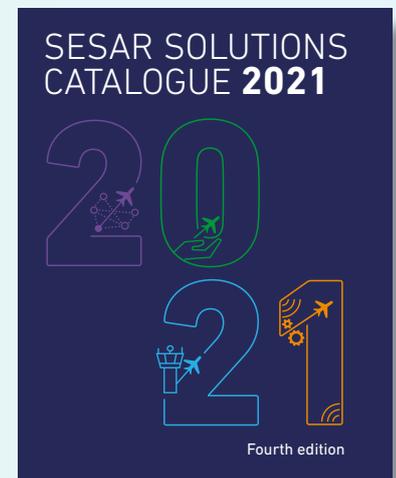
Digital Sky Awards recognises innovation in action

In June, the JU announced the winners of the 2021 Digital European Sky Awards, celebrating the best of research and innovation in air traffic management in Europe. The five winning projects were selected from a shortlist, following rigorous evaluation by a distinguished jury and a public vote. The awarded projects are emblematic of the work underway to deliver smarter and more sustainable air transport, across all three strands of research which make up the SESAR innovation pipeline.

The winners were announced during an award ceremony on 17 June, attended by over 300 participants and featuring words of support by European Commissioner, Adina-Ioana Vălean.

2021 AWARD WINNERS – BY CATEGORY

EXPLORATORY RESEARCH

The category recognised projects that pushed the limits of our knowledge of ATM and aviation, advancing new ideas and concepts, and applying innovative practices from other domains. The winning project, Resilient Synthetic Vision for Advanced Control Tower Air Navigation Service Provision (RETINA), showed how augmented reality can improve controllers' situational awareness. The project results have been fed into the SESAR Innovation Pipeline for further exploitation as part of SESAR project PJ.05-W2 DTT.

INDUSTRIAL RESEARCH

The category recognised projects that have accelerated best-in-class solutions ready for industrialisation by the ATM community. The winning project, Increased Runway and Airport Throughput PJ.02 EARTH, focused on improving runway and airport throughput, considering wake vortex, weather, the environment and noise around the airport, for different levels of traffic demand, future aircraft capabilities and airport configurations.

DEMONSTRATION

The category recognised projects which have showcased the benefits of SESAR innovation in live operational contexts, helping to secure broader stakeholder buy-in. The winning project, Initial trajectory information sharing (DIGITS) – PJ.31, demonstrated the benefits for ATM when the aircraft shares its complete predicted 4D trajectory (3D + time) with air traffic control services. DIGITS also allowed to fine tune the requirements for integration of aircraft trajectory data in the ground systems.

SUSTAINABILITY

The category recognised projects offering multifaceted solutions to reducing ATM's impact on the environment (noise and emissions), contributing towards making Europe the most environmentally-friendly sky to fly in the world. The winning project, Flying Air Traffic Management for the benefit of environment and climate - FlyATM4E, is developing a concept to identify climate-optimised aircraft trajectories, which enable a robust and eco-efficient reduction in aviation's climate impact. Climate optimisation will consider CO_2 and non-CO_2 effects, such as contrails and contrail-cirrus, water vapour, NOx and particulate emissions.

U-SPACE

The category recognised projects that delivered tangible solutions for the safe, efficient and secure integration of drones into European airspace, facilitating the overall growth of the European drone services market. The winning project, Concept of Operation for EuRopean UTM Systems – CORUS, developed a concept of operations for drones in very low-level airspace, laying the groundwork for the implementation of U-space, and the safe and secure integration of drones.
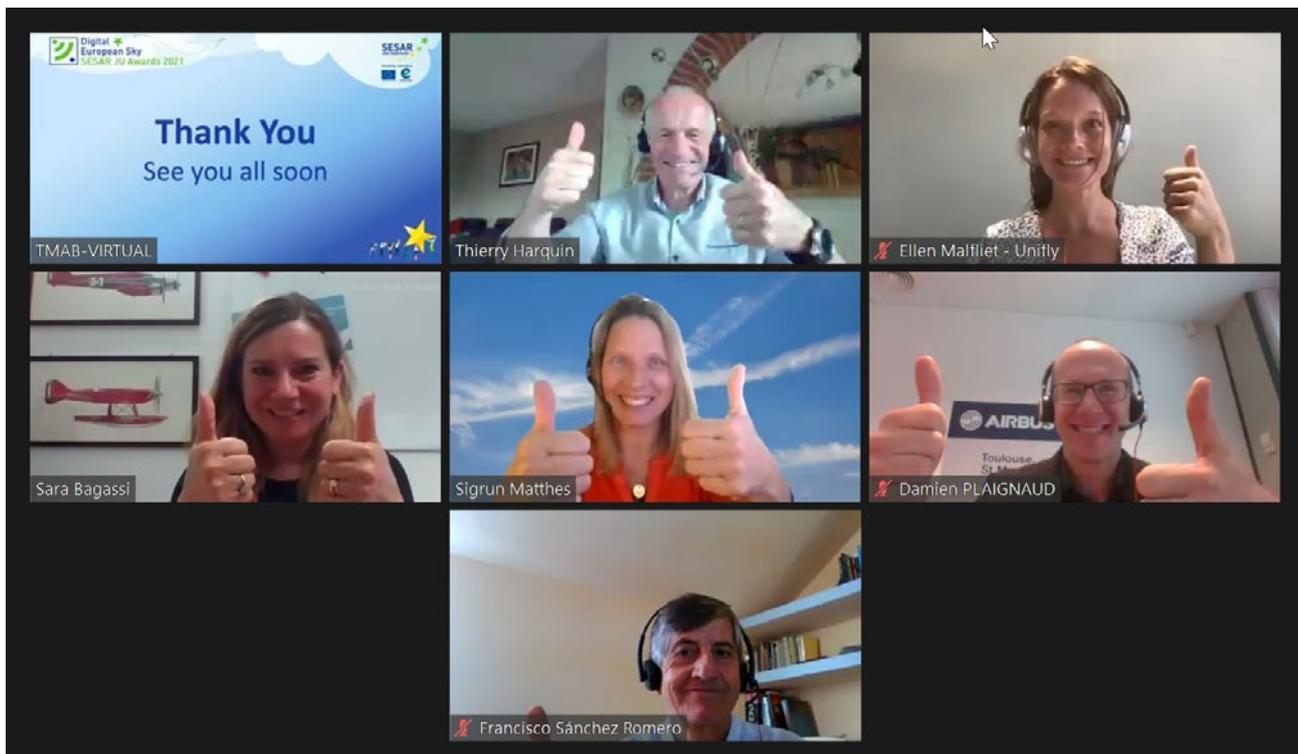
The green promise of aircraft taxiing

Taxibots, E-Taxi systems, single engine taxiing are some of the technologies under investigation by partners in the Advanced Engine Off Navigation (AEON) project to reduce significantly CO_2 emissions caused by aircraft taxiing at airports.

The project aims to define a concept of operations for engine-off taxiing techniques, making use of novel technologies that are coming onto the market, such as:

© Airbus

- Non-autonomous taxiing, such as TaxiBots, a hybrid towing vehicle which, unlike the normal pushback trucks, can tow full aircraft to near the start of the runway, without the aircraft having to start its engines. This is expected to reduce fuel consumption during taxiing by 50% to 85%.

- Autonomous taxiing like E-Taxi system, which relies on electric motors embedded in landing gear to allow planes to push back and taxi without their jet engines running - saving fuel, curbing emissions and ending last-minute delays while waiting for airport tugs. This is expected to reduce fuel costs by around 4% of the overall consumption, 50% of taxi fuel and up to 85% of ground operations costs considering other benefits like pushback costs, brake wear, etc.

- Single engine taxiing, which involves using only half the number of engines installed to generate the energy needed for taxiing, reducing taxi fuel consumptions by 20%.

Importantly fuel savings translate into reductions in CO_2/NOx emissions, while minimising engine use results in reduced noise.

Bringing together knowledge and expertise from research partners ENAC, Deep Blue and TU Delft, the project will work closely with airports, airlines and manufacturers on developing the following:

Overall aircraft engine-off navigation concept of operations, detailing how the three eco-friendly solutions above may combine in the airport surface management process both at strategical and tactical level in order to minimise fuel consumption and emissions without impacting arrival and departure flight schedules;

Business model to help airports and/or airlines evaluate their benefits in the implementing these technologies;

Real-time evaluation of environmental indicators to support decision-making, conflict free routing for all vehicles, reallocation of techniques to adapt to in real time.

The project aims to ensure that their approach can be integrated in to airport collaborative decision-making tools.

The research is very much in line with the JU's goal of delivering solutions to make aviation smarter and more sustainable in support of the Commission's strategy in this area.

More about the project: https://www.aeon-project.eu

INTERVIEW

Weather windows designed for greener flights

Cutting carbon emissions is one of several ways that aviation can help to slow climate change, explains Dr Sigrun Matthes, atmospheric physicist with Germany's DLR research institute and research in the FlyATM4E exploratory research project. Recent analysis shows controlling both CO_2 emissions and non-CO_2 effects has the potential to double the benefits available from carbon emissions alone, and within a much shorter time frame than that envisaged for sustainable aviation fuel.

How will FlyATM4E lead to greener skies?

FlyATM4E exploratory research is examining non-CO_2 effects such as contrails and contrail-cirrus, water vapour, nitrous oxide (NOx) and particulate emissions to identify where there is potential to reduce the climate impact. Non-CO_2 effects are strongly dependent on the weather and vary considerably according to atmospheric conditions such as air temperature and altitude. This uncertainty far exceeds that of CO_2 emissions which are the direct result of events like route length, taxi time and wind strength.

Every aircraft has access to weather information, and it is the expansion of this interface with meteorological data that provides the opportunity to develop climate-optimised trajectories in collaboration with air traffic control with the help of advanced MET data products on climate effects.

What are the effects of non-CO_2 emissions?

Non-CO_2 effects, such as contrail cirrus clouds (ice crystals that form behind an aircraft) and NOx-induced changes of ozone and methane, upset the radiative balance of the atmosphere. They can cause both warming and cooling effects and, unlike CO_2, do not follow a linear pattern but contribute to both positive and negative Effective Radiative Forcing (ERF). FlyATM4E is researching the synoptic patterns that trigger the formation of effects such as persistent contrails, and the temporal and spatial factors that determine whether NOx emissions will lead to warming

© Roger Riedel

FlyATM4E

> " *Managing non-CO_2 effects represents an important part of reducing aviation's total environmental footprint.* "

or cooling effects in the atmosphere. The analysis creates an air traffic management-oriented weather chart to show where the climate impact is high.

How can non-CO_2 effects be reduced?

FlyATM4E is using data from different sources including numerical weather forecast and reanalysis data, and earth-system climate models to identify particular weather situations that are more favourable for reducing climate change effects. Specifically, the research is looking at which days during different seasons and under what synoptic patterns there are opportunities for mitigation gain. Improving the quality of

the forecast model brings more certainty to planning a robust mitigation strategy.

Prototype algorithms provide a link between the meteorological data and the climate effect of individual emissions to enable the flight planner to check the trajectory and assess the climate impact. FlyATM4E aims to make this data service available as a SESAR solution to help airspace users and air navigation service providers select climate-optimised trajectories. There is still a high degree of uncertainty and a need for additional modelling to establish a robust model. By collaboration with other research initiatives aiming to use these prototype in live trials, project partners expect to mature the technology and identify some of the 'big hits'.

What are the potential benefits?

Managing non-CO_2 effects represents an important part of reducing aviation's total environmental footprint. This is estimated to amount to about 5% of total anthropogenic change, with approximately half caused by CO_2 emissions and half from the effects of non-CO_2 emissions.

A feasibility study in a one day case study has assessed how small flight detours avoid the formation of persistent contrail cirrus and NOx-induced effects, reducing the total climate impact on that specific by more than 40% with a small 0.5% increase of fuel. However, large uncertainties in these results still prevail. By modelling these climate impact metrics in multiple environments including trans-Atlantic routes, FlyATM4E is aiming to identify sufficiently robust meteorological strategies capable of supporting eco-efficient routes with climate-optimised aircraft trajectories and large mitigation potential.

More about the project: https://flyatm4e.eu/

[1] International Panel on Climate Change (IPCC)
[2] International Energy Agency (IEA)

INTERVIEW

AI, boosting safety and resilience in aviation

There is growing pressure on the ATM system to become more cost efficient and at the same time manage traffic that is set to become more complex and diversified. All the while maintaining or even enhancing the already high levels of safety! This sounds like a bit of conundrum, but it is one that can be solved with the help of artificial intelligence, explains Paula López-Catalá from Innaxis Research Institute from the recently started SafeOPs project.

© Innaxis

SafeOps is about ensuring safe operations in ATM, enabled by AI. Why is that necessary?

Machine learning technologies have the ability to analyse vast amounts of diverse data (usually coming from different sources) to extract patterns. This hidden knowledge can be used to identify/predict safety risks or performance inefficiencies and, in doing so, offer support to controllers in their decision-making. By processing years of operational data (i.e. years of practice), AI can also support controllers' training needs and subsequent performance in the operational room. It is against this backdrop that SafeOPS is investigating how to integrate data-driven and automation-based decision intelligence into the current ATM system.

How is the project addressing?

The key is to bring together the machine learning experts and the ATM and airline operational staff and domain experts to address together the human factors associated with AI. In doing so, they work together to identify possible hidden safety risks and define operational problems. In the long run this approach facilitates the adoption of the technologies and higher levels of automation by the end users. The ATM human agents will have to adapt to receiving more information from big data analytics, precise but expressed

in probabilistic terms. Clever HMI refinements will certainly help to mitigate the potential overflow of information. However, also research on the impact of information automation on the ATM system needs to be conducted.

Is there a specific application of AI that the project is focusing on?

SafeOPS focuses its research on go-around forecasting. Initiated by the pilot or air traffic control, go-arounds are aborted landings by aircraft on the final approach. These occur on average 1-3 times for every 1,000 approach. Even though performing a go-around is encouraged in situations deemed "unstable", one in ten go-around reports still show potential safety risks. The project is looking at the processes behind go-arounds today, the probabilistic data available and the potential value of a decision-making support tool and impact on the safety and resilience of the system.

How will you test your research/solution? Could it be commercialised? Do you foresee industry taking up this concept and integrating it into their systems/operations. If so, how?

Yes, several ANSPs are asking for greater flexibility in technology architectures and AI will be a key piece of the next generation of systems and critical for increased efficiency and safety improvements in the operational room. SafeOPS aims at demonstrating the feasibility of these technologies from a technical perspective in cooperation with the operational experts. Ultimately, we have to be sure that the solution developed responds to a real operational problem and matches the requirements and needs of the users, paving the way towards a future implementation.

SafeOPS consortium (TU Munich, Innaxis, DFS, Iberia, Pegasus and DeepBlue) is committed to fully align this initial research to enable its future adoption while, in parallel, significant progress in certification of AI technologies would be required from authorities.

More about the project: https://safeops.eu/

SESAR Innovation Days showcases novel concepts to make aviation smarter and more sustainable

Multimodality, climate neutral aviation and urban air mobility were just some of the research themes to be presented during the SESAR Innovation Days (SIDs), which took place on 6-9 December as a virtual conference. Results stemming from the showcased projects have the potential to push the boundaries of air traffic management (ATM), making it smarter and more sustainable in the coming years, participants heard.

Now in its eleventh edition, the SESAR Innovation Days, a flagship event in the aviation research calendar, is showcasing some of the breakthrough concepts from the SESAR Joint Undertaking's exploratory research portfolio, as well as novel outcomes from the broader ATM research community.

Altogether, the conference featured more than 30 posters and 30 papers, covering wake vortex detection, data-driven methods for safety and resilience prediction, climate-optimised trajectories, capacity sharing in virtual centres, drone traffic management, among other research topics.

The concepts presented reflect Europe's vision to make its airspace the most efficient and environmentally-friendly sky to fly in the world, contributing to the long-term sustainability of the aviation industry and its recovery from the COVID crisis.

"The pandemic has highlighted the urgent need to move ahead with the digital transformation of air traffic management in Europe, to build greater resilience, scalability and sustainability into the system," said Richard Frizon, Executive Director ad interim of the SESAR Joint Undertaking. "This requires the continuing

engagement of the ATM research community, young talent and strong collaborations like those on display at the SESAR Innovation Days."

Researchers [in ATM] have a double objective to work on; the decarbonisation of aviation and digitalisation, said Eamonn Brennan, Director General, EUROCONTROL, who gave the opening keynote. What's different today is that these are no longer regarded as separate objectives; we have to have digitalisation

done in a way that reduces our carbon footprint. So whatever we develop and implement has to be innovative, but it has to be productive, add capacity and decarbonise all at the same time, he added.

We also must think multimodal, and move away from modernising modes of transport in isolation of one another. That was the message passed by Carlo Borghini, Executive Director of Europe's Rail Joint Undertaking, in his keynote
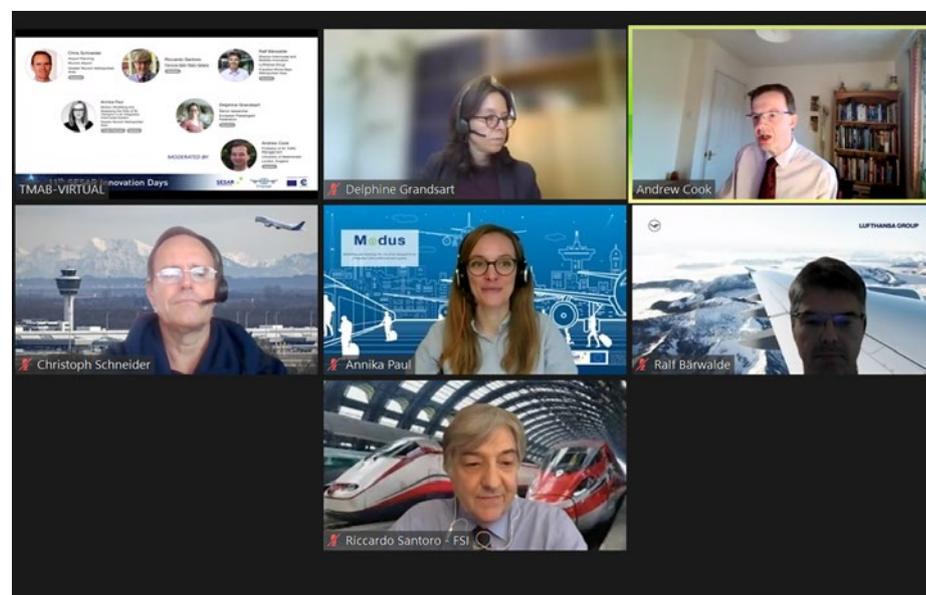
address. A multimodal transport system, offering seamless mobility services, is an essential component of smarter and more sustainable mobility in Europe, he argued. The topic was also the focus of a conference panel, which looked at progress made towards multimodality and what steps need to be taken to speed up its delivery.

The conference also dedicated a session to the application of artificial intelligence in ATM. The panel of experts discussed the limitless potential of AI to support the automation of air traffic control, but underlined the need for an approach that is human-centric and progressive in order for these applications to be reliable, safe and certifiable.

Fittingly, the conference closed with the SESAR Young Scientist Award ceremony, celebrating the next generation of aviation and ATM researchers. The 2021 edition of the award widened its scope, recognising scientific excellence in two categories; post doctorates ("PhD"), and undergraduate and master students ("students").

INTERVIEW

From satellite constellations to airspace management: new perspectives on passenger needs

Two winners were recognised in the SESAR Young Scientist Award 2021, for the first time applauding both postgraduate and undergraduate achievements. Philippe Monmousseau's work on performance-based assessments in air traffic management at the ENAC Academy in France secured the PhD award; and Chen Xia, Universidad Politécnica de Madrid, become the first undergraduate to win for her thesis addressing conflict anticipation and resolutions to mitigate the risk of mid-air loss of separation.

Speaking about their successes, both see aviation as amounting to much more than the flight itself. "Air transportation is inherently multi-modal," says Philippe

Monmousseau, who followed "an unconventional approach to studying the air transportation system: leaving the plane aside and focusing on data generated by passengers throughout their trip." This led to new metrics and models to better understand and visualise pain points from a passenger perspective – a long way from his initial interest in satellite constellations sparked by a maths degree and masters in aerospace engineering. "ATM is more than just a research field. It is a combination of numerous fields, pick your favourite and go for it!" he advises other researchers.

> " *ATM is more than just a research field. It is a combination of numerous fields, pick your favourite and go for it!* "

© Philippe Monmousseau

Chen Xia, meanwhile, chose to study airspace management after discovering the key role it plays in ensuring flight safety. "The main aim of my work is to study the current tactical resolution strategies of potential conflicts and characterise the variables that affect or trigger the use of a strategy. A better understanding of the resolution process will help to further improve and develop air traffic control support tools." Chen Xia identifies a huge variety of concepts and ideas, not all of which are compatible. "How all the parties reach agreement might be a challenge," she warns, especially as traffic levels start to increase again and even exceed pre-COVID levels. "Here in Europe, SESAR plays a key role in harmonising these new developments."

The pandemic has brought many issues to the surface, says Philippe Monmousseau. "I think it has accelerated the shift from a flight-centric approach to air traffic management to a passenger-centric approach." He sees the biggest challenges facing airspace management driven by passenger desires: in particular a smaller carbon footprint and an enhanced door-to-door experience. "This requires many technological innovations in the way we build and fly planes and an important change of paradigm regarding the air transportation system. Passengers want to go from point A to point B, with personal constraints and convictions, and not from airport A to airport B. Air traffic management will have to team with various other transportation systems in order to satisfy this need, and passengers will have to trust these systems with data that they can use to achieve this goal. Aviation has to convince its future passengers that it can meet that desire."

Researching wider aspects of air transportation such as access to airports, passenger needs and interaction between airlines will help to improve the door-to-door experience, says Philippe

© Chen Xia

An important part of [SESAR] is harnessing new ideas[...] and applying them in connected way to benefit the whole industry, avoiding duplication of effort

Monmousseau. An important part of this activity is harnessing new ideas emanating from European research work and applying them in connected way to benefit the whole industry, avoiding duplication of effort, adds Chen Xia. The SESAR Young Scientist Award adds to this process by not only increasing the visibility of successful projects, but also raising the profile of promising students who are helping to bring these new concepts to fruition.

More about the award:
www.sesarju.eu/YSA

Engage SESAR Summer School 2021

Engage, the JU's knowledge transfer network, held a 3rd virtual edition of its summer school, with almost 100 participants (post-doctorates, masters students and industry representatives) from 20 countries taking part from 30 August to 2 September. The event succeeded in establishing a forum for the exchange of ideas between industry and academia, thereby fulfilling an educational purpose as well as supporting the uptake of academic research by the ATM industry.

https://engagektn.com/

Ongoing projects

ARTIMATION – Transparent artificial intelligence and automation to air traffic management systems

ARTIMATION aims to investigate AI methods in predicting air transportation traffic and optimizing traffic flows based on explainable artificial intelligence (XAI) to address the challenge related to transparency of automated system in the ATM domain. ARTIMATION expexcts to provide a proof-of-concept of transparent AI models that includes visualisation, explanation and generalisation to ensure safe and reliable decision support.

Web: www.sesarju.eu/projects/artimation

AISA - AI situational awareness foundation for advancing automation

To implement advanced automation, AI and human need to be able to share situational awareness. Therefore, AISA project is exploring the effect of, and opportunities for, distributed human-machine situational awareness in en-route ATC operations. The project is developing an intelligent situationally-aware system by combining machine learning with reasoning engine.

Web: aisa-project.eu/

MAHALO - Modern ATM via human/automation learning optimisation

To answer the question if automation should match human behaviour or be understandable to humans, MAHALO aims to develop an individually-tuned ML system to solve ATC conflicts and couple this to an enhanced en-route CD&R display. Insights will be used to define a framework to guide design of future AI systems.

Web: mahaloproject.eu

TAPAS -Towards an automated and explainable ATM system

TAPAS aims to explore highly automated AI-based scenarios through analysis and experimental activities applying explainable artificial intelligence (XAI) and visual analytics, in order to derive general principles of transparency which pave the way for the application of AI technologies in ATM environments, enabling higher levels of automation.

Web: https://tapas-atm.eu/

AICHAIN – A platform for privacy-preserving federated machine learning using block chain to enable operational Improvements in ATM

AICHAIN proposes an innovative digital information management concept combining federated machine learning (FedML) and blockchain technologies. This enables the cyber-secured exploitation of large private data sets by an privacy-preserving federated learning architecture in which neither the training data nor the training model need to be exposed.

Web: www.aichain-h2020.eu/

CREATE - Innovative operations and climate and weather models to improve ATM resilience and reduce impacts

Air operations largely use weather information to make the air traffic flow safe, continuous and efficient. As climate changes are ongoing, available information on the weather on short and longer notice are increasing and technology is being improved. CREATE aims to achieve innovative procedures in ATM to reduce climate and environmental impact, while becoming more resilient to weather phenomena.

Web: https://create-project.eu/

DYNCAT - Dynamic configuration adjustment in the TMA

DYNCAT aims to enable more environmentally friendly and more predictable flight profiles in the TMA, namely on approach, by supporting the pilots in configuration management. The project is analysing the existing aircraft in operation and air traffic control procedures and propose improvements to on-board and ground procedures. The project aims also to identify the necessary technological and regulatory changes for improved airborne procedures and assess the environmental potential of improved operations.

Web: www.sesarju.eu/projects/DYNCAT

FlyATM4E - Flying ATM for the benefit of environment and climate

FlyATM4E aims to expand approved climate-assessment methods and optimization of aircraft trajectories to identify promising mitigation options suitable to solve the task of reducing overall climate impact of aircraft operations. The project is assessing the feasibility of a concept for environmental assessment of ATM operations working towards environmental optimisation of air traffic operations.

Web: flyatm4e.eu/

FMPMet - Meteorological uncertainty management for flow management positions

FMPMet aims to integrate meteorological forecast uncertainty information into the decision-making process for flow management position (FMP). FMPMet aims to provide the FMP with an intuitive and interpretable probabilistic assessment of the impact of convective weather on the operations, up to 8 hours in advance.

Web: fmp-met.com

SINOPTICA - Satellite-borne and in-situ observations to predict the initiation of convection for ATM

SINOPTICA aims to explore the potential of assimilating remote sensing, GNSS-derived datasets and in situ weather stations data into very high-resolution, very short-range numerical weather forecasts to provide improved prediction of extreme weather events to the benefit of ATM operations.

Web: http://sinoptica-project.eu/

ALARM - Multi-hazard monitoring and early warning system

ALARM aims to develop a prototype global multi-hazard monitoring and early warning system (EWS). A global multi-hazard monitoring means near-real time and continuous global Earth observations from satellite, with the objective to generate prompt alerts of natural hazards affecting ATM and to provide information for enhancing situational awareness and providing resilience in crisis.

Web: www.sesarju.eu/projects/ALARM

FARO - Safety and resilience guidelines for aviation

FARO aims to bring new insights about safety and resilience in ATM, with four objectives: to exploit existing safety knowledge, to quantify the impact of increasing automation on ATM safety, to analyse the impact of increasing automation on ATM resilience, and to provide design guidelines and identify future research needs.

Web: faro-h2020.eu/

BEACON - Behavioural economics for ATM concepts

BEACON is studying the feasibility of extending user- driven prioritisation process (UDPP) to allow multi-prioritisation processes in the airspace and exchange of slots between airlines. It will build two models: a strategic model and a detailed tactical simulator To properly capture the agents' behaviours, BEACON is making use of behavioural economics.

Web: www.sesarju.eu/projects/beacon

ITACA - Incentivising technology adoption for accelerating change in ATM

ITACA aims to accelerate the development, adoption and deployment of new technologies in ATM. ITACA is developing a new set of methodologies and tools enabling the rigorous and comprehensive assessment of policies and regulations aimed at amplifying the uptake of new technologies within ATM.

Web: https://www.itaca-h2020.eu/

SafeOPS - From prediction to decision support - strengthening safe and scalable ATM services through automated risk analytics based on operational data from aviation stakeholders	Maintaining safety and cost-efficiency of air transport operations while increasing the capacity will push the next generation of ATM systems towards digitalisation. In the mid-term, a digitalised system in the human operated ATM environment will be capable of delivering reliable predictive analytics based on automated information processing. SafeOPS aims to support these future services by investigating the use of big data analytics together with new risk assessment methodologies. Web: www.sesarju.eu/projects/SafeOPS
SIMBAD - Combining simulation models and big data analytics for ATM performance analysis	SIMBAD aims to develop and evaluate a set of machine learning approaches aimed at providing state of-the-art ATM microsimulation models with the level of reliability, tractability and interpretability required to effectively support performance evaluation at ECAC level. The project aims to demonstrate and evaluate the newly developed methods and tools through a set of case studies. Web: www.sesarju.eu/projects/SIMBAD
Modus - Modelling and assessing the role of air transport in an integrated, intermodal transport system	Modus analyses the performance of the overall transport system by considering the entire door-to-door journey holistically. The project identifies (future) drivers for passenger demand and supply and assesses the impact on airside and landside processes and capacities. Based on these analyses, potential solutions to meet high-level European transport objectives are proposed. Web: modus-project.eu/
TRANSIT - Travel Information management for seamless intermodal transport	TRANSIT aims to develop a set of multimodal key performance indicators (KPIs), mobility data analysis methods and transport simulation tools, allowing the evaluation of the impact of innovative intermodal transport solutions on the quality, efficiency and resilience of the door-to-door passenger journey. Web: www.transit-h2020.eu/
X-TEAM D2D - Extended ATM for door2door travel	X-TEAM D2D aims to define, develop and initially validate a concept of operations for the seamless integration of ATM and air transport into an overall intermodal network, including other available transportation means (surface, water), to enable the door-to-door connectivity, in up to 4 hours, between any location in Europe. Web: xteamd2d.eu/
SYN+AIR - Synergies between transport modes and air transportation	SYN+AIR aims to generate common goals for transport service providers, which will justify data sharing while facilitating the user to execute a seamless D2D journey. SYN+AIR aims to generate customer door-to-door journeys and is analysing how those journeys can be facilitated through improved planning and operations activities powered by data sharing. Web: www.sesarju.eu/projects/synair
NewSense - Evaluation of 5G network and mmwave radar sensors to enhance surveillance of the airport surface	NewSense aims to improve safety and efficiency of operations primarily in secondary airports with innovative low-cost surface surveillance solutions, based on 5G cellular networks for the long term, and msafmWave radar for the medium term, allowing the implementation of affordable advanced-surface movement guidance and control systems (A-SMGCS). Web: www.sesarju.eu/projects/NewSense

SINAPSE - Software defined networking architecture augmented with artificial intelligence to improve aeronautical communications performance, security and efficiency	SINAPSE aims to propose an intelligent and secured aeronautical datalink communications network architecture design, based on the software defined networking (SDN) architecture model augmented with artificial intelligence (AI) to predict and prevent safety services outages, to optimise available network resources and to implement cybersecurity functions protecting the network against digital attacks. Web: 5.196.117.230/sinapse/
AEON - Advanced Engine Off Navigation	AEON aims at defining a concept of operations focusing on engine-off taxiing techniques, and a set of dedicated tools to support the operators. The project defines how to determine, in real time, efficient and conflict-free routing plans for autonomous and non-autonomous aircraft taxiing from gates to the corresponding runways and the other way around. Web: https://www.aeon-project.eu/
ASPRID - Airport system protection from intruding drones	ASPRID aims to develop a service-oriented operational concept and system architecture to protect airport operations from unwanted drones. To do so, the project is analysing aircraft and airport (runway and ground) operations to pinpoint possible vulnerabilities. With this, the project aims to identify possible technologies, procedures and regulations that could help better safeguard against drone incursions and/or can help them recover from any disruptions as quickly and as efficiently as possible. In doing so, the project proposes a more integrated and coordinated approach to handling drone incursions. Web: https://www.asprid.eu/
IMHOTEP - Integrated multimodal airport operations for efficient passenger flow management	IMHOTEP aims to develop a concept of operations and a set of data analysis methods, predictive models and decision support tools that allow information sharing, common situational awareness and real-time collaborative decision-making between airports and ground transport stakeholders. Web: www.imhotep-h2020.eu/
HAAWAII - Highly automated air traffic controller workstations with artificial intelligence integration	HAAWAII aims to research and develop a reliable, error resilient and adaptable solution to automatically transcribe voice commands issued by both air-traffic controllers and pilots, and to perform proof-of-concept trials in challenging environments. Also, the objectively estimated controllers' workload utilising digitised voice recordings of the complex London TMA is being assessed. Web: www.haawaii.de
CADENZA - Advanced capacity and demand management for European network performance optimisation	CADENZA aims to develop a detailed trajectory broker concept for the European network, incorporating advanced demand-capacity balancing mechanisms. The trajectory broker will balance capacity and demand through a coordinated capacity provision process and collaborative trajectory management (including a novel trajectory charging scheme). Significant improvements in cost-efficiency and delay are expected. Web: https://cadenza-project.eu/
ECHO - European concept of operations for higher airspace operations	ECHO aims to deliver a comprehensive demand analysis and innovative and feasible concept of operations enabling near term and future higher airspace operations in a safe and orderly manner. The higher airspace including the operators forms a new, almost legacy free environment enabling an expeditions uptake of innovations or extrapolated SESAR solutions. Web: https://higherairspace.eu/

|	
ISOBAR - Artificial intelligence solutions to meteo-based DCB imbalances for network operations planning	ISOBAR aims at the provision of a service- and AI-based network operations plan, by integrating enhanced convective weather forecasts for predicting imbalances between capacity and demand and exploiting AI to select mitigation measures at local and network level in a collaborative ATFCM operations paradigm. Web: isobar-project.eu/
START - A stable and resilient ATM by integrating robust airline operations into the network	START aims to develop, implement, and validate optimisation algorithms for robust airline operations that result in stable and resilient ATM performance even in disturbed scenarios The main focus of the project is the optimisation of conventional traffic situations while considering disruptive weather events such as thunderstorms. Web: start-atm.com
FACT - Future all aviation CNS technology	FACT aims to increase safety, security, efficiency, and robustness of future air traffic environment through development of integrated CNS functional architecture supporting the use of common performance based approach, addressing needs of large spectrum of airspace users across varied operational environments. Web: www.sesarju.eu/projects/FACT
NOSTROMO - Next-generation open-source tools for ATM performance modelling and optimisation	The ATM system is composed of elements that interact with each other generating a number of properties characteristic of complex adaptive systems. NOSTROMO aims to develop new approaches to ATM performance modelling able to reconcile model transparency, computational tractability and ease of use with the necessary sophistication required for a realistic representation of the ATM system. Web: www.sesarju.eu/projects/NOSTROMO
SlotMachine - A privacy-preserving marketplace for slot management	Until now, ATFM slots have only been subject to intra-airline swaps, used by airlines to prioritize expensive flights and thus minimise overall costs. Airlines want to keep the cost structure of their flights confidential, as they fear a competitive disadvantage when disclosed. This desire for confidentiality has hampered slot swapping between different airlines. SlotMachine aims to employ blockchain technology and secure multi-party computation to extend the existing UDPP solution with the possibility to keep private the participating airlines' confidential information, such as the cost structure of flights. Web: www.sesarju.eu/projects/SlotMachine
INVIRCAT - IFR RPAS control in airports and TMA	INVIRCAT aims to create a concept of operations for remotely piloted aircraft systems in the terminal manoeuvring area of airports, assessing it through simulations and draft a set of recommendations for rulemakers and standardisation bodies. Web: www.invircat.eu/
SAFELAND – Safe landing through enhanced ground support	SAFELAND aims to support flight and landing of aircraft operated by a single pilot, in case of partial or total incapacitation of the pilot. SAFELAND is focused on the ground side, specifically on the role ATM could have in managing the transition from a single pilot operated flight to a status with reduced or absent contribution of the onboard pilot to landing. Web: safeland-project.eu/
URClearED - A unified integrated remain well clear concept in airspace D-G class	URClearED aims to support current study activities on the RWC functionalities by defining and analysing operational scenarios, which allow to assess requirements and assumptions made in current standards and applicable documents, and then paving the way to future industrial level activities on such system. Web: www.urcleared.eu

Engage is the knowledge transfer network encouraging collaborative research on future and emerging innovative ideas, expertise on ATM. The network is focused on inspiring new researchers, and helping to facilitate the transfer of results from fundamental and applied research into industrial research. In 2021, it held a third successful summer school, several thematic workshops and continued to support PhDs and catalyst-funded projects, as well as the SESAR Innovation Days. The network has also made progress on the Engage Wiki, featuring an interactive research map that allows users to explore the results of a bottom-up clustering from unsupervised machine learning applied to SESAR 1 and SESAR 2020 projects and papers.
The Wiki also features an ATM concepts roadmap showing how previous SESAR research connects with the flagship activities of the 2020 SRIA, identifying future challenges; and an interactive database of undergraduate and postgraduate programmes offered in Europe.

https://engagektn.com
https://wikiengagektn.com

© Shutterstock
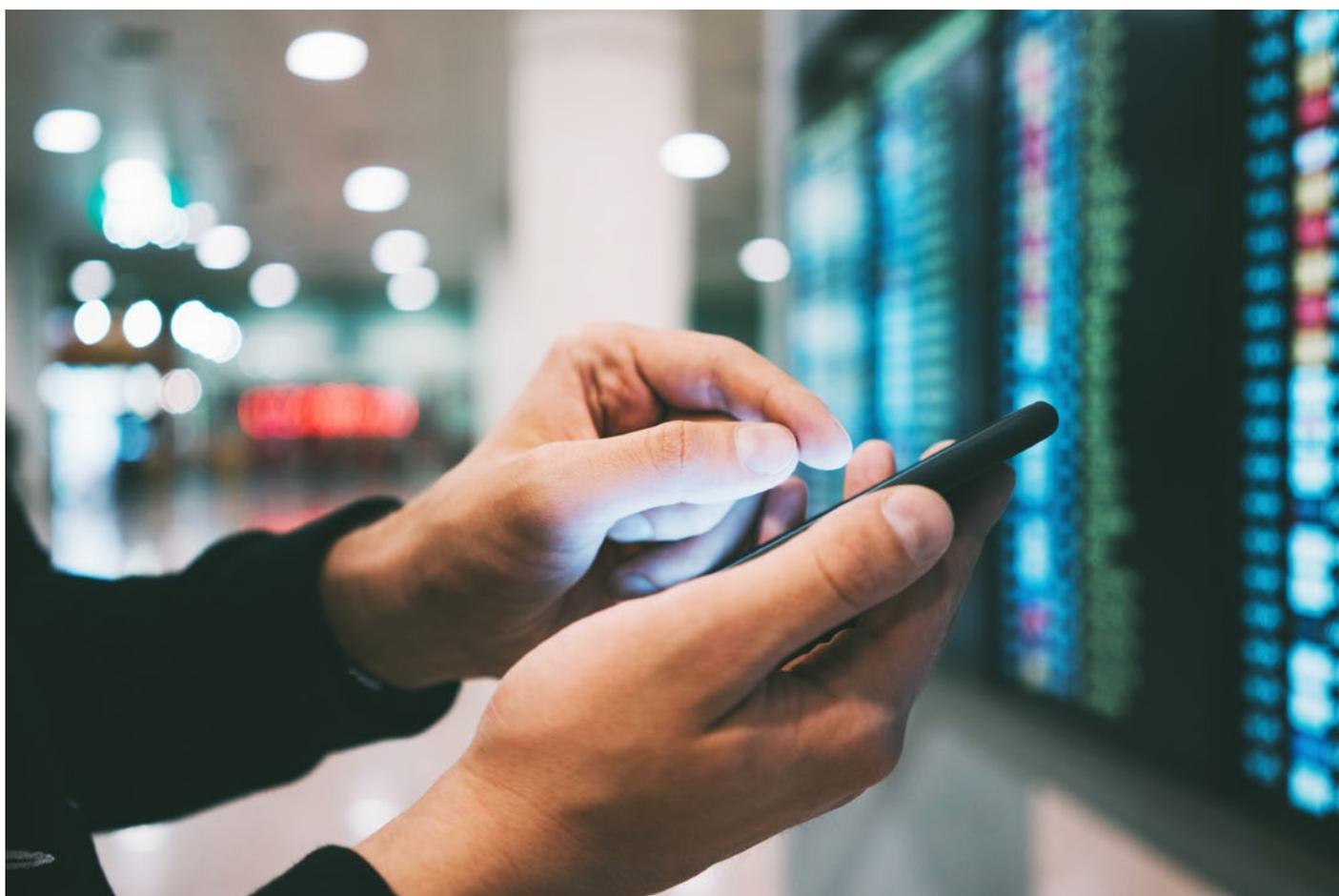
DELIVERING SESAR SOLUTIONS
Industrial research & validation

Airspace delegation solution passes maturity tests with flying colours

Partners in the PROSA project (PJ.10-W2) have confirmed the cost-efficiency gains offered by a solution to delegate ATM services within a virtual centre environment. The validation made use of a pan-European, multi-vendor platform, demonstrating the feasibility of enabling Europe to move towards more interoperable, cost-efficient and flexible air traffic service provision.

The solution (PJ.10-W2-Solution 93 - Delegation of airspace between ATSUs using virtual centre concept) was validated using two operational use cases (night and contingency operations) in two different portions of the airspace managed by control centres in Karlsruhe (Germany) and Zurich (Switzerland).

Led by the German air navigation service provider, DFS, the exercise made use of a distributed pan-European infrastructure prototypes from Indra, Frequentis and DFS. Operational experts from DFS, NATS and PANSA were involved in the validation, while ENAV assessed the impact on the controller working position (CWP), in relation to the air traffic controller performance, as well as safety issues.

The partners analysed the behaviour and views of air traffic controllers involved in the exercise and found that the solution was operationally feasible and acceptable. They also confirmed cost-efficiency gains related to air traffic controller productivity) for the delegation of ATM services provision at night.

The successful validations mean that the solution has now reached a V2 level of maturity (technical level of readiness TRL4) and is ready to undergo the next round of testing with the view to making it available for industrialisation (i.e. V3). With this in mind, the solution will be further tested in 2022 in a series of exercises (*) as part of the PROSA project but also in conjunction with activities planned in the SESAR JU's flagship project on virtual centres (PJ.32). The tests are expected to shed further light on the benefits that this solution can offer, while also paving the way towards a more resilient and scalable ATM system at European level.

The project aims at providing air traffic controllers with more automated tools, thereby allowing them to concentrate on situations where human intervention is crucial. The project aims to not only improve current conflict detection tools, but also develop new tools supporting the air traffic controller with resolution advisory and monitoring of flight trajectory. The project will address new ways of working together, taking into account developments such as drones.

More about the project:
www.sesarju.eu/projects/PROSA2

(*) EXE2 (led by ENAIRE), EXE3 (led by SKYGUIDE), EXE4 (led by ENAV), EXE5 (led by COOPANS), EXE6 (led by PANSA)

© PROSA
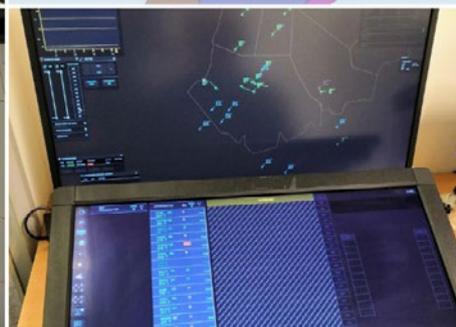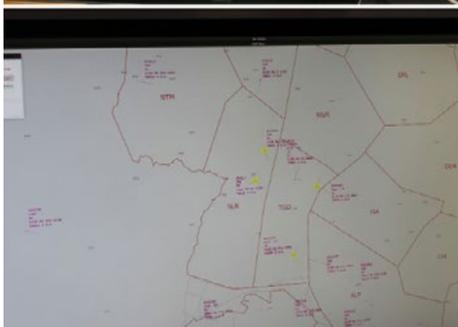
Get set for more flexible and resilient air traffic management

The FALCO project (PJ.33) is investigating solutions for making air traffic management more flexible, efficient and responsive to changing traffic demand and conditions. The project is also trialling on L-band digital aeronautical communication system (LDACS), a technology offering spectrum-efficient data link connectivity and digital voice communications.

The project is working on two solutions, aimed at increasing the efficiency of air traffic management:

Building on previous research (PROSA - PJ.10), the project will investigate ways of deploying more flexibly air traffic controllers to specific portions of airspace, sectors and working positions, when and where needed. This would mean that air traffic controllers could potentially cover larger portions of airspace or take over service provision in case of outages at neighbouring air traffic control sectors. In doing so, ATC service provision would become more resilient and responsive to unexpected events, changes in traffic demand or staff shortages. This would lead to knock-on benefits in terms of cost efficiency and capacity.

Based on the findings on LDACS that were reached in previous SESAR projects (PJ.14 and PJ.14-W2), FALCO will also test LDACS under real conditions with flight trials. LDACS offers a viable and more spectrum efficient alternative to existing analogue radio communications; It is also an important enabler for the roll-out of dynamic airspace configuration, flight-centric ATC and virtual centres – critical solutions for making air traffic management more scalable and sustainable in the long run.

More about the project:
www.sesarju.eu/projects/FALCO

This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017479

Getting ahead of "critical" flights in flow management

JU partners are developing a more proactive approach to identifying and managing "critical" flights in the Network. The aim is to help airlines minimise costs while improving flight predictability.

A delayed flight can be seen as critical for several reasons: It may miss an important connection; an airport curfew may come with heavy cost penalties; expiry of crew hours; high passenger compensation; or few scheduled alternatives. Researchers in the SESAR 2020 programme are working on a solution (PJ.07-W2-38: enhanced integration of AU trajectory definition and network management processes) that will allow airspace users to flag up critical flights with the Network Manager (NM) using a proactive flight delay criticality indicator (P-FDCI). This SESAR research activity is conducted in close collaboration with the Network Manager following an iterative approach and focusing on quick wins.

© SESAR

© Shutterstock

This collaborative decision-making process will help airlines to work more closely with the Network Manager and local flow Managers to find solutions to adhere as closely as possible to the original schedule for critical flights. This solution contributes also to the digitalisation and automation of information exchanges to reduce operators workload.

All of which helps to minimise operational costs and increase transparency.

Two types of the FDCI can be activated at any point in the day in view of the evolution of traffic:

- Proactive FDCI or P-FDCI - (currently under development): issued for critical flights before any demand and capacity balancing (DCB) measure is allocated to the flight by the Network Manager. In these cases, airlines can indicate preferences such as making progress in time or a specific flight level so the Network Manager can adapt measures to these preferences, where possible.

- Reactive FDCI (delivered in 2020 as part of SESAR 2020 wave 1 reaching V3 maturity) and deployed by the Network Manager in releases NM24.0 and NM25.0 : issued when a DCB measure is already affecting the flight allowing the Network Manager make any corrective action to reduce the impact when possible

The solution also makes use enhanced 'What-If'' function, and enriched DCB information such as hotspots and congestion indicators, to allow airlines to assess the network DCB impact on a flight plan or preliminary flight plan.

Led by EUROCONTROL's Network Management Innovation Unit, the SESAR solution is developed in strong collaboration with operational experts from airlines,the Network Manager, air navigation service providers and industry (Airbus, Thales, Navblue, Metron, Dassault) with a view to its implementation.
This solution is one of several in the PJ.07-W2 Optimised Airspace Users Operations (OAUO) project.

Keeping an augmented eye on the traffic

Binoculars are still used in control towers for everyday operations. Now researchers from JU member NLR - Netherlands Aerospace Centre, are investigating augmented reality goggles that will help controllers better manage airport traffic! The tests are part of PJ.05-W2-97.1 'Virtual/Augmented Reality applications for tower' into virtual reality and AR applications in tower environments.

The researchers specifically looked at attention guidance strategies with an augmented reality device, the Microsoft HoloLens 2 (TM), inside an air traffic control tower environment for Schiphol Airport. That environment was simulated and consisted of a realistic but downscaled

presentation of the airport with two tower controller working positions emulating current tower systems.

The research builds on work already performed during by the exploratory research project RETINA.

The downscaled Schiphol Tower set-up allowed researchers to focus their work on the application of augmented reality with the introduction of (virtual) aircraft labels, as well as special symbology and auditory cues for capturing and guiding tower controller attention in the case of critical events. Some typical attention-critical events that might occur at an airport, such as go-around operations and runway incursions, were generated by a team of NLR experts and presented to the tower controllers while they were operating traffic as usual.

The augmented reality blends real world images with computer-generated data in real-time, so that visual information can be enhanced to improve identification and tracking of aircraft (or vehicles) on and around the airport. In low visibility, synthetic vision can show digital georeferenced data that supplement the missing real vision (virtual reality).

Human performance and air traffic control operational experts observed and surveyed the simulations – their report is expected in the coming months. But the first results look promising: air traffic controllers reported that interpreting traffic situations is faster and easier with the dedicated symbology in augmented reality.

More about the project:
https://www.remote-tower.eu/wp/

© NLR

Ongoing projects

AART - Airport airside and runway throughput

(PJ.02 W2)

To improve the efficiency and resilience of arrival and departure operations at capacity constrained airports and access to secondary airports, the project addresses human, technical, procedural and performance aspects in the following areas: Advanced geometric GNSS based procedures in the TMA; separationEvolution of separation minima for increased runway throughput improved access to secondary airports digital evolution of integrated surface management; and safety support tools for avoiding runway excursions.

Web: www.sesarju.eu/projects/aart

TAM - Total airport management

(PJ.04 W2)

European airports need to become more operationally efficient. To this end, the project is developing concepts, tools and procedures to increase the predictability and resilience of airport operations, improving the punctuality of flights in a safe and environmentally sustainable manner. The aim is to improve airport/network integration for large and medium/regional airports, improve airport airside/landside integration, and reduce the impact of meteorological aspects on airport operations. The project is also investigating how environmental aspects can be better monitored and managed in day-to-day airport operations.

Web: www.sesarju.eu/projects/TAM2

DTT - Digital technologies for tower

(PJ.05 W2)

The project aims works on two different topics: multiple remote tower and remote tower centre; and new human machine interaction (HMI) modes for airport tower. The solutions developed by the project are expected to positively contribute to safety and increase situation awareness and controllers' productivity.

Web: www.sesarju.eu/projects/DTT

CI - Content integration, performance management and business case development

(PJ.19 - W2)

This project assesses the performance of the SESAR Solutions compared with the performance ambitions set out in the European ATM Master Plan. This is done in close collaboration and coordination with all SESAR 2020 projects through a continuous, rolling and iterative content integration process.

AMPLE - Master planning

(PJ.20 - W2)

The project brings together the SESAR community, ensuring the broad ATM representativeness required from air navigation service providers, airports, airborne and ground industry and Network Manager, in order to maintain the European ATM Master Plan, the roadmap on ATM modernisation.

EAD - Enhanced arrivals and departures

(PJ.01 - W2)

The project is developing concepts, tools and procedures to optimise terminal manoeuvring areas (TMAs) in a safe, cost-efficient and environmentally sustainable manner. This will be achieved by taking advantage of the latest technological developments from both an airborne and a ground-system perspective and through the secure sharing of data. The needs of all airspace users are being addressed including rotorcraft. The aim is to exploit the environmental benefits achieved from continuous climb operations (CCO), continuous descent operations (CDO) and improved arrival sequencing. A focus is to minimise delays and improve resilience and predictability for high-density/complex TMAs.

Web: www.sesarju.eu/projects/EAD

PROSA - Separation management and controller tools (PJ.10 W2)	The project is validating a series of separation management and controller tools aimed at boosting the performance of the air traffic system across all key areas. The project will focus on three solutions: flight-centric ATC and improved distribution of separation; delegation of airspace amongst air traffic service units (ATSU); HMI interaction modes for ATC centres. Web: www.sesarju.eu/projects/PROSA2
ERICA - Enable RPAS insertion in controlled airspace (PJ.13 W2)	The project is developing and validating the key operational and technological enablers that are necessary to ensure the integration of remotely-piloted aircraft systems (RPAS) into non-segregated airspace. These include a detect and avoid (DAA) system for IFR RPAS operating in airspace A to C for collision avoidance and a framework for allowing routine access and operations by RPAS. Web: www.sesarju.eu/projects/ERICA
4D Skyways - Improving trajectory management for European air transport (PJ.18 W2)	The project builds on research outcomes on trajectory management to enable a move towards trajectory-based operations (TBO). The focus is now on improving the ground trajectory prediction and separation management/ monitoring tools by using aircraft trajectory data, more precise weather data, improved algorithms and machine-learning techniques. The project is exploring new automation techniques that can support trajectory exchanges (big data, machine learning, voice recognition, etc) and define a common trajectory service as an alternative architecture for trajectory exchanges between ground ATM actors compared to the current fragmented approach. Web: www.sesarju.eu/projects/4DSkyways
VC - Virtual centre (PJ.32 W3)	Traditionally, ANSPs host a monolithic ATM system in each air traffic system unit (ATSU) with very few information services and infrastructure elements being shared between the different centres. In the virtual centre approach, the controller working positions are decoupled and may even be geographically separated from the ATM information services that they consume, and these ATM information services may be shared between different ATSUs or even between ANSPs. The project is further investigating the air traffic flow and capacity management (ATFCM) aspects of such airspace delegation among ATSUs. www.sesarju.eu/projects/VC
FALCO - Flexible ATCO endorsement & LDACS complement (PJ.33 W3)	The project is investigating and validating technologies and procedures, enabling a more flexible and efficient re-organisation and endorsement of air traffic controllers (ATCOs), based on traffic complexity, sector classes and the level of skills, experience and training a controller has received on a specific class of working environment and supporting system. The project is also working on replacing analogue voice communication with a capability supported by I-band digital aeronautical communication system (LDACS) in order to improve air-ground connectivity. www.sesarju.eu/projects/FALCO
I-CNSS - Integrated CNSS (PJ.14 W2)	The project is developing the future technologies coming from the communication, navigation and surveillance (CNS) domains in order to support and manage operational services, like the 4D trajectory management, in the future ATM system. Performance requirements for CNS systems are becoming increasingly complex and demanding and must be considered as part of an integrated and holistic system of systems and a unified concept of operations, where possible. Web: www.sesarju.eu/projects/ICNSS

OAUO - Optimised airspace users operations

(PJ.07 W2)

The project aims at defining and validating improved airspace user processes and tools in order to optimise ATM Network operations. The project is developing a collaborative framework managing delay constraints on arrivals; and mission trajectory management with integrated dynamic mobile Areas (DMA) Type 1 and Type 2. It is also looking at developing requirements and validating procedures and workflows for flight/wing operations centre to enable collaborative decision making between stakeholders throughout the flight trajectory. Other areas of focus include integrating airspace user (AU) priorities and preferences in airport and Network processes; making use of automation in collaborative decision making and coordination; better interoperability between AU and the NM operations.

Web: www.sesarju.eu/projects/OAUO2

DNMS - Digital network management services

(PJ.09 W2)

The project focuses on improving the network traffic prediction for all stakeholders involved in demand capacity balancing, dynamic airspace configurations, integrated network management and ATC planning and collaborative network performance management. This project is structured around three solutions: dynamic airspace configurations (DAC); enhanced network traffic prediction and shared complexity representation; and a prediction algorithm to anticipate the performance degradation in identified areas within the network.

Web: www.sesarju.eu/projects/DNMS

AURA - ATM U-space interface
(PJ.34 W3)

The project aims to identify the requirements for U-space information exchange with ATM through system-wide information management and will validate a set of selected U-space services, developing the service definition for the SWIM candidate services. It will also provide inputs for the current regulatory and standardisation initiatives regarding U-space with a high involvement of external stakeholders.

Web: www.sesarju.eu/projects/aura
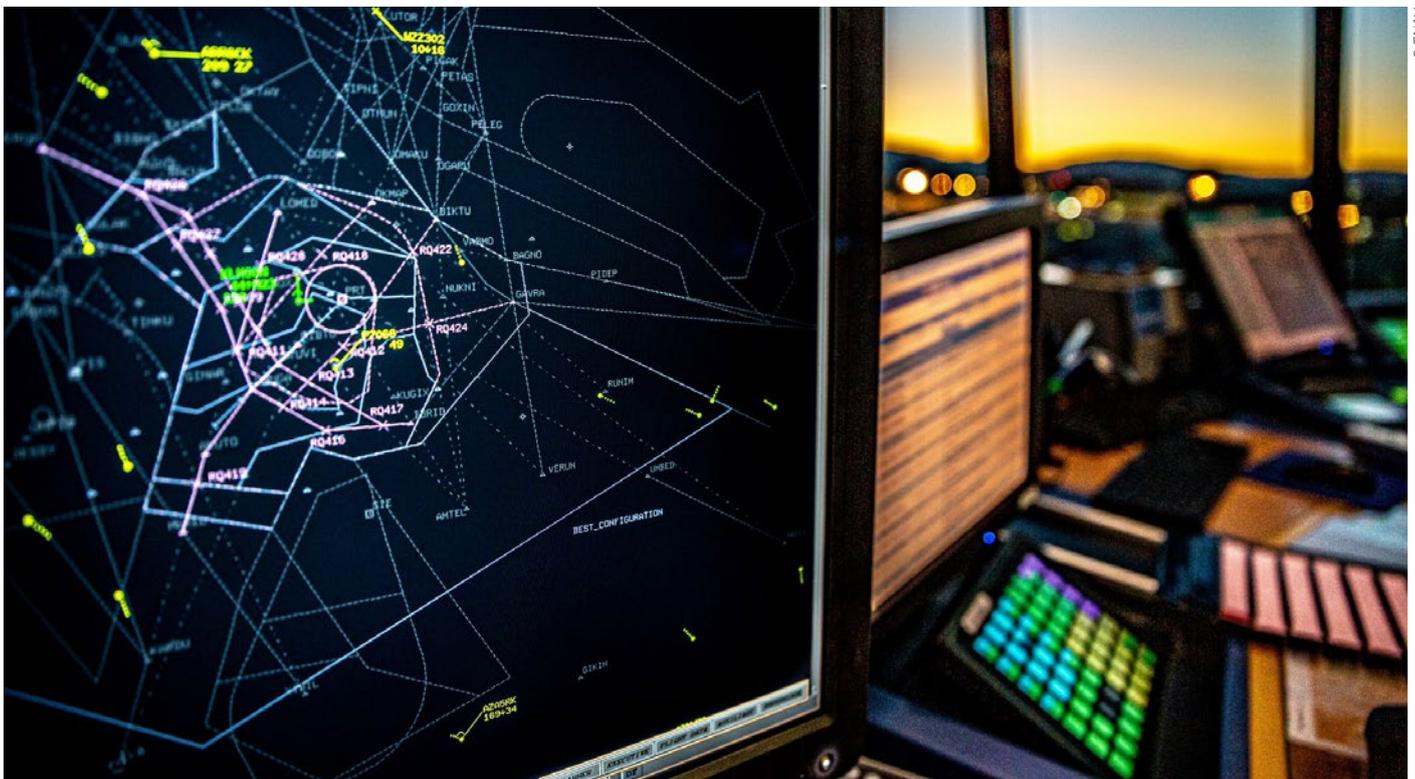
© ENAV

DEMONSTRATING SESAR

Very large-scale demonstrations

Demonstrating sat-based air traffic control

In 2021, JU members and partners finalised plans to demonstrate the use of low-orbit satellites for the provision of satellite-based VHF voice and data communications to manage aircraft in oceanic regions of the world. The VOICE project aims to show how satellite-based VHF communications, together with satellite-based surveillance can help optimise air traffic in oceanic regions while reducing the carbon footprint and maintaining safety levels.

The VOICE project is progressing on schedule with the finalisation of its demonstration plan (DEMOP), which describes how the project demonstration and its exercises will be organised during the demonstration execution period. The main goal of the exercises, which are due to take place between June and December 2022, is to demonstrate the advantages of having satellite-based VHF voice and data communications between pilots and controllers in oceanic airspace. The presence of these services could lead to an increase in safety, as well as in capacity in these oceanic regions. Besides, it will be demonstrated the possibility of contingency measures in case of loss of communications between an airspace and the ATCO in charge thanks to the use of these systems.

The following use cases will be studied within the demonstration activities:

- Use case 1: Use of satellite-based VHF voice/data communication and satellite ADS-B in oceanic airspace, without VHF terrestrial coverage.

Controllers from Canarias Area Control Centre will monitor the aircraft using positions (ADS-B) and will interchange non-operational critical flight data (CPDLC and ADS-C) and voice communications with aircraft flying in Canarias oceanic airspace. The exercise will be repeated in Cape Verde (flights overflying SAL oceanic airspace managed by controllers in Cape Verde ACC).

- Use case 2: Use of satellite-based VHF voice/data communication and satellite-based ADS-B as a means of contingency/delegation.

Controllers from SAL ACC will visualize aircraft positions, interchange flight data and perform voice communications with aircraft flying over CANARIAS FIR airspace, and vice versa. This will imply that a flight will receive communications from an Area Control Centre different from the ACC that is overflying.

This will serve as a proof that this system could be used as a means of contingency or ATC delegation, for covering problems on ground-based CNS services, or for complementing its use.

- Use case 3: Use of satellite-based VHF voice/data and satellite-based ADS-B in terrestrial airspace.

Controllers in Canarias ACC will send/receive flight data information to/from the flights overflying Canarias airspace within radar coverage. Its main objective is to demonstrate the utility of satellite-based VHF as an alternative means to voice/data exchange working as a redundant/contingency system for terrestrial airspace.

The project partners are hopeful that the demonstrations will not only show the feasibility of using low-orbit satellites in these three scenarios but that their findings may be used by standardisation bodies working on satellite-based VHF. Work with entities is a key aspect for VOICE project as they will use the project results and work on satellite-based VHF concept to provide their conclusions as inputs for the World Radiocommunication Conference by end November 2023 (WRC23), where the frequency allocation, technical regulations and operational procedures will be discussed.

© Shutterstock

More about the project:
www.sesarju.eu/projects/voice

Flight trials on energy-efficient flying kick off

In September, as part of the ALBATROSS demonstration, Air France, Airbus and DSNA conducted the inaugural flight trial between Paris and Toulouse, showcasing how SESAR Solutions can make flying more energy efficient. The trial coincided with the Airbus Summit, which discussed the various pathways towards sustainable aviation.

Launched in February 2021, ALBATROSS is conducting as series of gate-to-gate live demonstration flights across Europe with a view to demonstrating the feasibility of implementing more energy-efficient flights, by combining several technical and operational innovations, known as SESAR Solutions.

ALBATROSS follows a holistic approach by covering all flight phases, directly involving all relevant stakeholder groups (such as airlines, ANSPs, network managers, airports and industry) and addressing both operational and technological aspects of aviation and air traffic management (ATM). Many solutions will be put into practice during the flight demonstrations, from new precision approach procedures to continuous climb and descent, a more dynamic management of necessary airspace constraints, sustainable taxiing and sustainable aviation fuel (SAF) usage.

Thanks to the transmission of four-dimensional trajectory data, ATM will be able to optimise and better predict an aircraft's trajectory, thereby enabling it to reduce immediately a flight's environmental footprint.

Starting from September 2021, these live trials will involve around 1,000 demonstration flights, showcasing mature operational solutions with potential fuel and CO_2 emission savings. The first results are expected to be available in 2022.

"We want to make the ALBATROSS' energy-efficient way of flying the norm in the future, ensuring the maximum gains in fuel and emission reduction, without impacting the passenger experience," said Philippe Lenne, SESAR 3 JU, who was speaking at the Airbus Summit to an audience of international press and other guests.

"By joining forces in ALBATROSS, we can demonstrate on a large-scale that greener flights are achievable, and every actor's contribution counts in this drive to make aviation more sustainable. By conducting the large scale demonstration within the framework of the JU, are also ensuring that resources are pooled to the maximum effect and to deliver the best possible results," he added.

The ALBATROSS partners are Airbus, Air France, Austro Control, DLR, DSNA, Eurocontrol, LFV, Lufthansa, Novair, Schiphol, Smart Airport Systems, SWEDAVIA, SWISS, Thales AVS France and WIZZ AIR UK.

More about the project:
www.sesarju.eu/projects/ALBATROSS

© Shutterstock

New "angle" to reducing noise of arrival aircraft and supporting more efficient runway use

In 2021, a series of large-scale live trials began to test satellite-enabled solutions aimed at reducing the noise of aircraft landing at airports, as well as reduced taxi time to reach the parking positions for some runway configurations. The solutions underwent extensive flight simulation testing before the flight demos, which took place at Twente Airport in The Netherlands and Rome Ciampino in Italy.

Thanks to their level of precision, enhanced satellite-based navigation systems, such as satellite-based augmentation system (SBAS) and ground-based augmentation system (GBAS), are opening up possibilities when it comes to designing more eco-friendly and optimised arrival procedures at airports.

Over the spring 2021, EUROCONTROL, supported by Lufthansa Aviation Training,

ran within PJ02-W2 AART three flight simulations campaigns in Frankfurt on an Airbus A319 simulator with airline pilots, to test three solutions in different visibility and weather conditions, making use of these satellite-based technological capabilities, supported by constellations such as Galileo:

- PJ.02-W2-14.2 enables aircraft to land on a second aiming point located further down the runway and identifies by ground markers, lights and visual aids. The glide slope for the SRAP procedure operates in parallel to the nominal one operated for the first aiming point.

- PJ.02-W2-14.3 features feature a glide slope between the published one (commonly 3°) and 4.49° (limit above which the steep approach concept applies), and provide a significant reduction in ground noise level to an order of magnitude of 3 dBA in approaches between 15 NM and 4 NM from the runway threshold.

- A combination of the abovementioned solutions (which is a new solution in itself: PJ.02-W2-14.5): enables inbound

aircraft to reduce noise footprint and possibly reduce runway occupancy time and/or taxi-in time depending on local runway/taxiway layout. Unlike the increased glide slope concept (which applies to the runway physical threshold), increasing the glide slope on an additional (second) runway aiming point should prevent a potential reduction of airport capacity and may increase capacity through optimised wake turbulence separations.

Developed within the framework of the Airport airside and runway throughput project (PJ02-W2 AART) the solutions were assessed using different configurations of runway markings and lighting. The outputs of the flight simulations included pilots' questionnaires, simulator data recordings and video recordings. These will be analysed and integrated into PJ02-W2 validation report for each solution available by mid-2022.

Now the findings are supporting the very large-scale DREAMS demonstration (VLD1-W2).

A first series of live flight trials took place at Twente, a non-commercial airfield, during the first week of October with the goal of evaluating in real visual conditions the runway dual markings and dual PAPI as necessary for SRAP and IGS-to-SRAP approaches, in line with the PJ.02 solution requirements. The demonstrations brought together EUROCONTROL, NLR - Netherlands Aerospace Centre, INDRA, AIRBUS and ENAV, as well as airspace users LUFTHANSA (AIRBUS A319) and TUI Fly Nederland (Boeing 737Max 8), all equipped with GBAS technology. The trials focussed on noise assessment, safety, human performance and operational feasibility, including the evaluation of the dual runway markings and precision approach path indicators (PAPI) as supporting visual aids.

The existing runway markings on Twente's Runway 05 were expanded with a second (ICAO compliant) set of markings, consisting of a second threshold, touchdown and aiming point markings, located 1,020 metres further, together with a second PAPI on the opposite side of the runway. The approach trials were based on GBAS GAST-D temporary ground station, supporting different GLS published approaches with 3.0, 3.2, 3.5, 4.0 and 4.49 degrees glideslope.

The NLR test aircraft (a Cessna Citation II) was equipped with two GAST-D receivers and made across two weeks a large number of approaches (with 15–20 approaches per day) for data acquisition and pilot evaluation purposes. A different guest pilot each day was asked to fly the approaches.

The Lufthansa and TUI fly aircraft evaluated visual aspects, flyability and gathered performance data on the 3.0 and 3.5° approaches to both thresholds.

The preparation of the demonstration also provided valuable insight into regulatory aspects, such as the GBAS frequency allocation process, approval aspects of the systems and planned flight operations, as well as the necessary infrastructure preparations. The findings will feed into both the regulatory work package and the next trials.

More flight trials on ISGS took place at Rome Ciampino airport under the lead of ENAV and Dassault Aviation, allowing the new approach procedure to be tested in a different airport environment and with different types of aircraft (business jets) in 2021.

Overall, VLD1 DREAMS aims to increase operational efficiency, shorten flying times and lower emissions by bringing EAP supported by advanced GNSS navigation technologies closer to industrialisation.

More about the projects:

www.sesarju.eu/projects/AART
www.sesarju.eu/projects/DREAMSVLD

Call launched for series of pilot Digital Sky Demonstrators

The European Climate, Infrastructure and Environment Executive Agency (CINEA) has launched a new call under the Connecting Europe Facility, containing provisions for a series of pilot SESAR JU Digital European Sky Demonstrators in the areas of green aviation and urban air mobility. The demonstrators are a key tool to support the SESAR JU's vision of delivering the Digital European Sky, matching the ambitions of the 'European Green Deal' and the 'Europe fit for the digital age' initiatives. A total budget of EUR 60 million is earmarked for the demonstrators, which are expected to be launched in 2022 and to run until 2025.

The two SESAR-related topics covered by the call, "U-space and urban air mobility" and "Aviation Green Deal", have been selected from among nine flagships outlined in the draft Digital European Sky Research and Innovation Agenda (SRIA). Published in November 2021, the SRIA will serve as the basis for the work programme of the SESAR 3 Joint Undertaking, which is due to be established before the end of 2021.

The Digital Sky Demonstrators will take place in live operational environments and will put to the test (on a very large scale) the technological solutions necessary to deliver the Digital European Sky. The demonstrators are part of an innovation pipeline designed by the SESAR Joint Undertaking to bridge the gap between applied/industrial research and industrialisation, and to accelerate market uptake. Critical to their success will be the involvement of early movers, as well as a strong close connection with relevant standardisation and regulatory activities and bodies.

€60 million available for #SESARJU Digital Sky Demonstrators via Connecting Europe Facility

#ConnectingEurope #DigitalSky

CEF SESAR call topics

- U-space and urban air mobility: to unlock the potential of the drone economy and enable urban air mobility (UAM) on a wide scale, a new air traffic management framework for low-altitude operations needs to be put in place. Known as U-space, the framework foresees a set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones. As such, U-space is an enabling framework designed to facilitate any kind of routine mission, in all classes of airspace and all types of environment - even the most congested - while addressing an appropriate interface with manned aviation and air traffic control. The maximum EU requested contribution per proposal is limited at EUR 7 million.

- Aviation Green Deal: The objective of net-zero greenhouse gas emissions by 2050 set by the European Green Deal, in line with the EU's commitment to global climate action under the Paris Agreement, requires accelerating the shift to smarter and more sustainable mobility. This implies the need for aviation to intensify its efforts to reduce emissions. To this end, a set of operational measures to improve the fuel efficiency of flights will have to be put in place with the aim of enabling aircraft to fly their optimum fuel-efficient 4D trajectory. At the same time, to ensure sustainable air traffic growth, it will be necessary to speed up the modernisation of the infrastructure in order to offer more capability and capacity, making it more resilient to future traffic demand and adaptable through more flexible air traffic management procedures. Furthermore, reducing the impact of aircraft noise and improving air quality will remain a priority around airports. The maximum EU requested contribution per proposal is limited at EUR 15 million.

Aeroporti di Roma S.p.A wins SESAR JU-ACI Europe digital transformation award

Rome Fiumicino Leonardo da Vinci Airport won 2021 SESAR JU-ACI Europe Digital Transformation Award. The airport was recognised for its investment in innovation and digitalisation, in particular, the opening of an airport operations centre, and more generally on deploying the total airport management (TAM) concept since 2016. With the opening of the APOC, Rome Fiumicino airport will soon be able to offer airport stakeholders the tools to monitor and manage passenger, baggage and aircraft processes and more generally steer the performance of the overall airport.

© ACI Europe

Ongoing projects

STAIRS - Surface Traffic Alerts Improve Runway Safety

(VLD2-W2

While safety has improved thanks to airport surface management systems, these systems do not fully resolve the risk of runway incursions and are not envisaged to be deployed at smaller airports. And although traffic collision avoidance systems (TCAS) haves been in use since 1981, there is currently no aircraft system to prevent runway collisions. SESAR JU members and partners have developed a solution making use of ADS-B technology to provide on-board surface alerts (PJ.03b-05 'Traffic alerts for pilots for airport operations'). This demonstration aims to assess the performance of this solution in real operational environments, in particular the absence of nuisance alerts, paving the way towards the deployment of the solution's or future ADS-B applications and standards.

Web: www.sesarju.eu/projects/STAIRS

ITARO - Integrated TMA, airport & runway operations

(PJ.37 W3)

The project plans to demonstrate on a larger scale several solutions in the airport environment, which research has shown can bring efficiencies, both operationally and environmentally. These include procedures to enable more efficient and integrated runway throughput and terminal operations; a collaborative framework for managing delay constraints on arrivals; and improved arrival and departure operations.

Web: www.sesarju.eu/projects/itaro

SORT - Safely Optimised Runway Throughput

(VLD3-W2

The project is testing solutions delivered such as optimised separation delivery on final approach (PJ.02-01-01); wake turbulence separations (for arrivals) based on static aircraft characteristics (PJ.02-01-04); reduction of wake turbulence risk considering acceleration of wake vortex decay in ground proximity (PJ.02-01-07); minimum pair separations based on required surveillance performance (PJ.02-03); trajectory based integrated runway sequence (PJ.02-08-01); and increased runway throughput based on local ROT characterisation (ROCAT) (PJ.02-08-03).

Demonstrations are taking place at London Heathrow, Vienna and Stockholm Arlanda.

Web: www.sesarju.eu/projects/sort

DREAMS- Demonstration of runway enhancements made with satellite navigation

(VLD01 W2)

This project aims to mitigate the climate impact of aviation through the development of meaningful and sustainable activities including efficient airport operations using GNSS technology and improved aircraft noise assessments.

Web: www.sesarju.eu/projects/DREAMSVLD

ADSCENSIO ADS-C enables and supports improved ATM operations

(PJ.38 W3)

Building on the results of DIGITS, this project aims to demonstrate the efficiency and robustness of a technological infrastructure to support datalink communications between the aircraft and various ground consumers for real-time transmission of four-dimensional trajectory data. The aim is to support the industrial implementation of the use of automatic dependent surveillance-contract extended projected profile (ADS-C–EPP) data downlinked from aircraft – the target is for 45% of all flights in Europe to have the capacity to share trajectory.

Web: www.sesarju.eu/projects/ADSCENSIO

ALBATROSS -The most energy efficient flying bird (VLD02)

ALBATROSS aims to support the transition towards greener and more sustainable aviation. Taking holistic approach, the project addresses all flight phases and demonstrate the complementary between airborne and ground solutions, such as alternative aircraft fuel, technologies for better air-ground connectivity, artificial intelligence and big data, and highly collaborative ATM procedures.

Web: www.sesarju.eu/projects/ALBATROSS

VOICE - Reduced separations and improved efficiency based on Vhf cOmmunICations over LEO satEllites (VLD02)

The project is demonstrating the benefits of using satellite-based VHF systems for voice and datalink air traffic services in remote and oceanic airspace where currently there is no coverage, especially in reducing separation without compromising on safety. Project partners are performing demonstration activities in oceanic areas to demonstrate the viability of space-based infrastructure as the backbone for current terrestrial airspace. They will also perform cross-border operations to illustrate the feasibility of using these technologies across national borders.

Web: www.sesarju.eu/projects/voice

© Shutterstock

ENABLING THE SAFE AND SECURE INTEGRATION OF DRONES

U-space

INTERVIEW

SESAR JU as an innovation incubator: learning from small and medium-sized enterprises

Creating a SESAR research consortium complete with grant agreements, proposals and submissions consumes precious hours for a small company, however if successful, delivers substantial benefit. Belgian startup Unifly led the consortium selected for the Safe and Flexible Integration of U-space services in a Real environment (SAFIR) U-space programme in 2018.

After two years testing Unmanned Aerial System (UAS) in realistic environments, Unifly's Unmanned Traffic Management (UTM) digital platform was selected by the Port of Antwerp to manage drone traffic in the port area at the start of 2021. "We are providing our full stack of services to a brand new customer segment," says Unifly Marketing Chief Ellen Malfliet. "Our visibility has grown: The more players we work with the bigger our network becomes." The collaborative nature of the SESAR JU programme also contributes to "cross-pollination" of knowledge and ideas. "Each participant looks at the big picture from a slightly different angle and this achieves more than the sum of its parts."

Small and medium-sized enterprises (SME) represent about 15% of companies participating in research co-funded by the JU. Ground-breaking programmes such as U-space however are setting new patterns with up to 50% SME participation. The disruptive technology behind this research is sending ripples through the programme, and across the airspace management sector generally.

The U-space portfolio of research within the JU programme aims to support safe, efficient and secure access to airspace for all vehicles within a digital ecosystem. "By definition, no SME can deliver complete ecosystemic solutions to complex challenges. It takes collaboration or cooperation to achieve this," says Tine Tomažič, CTO of light aircraft (manned and unmanned) producer Pipistrel. "Programmes like SESAR allow SMEs to form interesting B2B partnerships and be noticed by companies higher-up the food chain. SMEs gain experience – such as demonstrating drone operations in a UTM environment at a major international airport – they would never normally access."

SME TopView, for example, reports accelerated growth and access to industry insight as a result of its participation in U-space projects such as the Drone European AIM Study DREAMS. "DREAMS has been crucial for TopView's strategy and growth," says Business Development Manager Vincenzo Ascione. "It has allowed us to become part of the U-space network. We have built strong and lasting partnerships across the EU resulting in business opportunities and research projects like the Integrated Common Altitude Reference System for U-space ICARUS."

Yet, despite many improvements to Horizon 2020 mechanisms, participation remains challenging, report SMEs. While the research supports developments that would be untenable for a small entity on its own, the time gap between selection, doing the work and receiving funds can be difficult for a small company. In addition, SMEs can spend months putting proposals together with no guarantee of success. "U-space is a very small world where everybody knows each other," says Ellen Malfliet. "If SESAR had an incubator of its own - a list of new players – they could push one or two of these tiny shrimps onto existing consortia to help them take their first big steps." This concept could be expanded to include training and mentoring to help small companies to meet the selection criteria suggests TopView's Vincenzo Ascione.

All the U-space SMEs found paperwork an administrative burden. "The programmes themselves function a bit in contradiction with how SMEs achieve their best innovation, which happens when there are fewest constraints," says Tine Tomažič. "If you're able to forecast almost every step of the journey, are you really innovating or are you simply engineering your future?"

How Horizon Europe addresses this going forward is important because innovation lies at the heart of its research. U-space in particular "needs innovative leaps that come from novel concepts," explains Marko Peljhan, Co-Founder of UAS producer C-Astral. "SMEs tend to be more holistic in their approach to problem solving since they learn to cover a very wide swathe of competences for their survival and growth. SMEs are sometimes way ahead of the curve."

Tine Tomažič agrees: "SMEs bring the mindset and agility towards getting things done. Failure is not an option for big companies, for smaller players to partially fail early may mean they reach their overall goals faster. We dare to be bold in our approaches, and we dare to challenge the established."

In a digital environment increasingly dominated by tech giants, safeguarding the diversity and flexibility brought by SMEs is important in ensuring programmes such as U-space continue to develop building blocks to support future airspace management. U-space enables this to happen by providing the overarching architecture which allows SMEs to deliver their unique value

SESAR researches technologies to protect airports from drone incursions

Drone intrusions at airports regularly hit the headlines and airports are taking measures in the short term to mitigate these, from grounding aircraft when drones are detected to reducing speed of aircraft on approach in order to limit damage in the event of a collision. Drones can therefore have significant impact on airport operations.

Research and development is underway on a broad range of systems that are able to impede such so-called rogue-drone flights over non-authorised areas by detecting and neutralising drones. While innovative, these solutions are not necessarily interoperable or customised with airport environments in mind.

Partners in ASPRID (Airport System PRotection from Intruding Drones), aim to develop a service-oriented operational concept and system architecture to protect airport operations from unwanted drones. To do so, the project is analysing aircraft and airport (runway and ground) operations to pinpoint possible vulnerabilities. With this, the project aims to identify possible technologies, procedures and regulations that could help better safeguard against drone incursions and/or can help them recover from any disruptions as quickly and as efficiently as possible. In doing so, the project proposes a more integrated and coordinated approach to handling drone incursions.

The benefit of having an integrate approach to addressing drone incursions are manifold:

- Increased airport operational and cost efficiency, by managing the operational flow and minimising the cost of disruptions in case of drone intrusions.

© Shutterstock

- Enhanced safety and security, by increasing awareness about threats and preventing/mitigating their effects.

- Enabling environmental and economy, fostering the safe and secure use of drones for airport services and arising new market opportunities related to drones and airport protection systems from drones.

- Regulation: Supporting drone & U-space with the definition of characteristics for zones where drones are (not) allowed to fly under any circumstances or restrictions due to the risk for the airport in terms of safety and security.

ASPRID is carried out by seven European entities from Spain, Italy and France. These entities are experts in the different sectors involved in the project: airports, research, innovation technologies, drone operations, IT, safety and security.

More about the project:
www.sesarju.eu/projects/asprid

Q&A

SAFIR-Med: Providing a solution to medical deliveries at scale

Drones have sparked a step-change in medical deliveries, accelerated by COVID and a burgeoning commercial drone industry. Trials in the Europe show that drones can fulfil medical deliveries in a fraction of the time of a road courier, reducing transport costs and lowering environmental impact.

Safe And Flexible IntegRation of advanced U-space services for MEDical air mobility (SAFIR-Med) kicked off in December 2020 with the aim of demonstrating safe, sustainable, socially accepted drone operations. It features five unmanned platforms in real-life exercises providing medical services and testing passenger flights in a real urban environment. This two-year project is bringing together cities, healthcare services, drone operators and airspace service providers aimed at identifying technology and procedures required for drones to operate safely and effectively in an urban environment.

Who will benefit?

Every minute saved in delivering an automated external defibrillator (AED) to a heart patient improves their life chances by 10%[1]. Currently only 1 in 12 out-of-hospital heart attacks survive[2] with an average 11 minutes response time for first responders[3].SAFIR-Med aims to demonstrate how time can be saved by delivering defibrillators direct to patients using the latest drone technology in monitored airspace.

SAFIR-Med also links hospitals and medical laboratories, carrying samples, vaccines and medicines in an urban setting. Delivery drones operating between these sites will automatically land, unload and recharge at dedicated stations, speeding up transfers and paving the way for frequent deliveries at scale. The new infrastructure fulfils an important role in support of Europe's transition to more centralised healthcare services.

Where are the demonstrations taking place?

Separate exercises are planned between hospitals and laboratories in Antwerp (Belgium), Aachen (Germany), Heerlen and Maastricht (The Netherlands) flying beyond visual line of sight (BVLOS). A special route between Antwerp and the nearby town of Mechelen will also test inter-city deliveries, using electric vertical take-off and landing (eVTOL) vehicles equipped with aerial sensors to support autonomous navigation.

How frequently will medical deliveries take place?

SAFIR-Med benefits networked healthcare services where several hospitals and laboratories work together to share resources and expertise. A pathology lab, for example, can maximise productivity by serving a network of hospitals. As many as four facilities may be part of the same network, each sending or receiving 10 deliveries a day. By transporting these 40 deliveries by drone, SAFIR-Med is demonstrating how this extra traffic can be kept off the roads, support more efficient operations, and meet increased demand. Countries including Austria, Belgium, Japan, the US and Switzerland are among countries exploring centralised healthcare services.

What will SAFIR-Med deliver?

SAFIR-MED BVLOS drone operations in real urban environments will demonstrate and improve operational procedures and mechanisms for effective interface with air traffic control. In addition to strategic and tactical deconfliction,

© Shutterstock

tracking and monitoring, geofencing and e-identification introduced during first wave SAFIR trials, SAFIR-MED adds dynamic geofencing, detect-and-avoid services and air traffic prioritisation rules, and will accelerate the adoption of drones into the healthcare system in a safe and socially-acceptable way.

How safe are drones?

Drones operate in very low-level airspace, below 150 metres, away from most manned aviation. The European Union Aviation Safety Agency (EASA) has published rules, which govern the performance requirements of drones in order to safeguard people and other airspace users. EASA is also developing unmanned traffic management (UTM) rules to define the U-space services drone operators use to safely plan and execute their flights and the European Commission has adopted regulations to enable drones and manned aircraft to operate in low-level airspace, which are due to come

into force in January 2023. The new rules establish a risk-based and operations-centric approach that enables the safe scaling up of routine drone operations, including BVLOS.

Do drones present societal challenges?

EASA and McKinsey published a joint study on urban air mobility (UAM) in May 2021 that found a positive attitude amongst EU citizens towards UAM, especially when used for medical or emergency transport. Safety was the top priority, with citizens supporting safety levels equivalent to current aviation requirements. Noise was the second main concern expressed. SAFIR-Med anticipates eVTOL vehicles operating between 90-120 metres, a height that generates very little noise at ground level. Progress towards safe integration of unmanned and manned vehicles would enable operations up to 150 metres and minimal noise disturbance.

More about the project:
www.sesarju.eu/projects/safir-med

(¹) *European Heart Journal*, Volume 39, Issue 2, 07 january 2018, European Sudden Cardiac Arrest network: towards Prevention, Education and New Effictive Treatments (ESCAPE-NET): A major European Horizon 2020 project focused on cardiac arrest

(²) *Resuscitation*, 1 Mar 2020, Survival after out-of-hospital cardiac arrest in Europe – Results of the EuReCa TWO study

(³) *Acta cirugica brasileira*, December 2018, Response time in the emergency services. Systematic Review.

Drone test flights for GOF 2.0 get underway

After months of intense preparation work, the first wave of trials of SESAR JU project Gulf of Finland 2.0 (GOF 2.0) got underway in September in 2021 in Estonia, with more trials planned in Finland, Poland, and Austria. The flight trials aim is to demonstrate the safe, secure, and sustainable integration of unmanned aerial vehicle and air taxi operations in urban airspace.

© GOF

During the trials, GOF 2.0 made use of the expertise of 15 scientific and commercial partners from the drone and aviation industry to demonstrate the operational validity of serving unmanned aerial systems and manned operations safely, securely, and sustainably in a unified, dense urban airspace using existing air traffic management and U-space services and systems.

For urban air mobility to become a transportation system it must be integrated with other transportation infrastructure, such as airports, harbours, train/bus terminals, as well as logistics centres. The ability of logistics drones to form a seamless transportation chain in and out of airports is therefore of utmost importance. The first wave of trials focused on testing and demonstrating automated parcel delivery drones operating at low level, unexpected Helicopter Emergency Medical Services (HEMS) flights, drone surveillance flights in urban area, entry and exit of various scale drones in defined airspaces, cross-border operations in U-space corridors with mixed electrical vertical take-off and landing (eVTOL), and drone traffic without degrading safety and following air traffic rules.

"The GOF2.0 project will demonstrate the operational validity of combining ATM/U-space services and systems and creating

a shared interoperable infrastructure for both manned and unmanned aviation, especially in dense urban environments. The provision of timely, relevant and accurate digital information to all airspace users on a system-wide basis will enable safe and secure management of unified airspace without segregation", explains Maria Tamm, Project Manager at EANS. "The outcomes from the GOF2.0 demonstrations will provide a unique opportunity for all stakeholders to gain a better understanding of the current possibilities and challenges when implementing U-space, advancing urban air mobility and moving towards smart and sustainable aviation."

The key lessons will be an important enabler for the further development of the drone market and will deliver the technical components (services, software, competencies, practices) required to cost-efficiently operate autonomous and semi-autonomous drones beyond visual line of sight in shared airspace.

More about the project:
www.sesarju.eu/projects/gof2

Segregating manned and unmanned aircraft – CORUS-XUAM's initial findings

The drone environment that will be implemented under the new U-space regulation is to a large extent segregated due to the inability of drones to fly in accordance with flight rules, and it is flight rules that underpin all of aviation," explained Robin Garrity, JU ATM Expert. **"Work is urgently needed to make flight rules ready for unmanned flight and that involves ICAO."**

Drone operators are limited by artificial boundaries, such as the 500 ft lower airspace ceiling, which does not reflect reality according to Airspace Integration (ATM/UTM) and Infrastructure lead at Volocopter, Jörn Jaeger. "The challenge is to align operations in both worlds, but it has to be manageable. There is no wish to increase air traffic control workload."

These challenges were among many discussed at the webinar hosted by CORUS-XUAM project lead, EUROCONTROL, and attended by more than 225 participants in September 2021. The two-year SESAR very-large demonstration programme plans to deliver an initial concept of operations (ConOps) for urban air mobility (UAM) by the end of 2022, providing an update of the U-space ConOps developed under the first CORUS research programme. Project coordinator Andrew Hately said the aim is to show it is safe to operate in Europe: "We need a convincing argument to take to ICAO in order to look at flight rules".

Among early applications, the Port of Antwerp (POA) launched its Droneportal in March 2021 to coordinate safety in the airspace above the port. "The unmanned traffic management (UTM) platform handles over 60 approved flights a month," said POA Security Expert Didier Venneman. "It serves as a geozone manager, an innovation platform and a regulator." Among different applications, the POA carries out aerial inspections (using AI to track oil spills), berth monitoring, 3D mapping and security functions. The activities involve coordination with emergency response agencies, local aerodromes, and other network partners. "Last week we began working with manned aviation. We believe sharing data and a common view of the airspace is the way forward." POA is also implementing drone identity tracking.

© Volocopter

In separate demonstrations, Volocopter is testing passenger craft in various environments. "We are pragmatic and operate using visual flight rules (VFR) like helicopters," explained Jörn Jaeger. The level of automation will steadily grow while the pilot increasingly adopts a monitoring role. "The industry needs to decide if Flight Rules have to be re-considered." This becomes more relevant as unmanned vehicles start to operate from different sites and locations. "As the level of automation develops, there will be a need for new procedures and airspace design changes." The operations need to be attractive for service providers to support viable business models.

Facing many of these issues, newly-formed UAS service provider SkeyDrone – a subsidiary of Belgian air navigation service provider skeyes – is examining the rules and regulations surrounding U-space. "Common situational awareness and data sharing is the first step," said Managing Director Hendrik-Jan Van Der Gucht. Standardised interfaces and certified service providers are central to this information exchange along with an integrated unmanned surveillance concept. "Integration will not happen overnight and segregation is necessary until we have more solutions."

Italian air navigation service provider ENAV is conducting further research supported by its U-space subsidiary D-Flight. The programme is preparing to launch UAM initiatives to improve urban mobility in major cities including Milan, Rome, Venice, Torino from 2022. Rome centre is currently supporting simulation work on the ATC/UAM interface and testing dynamic airspace reconfiguration enablers according to Project Manager Christiano Baldoni.

A common concern raised by the panel was the multiplicity of geo-zones. "Geo-zones are a good idea, but thousands of geo-zones are a burden," said Hendrik-Jan Van Der Gucht, adding the lack of a communication standard adds to this complexity. Areas present different levels of risk, explained Didier Venneman. "We divide the port into areas and apply rules according to the risk involved. This includes ground risk in some areas. Specific Operations Risk Assessment (SORA) complies to some extent so we try to use this."

There are other issues, including societal acceptance and noise, that call for a stepwise approach said Jörn Jaeger. "Creating an artificial boundary does not reflect reality. More integration is needed but not in layers. If the performance requirements are there, height doesn't matter." For Volocopter, vertical limits present a challenge. "We do not fly straight up and down but remain at low level for some time."

Robin Garrity warned against "radical new aviation environments", saying this is "not a clean sheet of paper". The aim of this ConOps programme is to address the blocking points and work out solutions that meet manned and unmanned requirements. He identified three main areas of concern. In addition to the inability of drones to fly in accordance with flight rules, he said high dependence upon automation and AI needs to be accompanied by safety assurances that match the flight risks. Thirdly, the service-based delivery of communications, navigation and surveillance also needs to be seen in the context of the wider airspace to ensure both new and existing technologies operate seamlessly. (SOURCE: Unmanned Airspace)

More about CORUS-XUAM:
www.sesarju.eu/projects/corusxuam

Ongoing projects

BUBBLES - Defining the building basic blocks for a U-space separation management service

BUBBLES aims to formulate and validate the concept of a U-space advanced (U3) 'separation management service'. It is developing algorithms to compute the collision risk of UAS (Unmanned aircraft systems), allowing to define separation minima and methods, so that a safety level stated in terms of overall probability of collision can be defined and maintained.
Web: https://bubbles-project.eu/

DACUS - Demand and capacity optimisation in U-space

DACUS aims to develop a service-oriented demand and capacity balancing (DCB) process for drone traffic management. This overall objective responds to an operational and technical need in European drone operations for a tangible solution integrating the functionalities of the SESAR U-space services for drone traffic management (DTM) to produce timely, efficient and safe decisions.
Web: https://dacus-research.eu/

ICARUS - Integrated common altitude reference system for U-space

ICARUS aims to propose an innovative solution to the challenge of the common altitude reference inside very low-level (VLL) airspace with the definition of a new U-space service and its validation in a real operational environment.
Web: www.u-spaceicarus.eu/

Metropolis 2 - A unified approach to airspace design and separation management for U-space

Metropolis 2 aims to provide the fundamentals for concrete solutions for U-space U3/U4 services that are needed to enable high density urban aerial operations, with a unified approach to the following U-space services: strategic deconfliction, tactical deconfliction, and dynamic capacity management.
Web: www.sesarju.eu/projects/Metropolis2

USEPE - U-space separation in Europe

USEPE aims to research drones' separation methods in high demanding environments, such as cities, and on the use of machine learning algorithms to automate the safe separation and deconfliction of drones, while maintaining airspace capacity in different environments. The research takes into account both the strategic and tactical flight phases.
Web: www.sesarju.eu/projects/USEPE

AMU-LED - Air mobility urban large experimental demonstrations

The project aims to develop a detailed concept of operations and define urban air missions followed by simulations and a large-scale real flight demonstration campaign to verify and validate the concepts. The project allows UAM stakeholders to specify various use cases applicable to logistics and urban transport of passengers, design or integrate UAM environment, test the UAS ground and airborne platforms and finally, assess safety, security, sustainability and public acceptance.
Web: https://amuledproject.eu/

CORUS-XUAM – Concept of operations for European U-space service – extension for urban air mobility

CORUS-XUAM is demonstrating how U-space services and solutions could support integrated urban air mobility (UAM) flight operations, allowing eVTOLs/UAS and other airspace users (unmanned and manned) to operate safely, securely, sustainably and efficiently in a controlled and fully integrated airspace, without undue impact on operations currently managed by ATM. The project is proposed by the consortium that delivered the CORUS U-space ConOps in 2019, extended by the addition of UAM expertise.
Web: https://corus-xuam.eu/

GOF 2.0 - Integrated urban airspace very large-scale demonstration	The project is demonstrating operational validity of serving combined UAS, eVTOL and manned operations in a unified, dense urban airspace using current ATM and U-space services and systems. Both ATM and U-space communities depend extensively on the provision of timely, relevant, accurate and quality-assured digital information to collaborate and make informed decisions. Web: www.sesarju.eu/projects/GOF2
SAFIR-MED – Safe and flexible integration in advanced U-space and flexible services focusing on medical air mobility	The project combines five unmanned UAV platforms (passenger eVTOL, hydrogen fuel cell VTOL, AED medical drone, X8 medical transport) with manned aviation in real-life demonstrations validating technology and the maximum number of U-space services in real urban environments. The results are expected to help refine the current U-space architecture principles and create measurable indicators for the inclusion on UAM smart city transport roadmaps, supporting standardisation and safety. Web: https://www.safir-med.eu
TINDAIR - Tactical instrumental deconfliction and in flight resolution	The project aims to demonstrate and refine the safety, performance, standardisation and regulatory requirements to enable UAM with specific focus on U-space U3 services identified in the U-space Blueprint and refined by CORUS, and, unlock new and enhanced applications and mission types in high density and high complexity areas. Web: https://tindair.eu/
Uspace4UAM - U-space for UAM	The project is carrying out a series of multi-national demonstrations, both with drones and UAM, covering different use cases, including mixed operations, to derive critical enablers for a wide set of UAM service applications that can be applied all over Europe. Web: www.sesarju.eu/projects/Uspace4UAM

SESAR DIGITAL ACADEMY WEBINARS

In 2021, the SESAR 3 JU hosted a wide range of webinars within the framework of the SESAR Digital Academy. These webinars provided participants with in-depth view of the broad range of research that is underway across the SESAR 2020 programme.

All webinar material, including recordings and Q&As, are available on the SESAR JU website. Watch out for more webinars in 2022!

Follow us
on social media

@ SESAR_JU

SESAR 3 Joint Undertaking

www.youtube.com/SESARJU

Publications Office
of the European Union