SESAR INNOVATION PIPELINE

Air traffic management research & innovation 2018 highlights

SESAR JOINT UNDERTAKING

EXPLORING THE BOUNDARIES OF ATM RESEARCH

DELIVERING SESAR SOLUTIONS

DEMONSTRATING SESAR SOLUTIONS

ENABLING SAFE AND SECURE INTEGRATION OF DRONES

SESAR JOINT UNDERTAKING

About the SESAR Joint Undertaking

SESAR is the technological pillar of the EU's Single European Sky policy and a key enabler of the EU Aviation Strategy. SESAR defines, develops and deploys technologies to transform air traffic management in Europe.

The SESAR Joint Undertaking (SESAR JU) is the public-private partnership set up to define and deliver technological solutions to make this transformation a reality. It works with all actors in the aviation value chain to agree on the research and development priorities, as well as technology roll-out plans, which are documented in the European ATM Master Plan - a collaboratively-agreed roadmap for ATM modernisation.

Founded by the European Union and Eurocontrol, the SESAR JU has 19 members, who together with their partners and affiliate associations represent over 100 companies working in Europe and beyond. The SESAR JU also works closely with staff associations, regulators, airport operators, airspace users, the military and the scientific community.

Horizon 2020 and Connecting Europe Facility

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SESAR 2020 AND THE INNOVATION PIPELINE

This brochure provides highlights of some of the SESAR research and development (R&D) activities that took place over the course of 2018 as well as what is coming in 2019.

SESAR 2020 is a European research and innovation programme, which aims to transform air traffic management into a more modular, scalable, automated, interoperable system that takes advantage of advances in digital and virtualisation technologies.

The programme builds on its predecessor, SESAR 1, to deliver high-performing operational and technological solutions for uptake by the aviation industry.

Guided by the European ATM Master Plan, SESAR 2020 focuses on developing solutions in several key areas:

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

Advanced air traffic services, including time-based separation & 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 & airspace use.

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

U-space

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.

The research is categorised into three strands: exploratory research, industrial research and validation and very large-scale demonstrations. These strands have been designed as an innovation pipeline through which ideas are transformed into tangible solutions for industrialisation.

EXPLORATORY RESEARCH

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

INDUSTRIAL RESEARCH & 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 sacale and in ral operations to prove their applicability and encourage the early take-up of solutions.

Exploring the boundaries of ATM research:

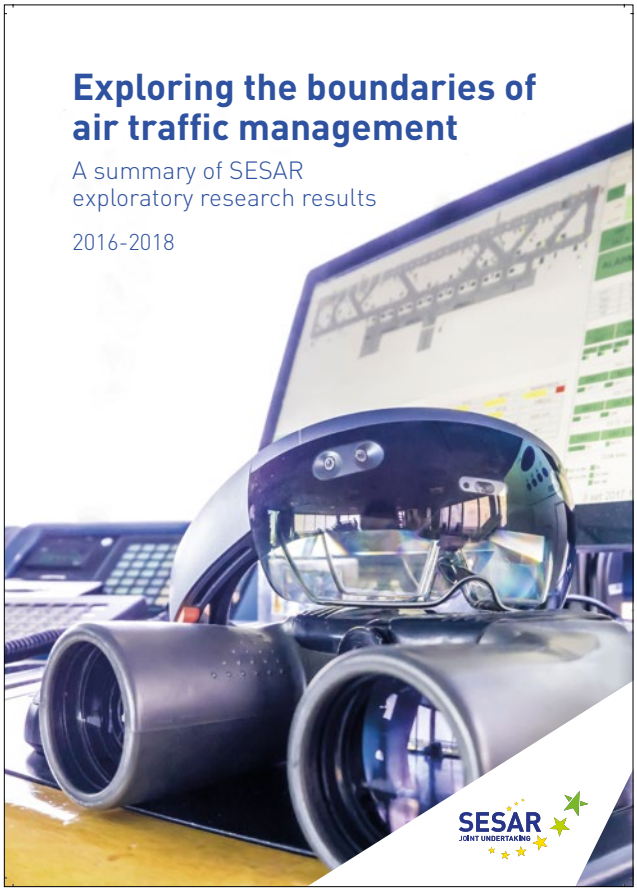
SESAR exploratory research

Through its exploratory research, the SESAR JU looks beyond the current R&D and what is already identified in the European ATM Master Plan. The aim is to investigate new ideas, concepts, and technologies, but also challenge pre-conceived notions about air traffic management and the aviation value chain.

The SESAR exploratory research activities are overseen by a scientific committee, established in 2017, bringing together independent and highly-regarded academics from across Europe and the aviation research domain, as well as observers from the European Commission, Eurocontrol and the SESAR Programme Committee.

In 2018, 28 exploratory projects came to a close, the results of which were published and communicated to stakeholders in a dedicated brochure. The projects explored innovations and technologies coming not just from aviation and ATM, but also other sectors, such as automotive, robotics or system engineering, as well as in other safety critical industries, etc. The most promising and mature technologies will now be considered for inclusion in the industrial research strand of the SESAR programme.

Discover examples of these projects on the following pages.



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> ***The aim is to investigate new ideas, concepts, and technologies, but also challenge pre-conceived notions about air traffic management and the aviation value chain.***

© RETINA

Keeping an augmented eye on air traffic control

Controllers in airport towers rely on seeing aircraft in order to manage them safely and efficiently. But when bad weather sets in, their visual situational awareness can be impaired, leading to a reduction in throughput. The results from the **"Resilient Synthetic Vision for Advanced Control Tower Air Navigation Service Provision"** or RETINA exploratory project showed the promise that augmented reality holds for enhancing air traffic control operations, particularly in low-visibility conditions.

Using synthetic vision and augmented reality technologies, RETINA developed a set of goggles through which controllers can see synthetic information overlaid on the actual "out-of-the-window" view. With these goggles, the controller can have a heads-up view of the airport traffic, call sign and aircraft type, supplemented by additional information, such as wind velocity and direction, airport layout and runway status, even during low-visibility procedures.

www.retina-atm.eu

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Flexible and efficient ATM service provision

ANSPs have to decide on their capacity provision for a particular day of operations well in advance, whereas airspace users need flexibility in flight planning and prefer to make their route choice decisions at shorter notice. This contributes to a mismatch between planned capacity and actual demand in the network.

The **"Coordinated capacity ordering and trajectory pricing for better-performing ATM" or COCTA project** developed a conceptual framework to improve efficiency of air navigation service provision in Europe by a better coordination of capacity and demand. In the framework, the Network Manager asks for airspace capacities in line with expected demand, employing a network-centred, demand-driven approach, as opposed to the current, largely supply-driven and piecemeal practice, with predominantly local (ANSP) perspectives. The Network Manager would then offer different trajectory options to the airspace users, tailored to capture different business and operational needs, thereby contributing to an optimised network performance.

https://cocta.hs-worms.de

Improving trajectory prediction

ATM is gradually moving towards the notion of allowing aircraft to fly their preferred trajectory, otherwise known as trajectory-based operations (TBO). One of the challenges related to the implementation of TBO is the ability to identify, model and manage the uncertainty associated to a trajectory. The integration of the uncertainty models in the planning systems improves the trajectory predictions and supports the assessment of the feasibility of integrating the models into existing demand and capacity balancing (DCB) tools.

The **"Combining probable trajectories" or COPTRA project** showed that in addition to quantifying uncertainty through data analytics, it is possible to limit it through model-driven state estimation techniques. This enables not only to include flight intent or initial condition uncertainties but also to take into account model uncertainties. COPTRA's models provide a clear quantitative understanding of delay propagation dynamics in space and time. The project results provide insight into how to achieve more efficient ATM operations in the future.

www.coptra.eu

© PNOWWA

Weathering the weather at airports

Adverse weather conditions can play havoc with airport operations, limiting or putting a stop to aircraft movements, runway maintenance, de-icing, tower control and even luggage handling. Having accurate meteorological data and forecasts means that airport operators can prepare for the worst in advance. But weather can change in a matter of hours. That's why partners in the **"Probabilistic Nowcasting of Winter Weather for Airports" or PNOWWA project** turned to nowcasting, very short-term (0-3h) probabilistic winter weather forecasts with a 15-minute-time resolution.

Focusing on snow, the partners extrapolated weather movements based on radar echoes and predictability of changes in snowfall intensity caused by underlying terrain (such as mountains and seas). Within these nowcasts, the project provided information on the probability of a wide range of events, such as runways freezing over or decreased visibility. Over the course of the winter of 2017, the project partners demonstrated their model in Austria and Finland, allowing them to gather airport feedback on the applicability of the model and its scalability to other airports.

www.pnowwa.fmi.fi

Mastering uncertainty in aviation

A better understanding of the factors that lead to uncertainty in air traffic is key when planning, executing, monitoring and synchronising trajectories between ground systems and aircraft. Having more accurate trajectories that factor in uncertainty can in turn increase the predictability of traffic, which has knock-on benefits, such as increased capacity, improved efficiency and reduced environmental impact.

To address mid-term trajectory planning, the project developed a stochastic optimisation approach to plan the most efficient trajectories with low levels of uncertainty. The methodology is capable of trading-off predictability and cost efficiency (flight time or fuel consumption). To address storm avoidance, the project developed a probabilistic trajectory predictor, which could proactively propose possible deviations in order to avoid stormy conditions.

As for addressing sector demand, the project defined a methodology to provide a probabilistic sector demand based on the uncertainty of the individual trajectories. The overall conclusion of the project is that ATM efficiency can be enhanced by integrating weather forecast uncertainty.

https://tbomet-h2020.com/on


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Improving ATM efficiency through artificial intelligence

Nowadays, air traffic control (ATC) instructions at the airport are usually still given via voice communication to the pilots. But ATC systems, to be safe and efficient, need up-to-date data. Therefore, it requires lots of inputs from the air traffic controllers (ATCOs) to keep the system data correct. Automatic speech recognition converts speech to text and is, therefore, an alternative input modality. Tools such as AcListant® and AcListant®-Strips have been tested in Dusseldorf and Vienna, and have shown that they can help reduce time taken to keep data up to date and increase ATM efficiency (fuel savings of 50 to 65 litres per flight).

Currently, modern models of speech recognition require manual adaptation to local environments. The **"Machine Learning of Speech Recognition Models for Controller Assistance" or MALORCA** designed a low-cost solution that adapts the speech recognition tools for use at other airports. The solution automatically learns local speech patterns and controllers models from radar and speech data recordings, which are then automatically encoded into the recognition software.

www.malorca-project.de/

New ideas on the horizon

A new wave of SESAR exploratory research activities got underway at beginning of 2018 aiming to foster new ideas and knowledge transfer in ATM in Europe. The activities include a knowledge transfer network to encourage collaborative research on future and emerging innovative ideas, expertise on ATM. Satellite signal jamming, improved airport surface movements using existing surveillance technologies and models to improve traffic predictability are just some of the topics that the selected projects will address.

For more information, visit: www.sesarju.eu/exploratoryresearch

© SESARJU

2018 SESAR Innovation Days

Now in its eighth year, the SESAR Innovation Days have become a landmark event in the European aviation research calendar. The SIDs focus on exploratory research in the field of ATM. The event is not only a vehicle for the SESAR JU to share progress and disseminate results of its exploratory research programme but also for the wider research community to present their work.

As in previous years, the 2018 event was shaped by scientific papers and presentations, which were selected based on an open call for contributions, managed by the SESAR Engage network. The event also featured a poster exhibition and a networking event, which provided participants opportunities to learn about other interesting projects and to meet like-minded researchers. Organised against the background of the Austrian European Presidency, a series of site visits took place to locations in the vicinity of Salzburg so that participants could see ATM research an Innovation in action.

The event also provided the backdrop for the 2018 SESAR Young Scientist Award ceremony, which is SESAR's main vehicle for young scientists in the ATM domain to receive recognition and showcase their research work. The prestigious prize went to Gianluca Di Flumeri for his research on electroencephalography-based measures and passive brain-computer interfaces to be used in operational environments.

Gianluca Di Flumeri, 2018 SESAR Young Scientist

Engage

Engage: SESAR's knowledge transfer network

Established in early 2018, the network's focus is two-fold: inspiring new researchers and helping to facilitate the transfer of results from fundamental and applied research into industrial research. It aims to ensure that promising research is progressed, and higher maturity results are delivered, through a wide range of activities and financial support actions, such as PhD and catalyst funding and thematic workshops.

http://www.engagektn.com/

Delivering SESAR Solutions

Industrial research & validation

> ***With validation sites across Europe, the SESAR JU and its members have taken research and innovation out of the lab and connected it with the real world.***

SESAR Solutions refer to new or improved operational procedures or technologies that aim to contribute to the modernisation of the European and global ATM system. The Solutions are validated according to key performance areas such as safety, cost and operational efficiency, capacity and the environment.

To deliver solutions ready for pre-industrialisation, the SESAR JU and its members have built a process, known as the release process, whereby solutions are tested or validated in real operational environments. In other words, SESAR JU and its members have taken research and innovation out of the lab and connected it with the real world. Validations take place in simulation platforms, on board commercial flights, dedicated airport testbeds and air traffic control centres. Exercises are not limited to a specific location, but can be used to test multiple environments irrespective of the location where the physical validation is held.

Significant progress was made in 2018 by the first wave of SESAR 2020 industrial research projects to advance and mature concepts and solutions addressing all aspects of ATM. The ultimate aim is to bring these to the required level of maturity for industrialisation and eventual deployment.

Here is a sample of some of the activities in this strand of research:

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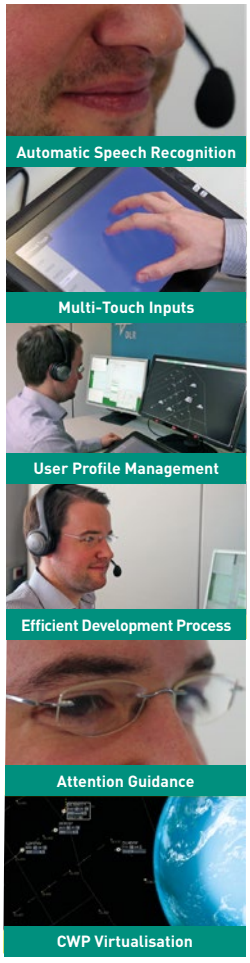
The sky's the limit with virtual centres

With virtual centres, Europe is breaking away from the conventional architecture for air traffic management. These centres aim to decouple the physical controller working position (CWP) from the remote provision of ATM data and technical services, such as flight data distribution and management, as well as surveillance data. The aim is to enable greater flexibility when it comes to organising air traffic control operations and, in doing so, seamless and more cost-efficient service provision to airlines and other airspace users.

Having successfully validated the technical feasibility of the solution in SESAR 1, SESAR members and partners are now working together in SESAR 2020 to take the solution out of the lab into a real operational environment for validation, focusing on three use cases: rationalisation of infrastructure, contingency and delegation of airspace. If all goes to plan, a system prototype in support of the first use case will be further validated during a large-scale demonstration in 2019.

SESAR JU reference: Virtual Centre (PJ16.03)



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Flight-centric air traffic control

European airspace is divided into flight information regions, which are subdivided into sectors to provide safe separation services for aircraft travelling through the airspace. Changing this to a flight-centred structure without reference to geographical sectors opens up the opportunity to distribute the workload more evenly, and to avoid lost productivity in under-loaded sectors. Aircraft may be under the responsibility of the same controller across two or more geographical sectors rather than handed over at sector boundaries.

Initial validations look promising in terms of enabling more flexible use of human resources and optimising capacity and levelling out airspace occupancy. More work is planned to refine the procedures and tools relating to traffic allocation and coordination. In the event of a conflict for example, it is important to establish which controller is responsible for its resolution. For high traffic densities, the solution also requires advanced conflict detection and resolution tools which may have multiple functions in addition to flight-centric operations. These tools can provide long look-ahead time and help to allocate conflicts to controllers.

Communications tools are also under review as the flight-centred solution will usually require the aircraft to remain in communication with the same controller for longer than is usual during current operations. This might extend beyond the coverage of a single VHF frequency and involve multiple VHF antenna or digital voice communications over Internet Protocol (VoIP).

SESAR JU reference: Flight-centric air traffic control (Flight Centred ATC) (PJ10.01b)

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Enabling access to airports in low-visibility conditions using enhanced flight vision systems

With the main airport hubs becoming busier, secondary gateways will come to the fore, dealing not only with an increasing number of scheduled flights but also acting as an important alternative for diverted flights. It is therefore crucial that smaller airports are accessible no matter what the weather conditions and that their ground operations are predictable. However, these airports have limited resources to invest in advanced ground infrastructure.

One option is to invest in emerging visual-based technologies that are located on board the aircraft and can be used by all aircraft types. Delivered by SESAR in 2018, the enhanced flight vision system can be displayed to the pilot using a coloured helmet-mounted display. The solution offers the advantage of operating independently of ground infrastructure at most runway ends with precision or non-precision landing procedures. These benefits make the solution a useful capability for airspace users in the business aviation community, typically small and medium operators with limited resources, operating at smaller airfields.

Research continues on combining enhanced vision systems (EVS) and synthetic vision systems (SVS) to enable not only landing but also taxi and take-off in low-visibility conditions. In doing so the systems enhance the positional awareness of the pilot during taxiing and can help to maintain standard taxi speeds safely in low visibility conditions. Beyond operations, enhanced visibility solutions will boost situational awareness in all weather conditions for all operators, contributing to increased safety.

SESAR JU reference: Reducing landing minima in low visibility conditions using enhanced Flight vision systems (EFVS) (#117) & Enhanced visual operations PJ.03a-04

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Handling complexity in the sky through automation

Delivered in 2018, the basic extended ATC planner is an automation tool and a set of procedures that support controllers in managing highly complex traffic. The solution aims to bridge the gap between air traffic flow and capacity management (ATFCM) and air traffic control. It provides real-time and fine-tuning measures to solve ATFCM hotspots, enabling early measures to be taken in order alleviate complexity closest to ATC activities.

The solution introduces an initial automated interface together with the related procedures that will facilitate the communication between local demand and capacity balancing (DCB) position and the controllers' work positions. The main benefits of the EAP function is better service provision to airspace users through reduced delays, better punctuality, less ATFCM regulations, and enhanced safety. The solution is seen as a potential enabler for the deployment of solutions, such as Extended AMAN or free routing operations. Following validations in 2015/2016, the solution was approved by French civil aviation authorities and has since become operational at Reims ACC (approved by the French NSA in December 2016).

SESAR JU reference: Extended ATC planner (#118)

© Eurocontrol

Automating flight planning in Europe

In 2018, SESAR made progress testing prototype systems and services for sharing consistent and accurate flight and trajectory data in real-time. Today, airspace users file their plans without knowing the future evolution of traffic. It is only when the plan is filed can the Network Manager respond to inform them of the traffic situation and any measures that have been put in place to address congestion.

To improve the flow of traffic, SESAR members developed a digital solution allowing airspace users to access information about the predicted traffic situation and congestion in real time, enabling them to file plans that avoid congestion or hotspots.

The prototypes and services tested by SESAR members and partners showed how access to the information enables airspace users to make more informed decisions about their preferences and priorities, as well as optimise aircraft trajectories in the flight-planning phase.

SESAR JU reference: Optimised airspace user operations (PJ.07 OAUO) & Advanced demand-capacity balancing (PJ.09 DCB)

Improved civil-military coordination on the horizon

Through SESAR, civil and military aviation stakeholders are working together on solutions to enable military air traffic operations in Europe's increasing complex and congested airspace. Tests in 2018 simulated operations of military aircraft in controlled airspace of Prague. They showed how a central management of military flight plans and real-time exchange trajectory information can improve the predictability of military operations and airspace use; and increase capacity of the overall network.

Europe's armed forces operate more than 150,000 flights per year. To accommodate these flights, the airspace is often closed, sometimes at short notice, to civil traffic. Given the growth of air traffic, SESAR is looking at technical systems and solutions that allow more flexible civil-military cooperation to maximise the use of airspace. Key to this cooperation is the ability of military planners to access flight plan and trajectory data provided by civil air traffic management systems, as well as the ability to feed these same systems with their own defined set of information.

Within this context, SESAR members validated the creation and submission of military flight plans (iOAT FPL), the central management of these plans by the Network Manager, and their distribution to local air traffic control centres where these military flights are taking place. The validation results are a major step towards enhanced civil – military coordination and are expected to contribute to a more complete view of the pan-European air traffic situation, civil as well as military, at ATM network level.

Underpinning this validation work is the ongoing collaboration between the SESAR JU and the European Defence Agency, which ensures the full integration of military needs into the SESAR research and innovation programme.

SESAR JU reference: Optimised airspace user operations (PJ.07-03) and mission trajectories (PJ.18-01a)

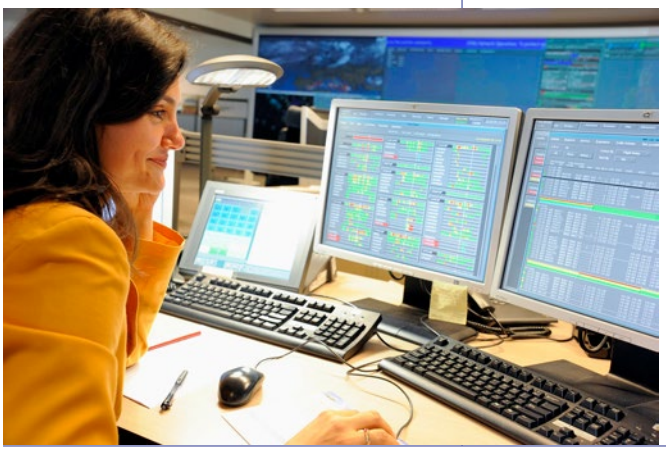
Getting dynamic about airspace configuration

With the move from fixed route networks to free route operations in Europe, air navigation service providers need to be able to organise, plan and manage airspace configurations with enough flexibility to respond to any change in traffic demand, to any unexpected event, and to any update in airspace reservation.

Building on the results of the SESAR 1 Flexible Airspace Management (FAM) project, SESAR members simulated dynamic airspace configurations in the Italian West and East sectors of Milano ACC, a free route environment of complex traffic situations. Partners were able to define the structure of the target sectorisation, and obtain new optimised configurations, more suited to the structure of the demand, and balancing controller workload. The new configurations were compared against the reference scenarios with operations performed in current airspace. They showed that using dynamic airspace techniques had a positive impact on capacity and efficiency since controllers' time and availability could be better managed.

These initial results show that dynamic sectorisation and dynamic airspace reservation/restriction (ARES) management should lead to quantifiable benefits to the network. Additional validations will take place in the near future to provide more results, leading to a formal SESAR Solution capable of being deployed across the network.

SESAR JU reference: Advanced Airspace Management (PJ.08 AAM)



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Demonstrating SESAR solutions

Very large-scale demonstrations

Very-large scale demonstrations offer a critical mass of proof of the performance benefits that SESAR Solutions can deliver to the aviation community. The demonstrations include trials involving live traffic and so typically take place in close-to-operational environments. These demonstrations are the result of open as well as restricted calls, so are capable of bringing a much broader set of stakeholders, among which airspace users and other aviation end-users. The fact that so many stakeholders are eager to participate is proving invaluable for accelerating the operational acceptance and the subsequent industrialisation of SESAR Solutions. In other words: "seeing is believing."

In 2017-2018, a number of demonstrations got underway. Discover examples of these projects on the following pages.

> ***"The demonstrations include trials involving live traffic and so typically take place in close-to-operational environments"***

Better air traffic flow in Europe through data sharing

In 2018, SESAR members and partners demonstrated a digital tool that provides air traffic control centres across Europe with a shared view of expected traffic, and the means to better control the demand and flow of flights in their portion of airspace.

The Network Manager Operation Centre (NMOC) is responsible for centralising flight plan management in Europe, offering an accurate picture of the air traffic on any given day. When the demand for the airspace outweighs the capacity, local air traffic control centres can request from the NMOC a so-called "regulation" to introduce an air traffic flow and capacity management or ATCFM measure in order to balance the demand through re-routing, controlling the time of arrival, etc.

Until now, these regulations have been coordinated with the NMOC by phone. While successful, this manual approach has several shortcomings, notably that there is no shared view nor easy traceability of the requested regulations. Aiming to address these limitations, the tool developed by SESAR members and partners offers a digital service through which regulations can now be created, shared, coordinated, modified and cancelled with a click of a button.

The SESAR demonstration showed how the digital exchange of regulation information can save time while also reducing errors in the workflow process. The digital tool is part of the set of solutions under investigation by the demonstration partners to enable a more dynamic approach to network coordination and to dealing with network constraints.

SESAR JU reference: Network Collaborative Management (PJ.24)

Making air travel more predictable

SESAR members are demonstrating how sharing trajectory data with air traffic control can improve the predictability of air traffic. Between now and the end of 2019, around 100 in-service Airbus A320 family aircraft will be progressively equipped with 'FANS-C', an avionics product which combines new datalink and telecommunications capabilities and which allows for the transmission of the complete predicted four-dimensional aircraft trajectory (3D + time) by the aircraft to the ground traffic control.

The project builds on the results of flight trials that took place in 2012 and 2014, and will aim to show how sharing trajectory information between the air and ground can enable a safer and more efficient handling and certainty of flight profiles. It will aim to show benefits in terms of minimising discrepancies in trajectory and improving controller support tools, such as conflict detection (e.g. medium-term conflict detection/ MTCD). On the airborne side, the aircraft can better manage their speed profile, which leads to fuel savings and an environmentally-optimised flight profile. The sharing of trajectory also means that aircraft sequences can be better managed and delivered into terminal manoeuvring areas (TMAs) with greater efficiency.

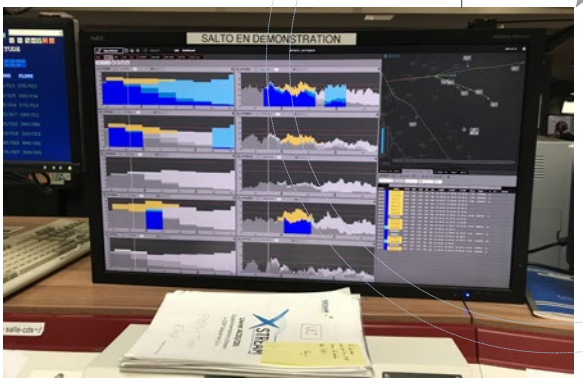
SESAR JU reference: Demonstration of air traffic management Improvements Generated by Initial Trajectory Sharing (PJ.31 DIGITS)

Taking cross-border flight efficiency to the xStream

In 2017 and 2018, commercial flights bound for Paris-Orly, Gatwick and Zurich were successfully managed using the xStream procedure of extending the arrival management horizon up to 250 nautical miles. With extended arrival management (E-AMAN), the flow manager is able to make an early plan of what the arrival sequence will be, and controllers manage arrival delays tactically during the cruising phase of the flight. With greater anticipation and predictability on the arrival sequence, the objective of E-AMAN is to enable delay absorption earlier in the flight, at higher altitude, improving the arrivals fuel efficiency. The E-AMAN is a key component of the first package of functionalities of the European regulation called Pilot Common Project (PCP).

These latest flight trials aim at further enhancing target time, ATFCM and E-AMAN queue management processes, while taking into account departure demand. The results showed a strong decrease in vectoring and holding time while the project received positive feedback from en-route and approach controllers and airspace users regarding the relevance and the efficiency of this new process.

SESAR JU reference: Cross-border SESAR trials for enhanced arrival management (PJ.25 - xStream)



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© Andrej Safaric

Bringing “gains” to general aviation

General aviation is an important economic enabler in Europe and feeder to the airline industry. In 2018, two projects got underway aimed at demonstrating how SESAR Solutions enabled by sat-based technologies can be used to enhance general aviation and rotorcraft operations without prohibitive cost or certification requirements.

- Enhanced terminal operations with LPV procedures (#51)
- Precision approaches using the ground-based augmentation system (GBAS) CAT II/III (#55)
- Approach procedure with vertical guidance (#103)
- Optimised low-level IFR routes for rotorcraft (#113)

The projects therefore aim to demonstrate clearly, through live flying exercises, the ability of GA to utilise new technology and procedures in flight. It also aims to test the viability

of adapting SESAR solutions to improve GA's operations and integration within a variety of operational contexts and environments. The projects will conduct flight tests using different types of aircraft in typical operational environments of general aviation and rotorcraft. The expected benefits will be to better integrate these airspace users in the airspace and at airports (controlled and uncontrolled).

SESAR JU reference: General aviation improved navigation and surveillance (GAINS) & GNSS solutions for Increased GA and rotorcraft airport accessibility demonstration (GRADE)

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Improving access to regional airports through sat-based technologies

Building on the results of a SESAR demonstration, this project aims to demonstrate augmented approach and landing operations, enabled by satellite technologies and using constellations such as Galileo. Running from 2018 to 2020, the demonstration will focus on the following solutions:

- GBAS CAT II with CAT I airborne and ground equipment, enabling lower decision heights to CAT II minima (DH 100ft) (addresses hubs and medium size airports)
- Enhanced flight vision systems (EFVS) to land using head up /or mounted display, with operational credit down to 300 metres RVR in non- CAT II/ III airports (addresses medium and small size airports)

The demonstration aims to show further evidence of the benefits offered by these SESAR Solutions, including improved accessibility in congested, low visibility conditions to pave the way for the uptake of technologies required to overcome limitations of the current Instrument landing system (ILS) equipment. Ultimately, the demonstration hopes to contribute to speeding up deployment of these technologies.

SESAR JU reference: Augmented approaches to land (AAL2)

Enabling the safe and secure integration of drones

U-space and other drone projects

U-space

Research and innovation is underway in SESAR to ensure that the increase of drone traffic in Europe's skies can be managed safely, in particular in relation to commercial air transport**.** Much of it is done within the framework of U-space, an initiative by the European Commission to ensure the safe and secure integration of drones across Europe. The aim of U-space is to put in place 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 a large numbers of drones, with an initial look at very low-level (VLL) operations. The services and technologies are categorised as: foundation services (U1), initial services (U2), advanced services (U3) and full services (U4).

U-space

In this context, in 2017 the SESAR launched a series of U-space projects addressing everything from the concept of operations for drone operations, critical communications, surveillance and tracking, and information management to aircraft systems, ground-based technologies, cyber-resilience and geo-fencing. In 2017-2018, Large-scale demonstrations got underway to showcase already matured U-space services and technologies for visual line of sight (VLOS) and BVLOS drone flights. The scope covers operations in rural and urban areas, in the vicinity of airports, in uncontrolled and controlled airspace, and in mixed environments with manned aviation. Projects are, for example, examining how to handle VLL operations where general aviation, commercial aviation and drones share the airspace.

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Stepping up to the PODIUM

The Proving Operations of Drones with Initial UTM (PODIUM) project is demonstrating unmanned aircraft system traffic management (UTM) services, procedures and technologies at four operational sites in Denmark, France and the Netherlands throughout 2018 and 2019. Specifically, the project is demonstrating solutions for visual line of sight (VLOS) and beyond visual line of sight (BVLOS) drone flights operating in very low level operations in rural and urban areas, in the vicinity of airports, in uncontrolled and controlled airspace, and in mixed environments with manned aviation.

The project aims to highlight the important role of UTM in providing a mutual traffic situational awareness for the involved local actors – including air traffic management (ATM) - as a means to facilitate their day to day drone management. PODIUM will contribute to de-risking the operational and industrial deployment of UTM by demonstrating a comprehensive web-based system, using tracking systems based on Mode-S, L-Band and GSM networks.

www.sesarju.eu/projects/podium

Protecting against unauthorised drone traffic

Partners in the CLASS project are researching real-time tracking and the display of both cooperative and non-cooperative drones. As a first step, the CLASS project tested drone detection and tracking technologies during live demonstrations, which took place at the Deenethorpe airfield (UK) in October. The project performed 40 flights and six scenarios in total. The resulting system will provide the basis with which to develop U-space services tailored to end-users, including airports. Advanced services include tactical geo-fencing (where the drone pilot is warned automatically if he trespasses into an unauthorised zone), geo-caging (where the drone pilot is warned that he is leaving a pre-defined zone), conflict detection and resolution.

Meanhwhile, partners in the GEOSAFE project are evaluating state-of-the-art geofencing solutions through an extensive flight-test campaign in Pourrières, Bordeaux, Montmagny and Valence in France. The test campaign will employ a number of commercially-available geofencing solutions to address drone behaviour in different situations. The campaign will also perform a technical assessment of the navigation system performance on the efficiency of geofencing.

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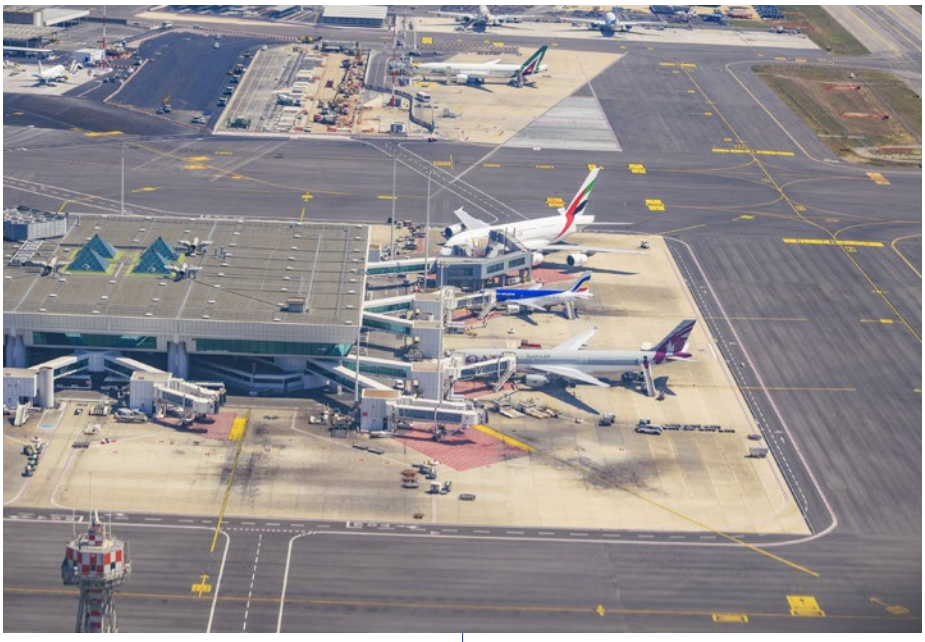
Interfacing with manned aviation

SESAR members are investigating how best to integrate large drones into non-segregated airspace alongside commercial traffic, particularly in the approach segment of the airspace near airports. Recent tests took place in Malta, Italy and France with future generation civil cargo drone vehicles inserted into commercial manned traffic. The tests assessed how controllers managed the traffic mix and dealt with some of the specificities of large drones, such as the fact that they travel at a lower speed than conventional aircraft. The results of the exercises are helping the project partners capture the requirements in terms of air traffic control procedures and system support (specific phraseology and human machine interface support), access to relevant data (information related to specific missions and procedures), communication requirements (maximum acceptable latency values) and acceptability of contingency procedures. The tests will also help define suitable training for controllers.

SJU reference: PJ.10 PROSA

Drones on the surface

Work is ongoing to enable large drones access to the airport surface, examining their integration with manned aircraft and compliance with air traffic control requirements. These drones are subject to the same rules, procedures and appropriate performance requirements as any other airport user so, in order to ensure safe airport surface operations. They therefore must be able to interface with ground-based airport systems and demonstrate their ability to act and respond to air traffic control, and other surface users just like conventional manned aircraft also in case of unexpected events.



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In this respect, SESAR research and development is focusing on drone "taxi-in" and "taxi-out" operations in both nominal and contingency situations (loss of command and control, loss of communication). We recently brought together air traffic controllers and remotely-control aircraft systems pilot, with human factors, safety and drone experts. Based on their feedback, we will further detail the key safety and performance areas that should be addressed, and to define new operational requirements. The aim is to deliver a solution that enables the safe integration of drones in airport environments, defining guidelines related to contingency situations on the ground, such as loss of command & control and loss of communication. Further testing is planned in 2019.

SJU reference: Integrated Surface Management (PJ.03a SUMO) project

A holistic roadmap for drone integration

SESAR has set out a roadmap for the integration of drones, both large and small. This embeds not just the timeline for U-space for which the initial roll-out is expected in 2019, but it also outlines the steps to be taken to ensure a coordinated implementation of solutions to enable larger drones alongside commercial airspace. The roadmap will be included in the next edition of the European ATM Master Plan, to be published in 2019, supporting the development and delivery of the services and technologies needed to support safe and secure drone management in Europe.

www.sesarju.eu/uspace

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WHAT'S COMING UP IN 2019

In 2019, the SESAR JU will bring to a close the first wave of industrial projects and with that deliver new candidate solutions for uptake by the market. These solutions will be captured in the 3rd edition of the SESAR Solutions Catalogue. At the same time, a second wave of industrial research and large scale demonstrations will get underway, giving priority to projects bringing quick wins to address capacity.

Another important deliverable in 2019 will be the next edition of the European ATM Master Plan. Taking into account evolutions in the ATM and aviation landscape, the plan will integrate the results of recently completed Airspace Architecture Study, as well as specific roadmaps on drones and communications, navigation and surveillance.

In order to continue to feed the innovation pipeline, the SESAR JU will launch a call on exploratory research. Finally, 2019 will see the delivery of the first services to support the European Commission's U-space initiative to enable the safe and secure integration of drones.

For the latest information, please consult our website:

www.sesarju.eu

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