

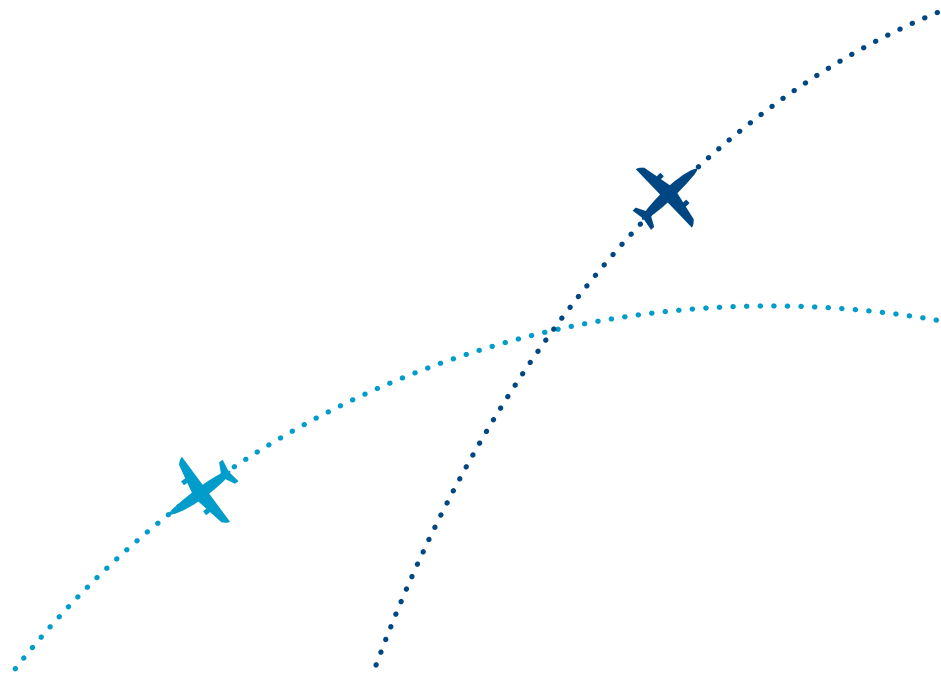
SEEING IS BELIEVING

A summary of SESAR Demonstration Activities 2012-2014



Seeing is Believing

A summary of
SESAR Demonstration Activities
2012-2014



More information on the European Union is available on the Internet (<http://europa.eu>).

Luxembourg: Publications Office of the European Union, 2015

Print ISBN 978-92-9216-024-1 doi:10.2829/30654 MG-05-14-082-EN-C

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Printed in Belgium

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

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Introduction by Florian Guillermet

Florian Guillermet, Executive Director, SESAR Joint Undertaking



Through a network of 3,000 ATM experts, the SESAR Programme for Research and Innovation is developing and validating new technologies, operations and procedures which will ultimately improve the way that air traffic is handled in Europe. These improvements are known as SESAR Solutions.

As with many things, ATM stakeholders need to try before investing in new technologies, which is why SESAR members and partners carry out flight trials and other demonstrations in real-life environments involving a wide range of operational experts, from airports, air traffic control centres, airlines, business aviation and general aviation. The fact that so many ATM actors 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.”

Between 2012 and 2014, the SJU co-financed a total of 18 Demonstration Activities, amounting to over 30,000 flight trials, which addressed all flight phases. Nine of these projects addressed the readiness of SESAR Solutions, providing concrete and tangible evidence of the benefits that they can bring to the overall performance of aviation and air traffic management in Europe. Given the importance of mitigating the environmental impact of aviation, a further nine projects were selected to specifically demonstrate how the Programme’s solutions can result in significant reductions in CO₂

emissions and noise. These “green” projects were run in collaboration with global partners, under the Atlantic Interoperability Initiative to Reduce Emissions (AIRE) ⁽¹⁾, representing the third edition of AIRE projects to be co-financed by the SESAR Joint Undertaking.

This report details the results of these 18 projects, as well as lessons learned and next steps, highlighting that SESAR is already delivering quick wins with some solutions proving ready for implementation. Similarly, as illustrated by some project outcomes, SESAR Demonstration Activities are providing a bridge towards deployment, reducing their time to market through accelerating their readiness for industrialisation both in Europe and worldwide. Finally, the results detailed in this report show that these Demonstrations Activities are contributing to making sure that SESAR Solutions are globally applicable and interoperable.

SESAR Demonstrations Activities are clearly bringing us closer to delivering a modernised ATM system and achieving a higher performing aviation sector for Europe. This is certainly good news for air traffic controllers, pilots and everyone else involved in aviation on a day-to-day basis. In the long run, it is equally good news for both European citizens and the economy, since the implementation of SESAR Solutions will help Europe’s aviation sector to offer a better passenger experience and stay to offer a better passenger experience and allow its sustainable growth.

The SJU will continue to evolve its Demonstration Activities portfolio by expanding the spheres of influence of its flight trials, as well as the solutions addressed. Our contributing partners and other stakeholders are pivotal to the success of SESAR with their continued and active involvement regarded as indispensable.

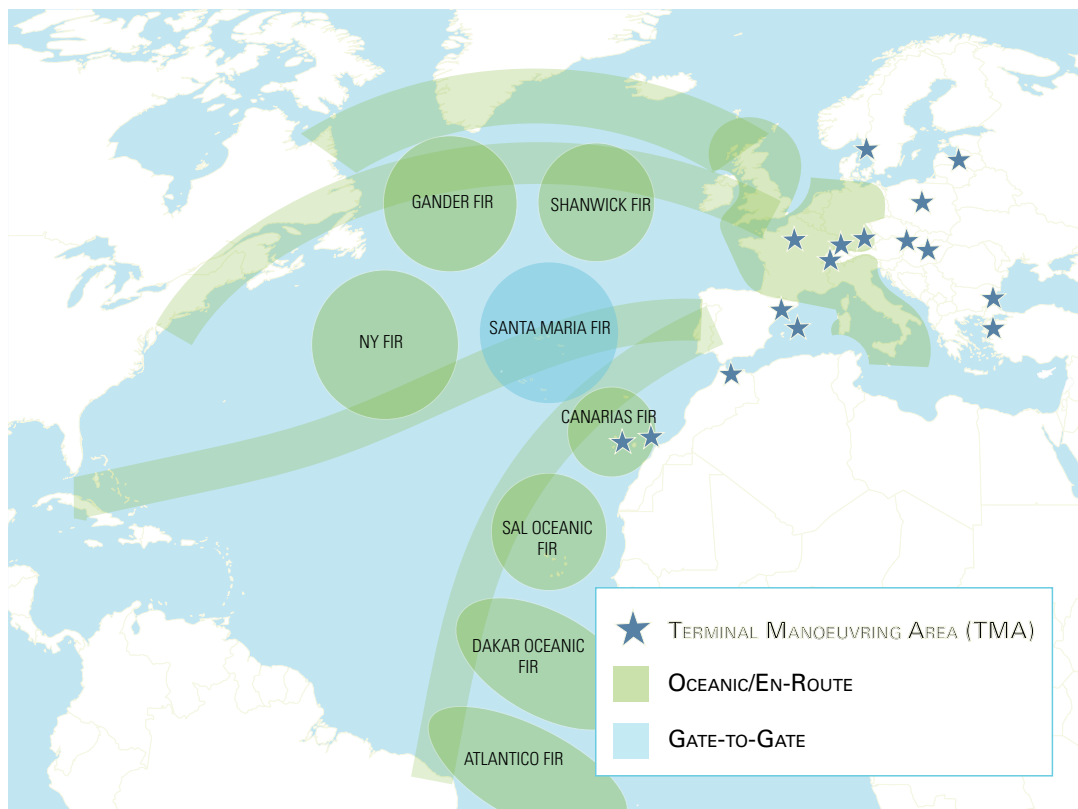
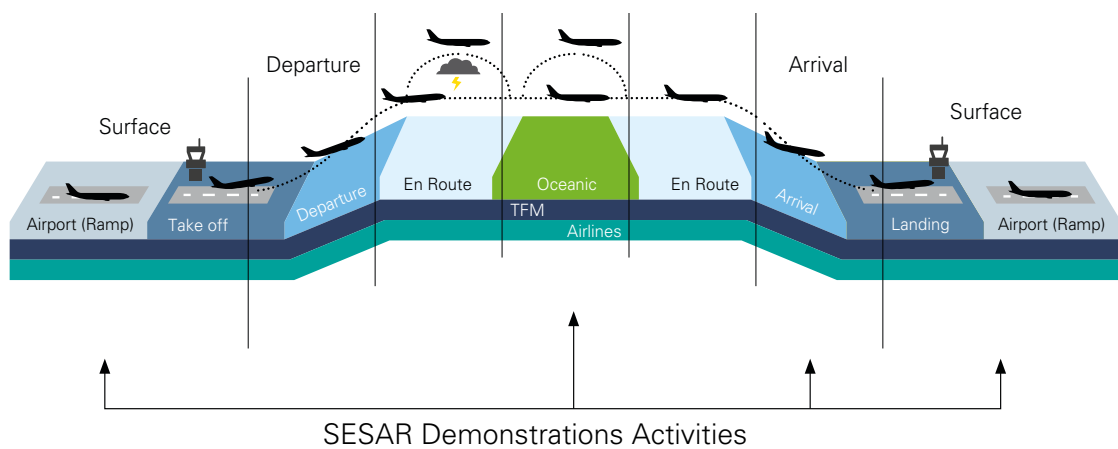
We hope you enjoy the read.

⁽¹⁾ The Atlantic Interoperability Initiative (AIRE) was launched in 2007 by the European Commission and the US Federal Aviation Administration (FAA) with the goal of reducing emission. The SESAR Joint Undertaking has managed the programme from an European perspective since 2008. The initiative’s aim is to improve aircraft’s energy efficiency and lower emissions and noise through ATM solutions. A total of 10,000 green flights were co-financed by the SJU between 2008 and 2011: www.sesarju.eu/AIRE

A quick overview

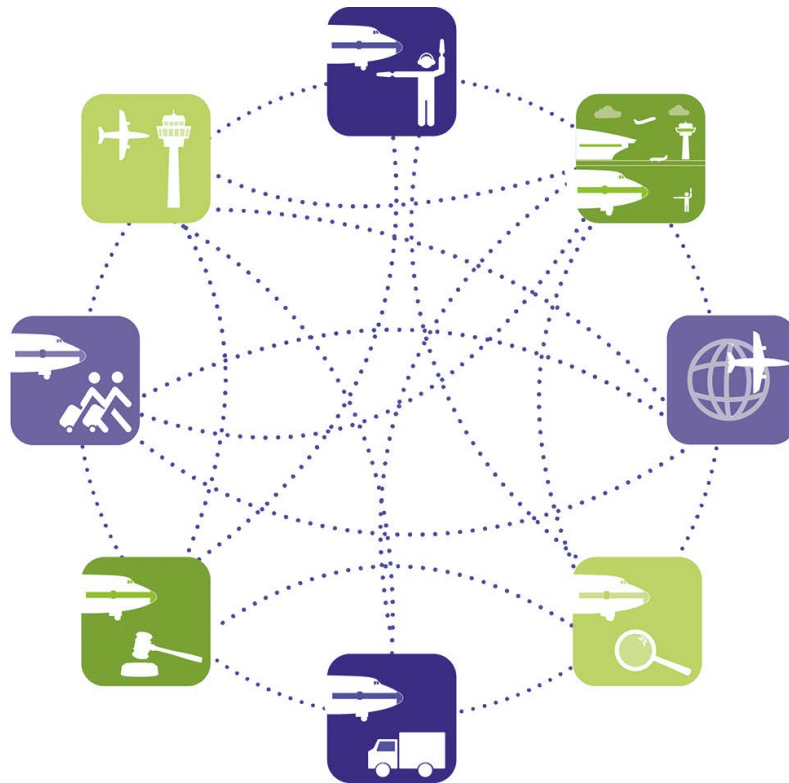
Over the period 2012 – 2014, SESAR’s Demonstrations Activities were organised according to the following categories:

- Terminal Manoeuvring Area (TMA)
- Oceanic/en-route
- Gate-to-Gate



Domain	Demonstration Activity/Project	Location	Number of Trials
TMA	AMBER	Riga International Airport	124
	CANARIAS	La Palma and Lanzarote airports	8
	DFlex	Paris Charles de Gaulle (Paris CDG)	2,000
	FAIR STREAM	Paris CDG, Flughafen Zürich and Munich Airport	825
	OPTA-IN	Palma de Mallorca Airport	101
	NEWBRIDGE <i>(Ongoing)</i>	Goteborg-Landvetter (ESGG)	3,000-4,000
	NASCIO	Babice / Lodz Balikesir Koca Seyit Barcelona / La seu d'Urgell Bratislava Interlaken Sabadell / La seu d'Urgell Tetouan Burgas	67
	REACT plus	Budapest Airport	4,113
Oceanic/ en-route	AFD	UK/Italian airspace	80
	ENGAGE Phase II	North Atlantic – between Canada & Europe	210
	FRAMaK	Karlsruhe Upper Area Control (UAC) and Maastricht UAC	528
	ICATS	USA-Iberian Peninsula	240
	SATISFIED	EUR-SAM Oceanic corridor	165
	SMART <i>(Ongoing)</i>	Lisbon flight information region (FIR), New York Oceanic and Santa Maria FIR	250
	TOPMET	Continental Europe	1,000
	TOPFLIGHT	Transatlantic to London Heathrow	20,000
	WE-FREE	Paris CDG, Venice, Verona, Milano Linate, Pisa, Bologna, Torino, Genoa airports	128
Gate- to-gate	MAGGO <i>(Ongoing)</i>	Santa Maria FIR	100

Project contributors



Airspace Users: Aeroclub Sabadell, airBaltic, Air Berlin, Air Europa Lineas Aereas, Air France, Alitalia, Borajet, BlueSkies, British Airways PLC, Brussels Airlines, CAT Helicopters, Delta Airlines, EasyJet Airline Company Limited, Estonian Air, FedEx, HOP!, IATC Academy, Iberia, Lotnicze Pogotowie Ratunkowe/Polish Medical Air Rescue (LPR), Deutsche Lufthansa AG, Malmö Aviation AB (TF), Norwegian Air Shuttle, Nova Airlines (Novair), Pyrenees Airlines, Royal Air Maroc, Scandinavian Airlines (SAS), Sociedade Açoriana de Transportes (SATA), SWISS International Air Lines AG Ltd, TAP Portugal, Swiss Air Rescue operator (REGA), Thomas Cook Airlines, Wizzair.

Air Navigation Service Providers and

authorities: Bulgarian Air Traffic services Authority (BULATSA), ENAIRE (formerly AENA), Estonian Air Navigation Services/Lennuliiklusteenindue Aktsiaselts (EANS), Deutsche Flugsicherung GmbH (DFS), Direction des Services de la navigation Aérienne (DSNA), Ente Nazionale Assistenza al Volo S.P.A (ENAV), Eurocontrol, Federal Aviation Administration (FAA), General Directorate of State Airports (DHMI), HungaroControl, LFV, Letovė

prevádzkové služby Slovenskej republiky (LPS SR), Luchtverkeersleiding Nederland (LVNL), Luftfartsverket (LFV), Latvijas Gaisa Satiksme (LGS), NATS (En Route) plc, NAV CANADA, Navegacao Aerea de Portugal (NAV Portugal), Office National des Aéroports (ONDA), SKYGUIDE.

Airports: Aéroports de Paris, Brussels Zaventem, Budapest Liszt Ferenc, Flughafen Zürich AG, La Palma and Lanzarote, London Heathrow, Flughafen Munich, Palma de Mallorca, Riga International Airport, Sabadell, Swedavia AB.

Industry: Adacel, Airbus ProSky, Barco Orthogon, Boeing, Centro de Referencia de Investigación, Desarrollo e Innovación (CRIDA), Egis Avia, GIE EUMETNET (DWD, Meteo France, UK Met Office), General Electric (GE) aviation, Ingeniería y Economía del Transporte (INECO), Stichting National Lucht- en Ruimtevaartlaboratorium (NLR), Indra Sistemas, Lockheed Martin UK Limited, Novabase, Pildo Consulting SL, Quovadis, Rockwell Collins France, Selex ES SpA, SENASA, SITA Information Networking Computing, Thales Air Systems SA, Thales Avionics SA, University of Zillina (UNIZA).

TMA projects

1. AMBER – Arrival Modernisation for Better Efficiency in Riga



Partners

AirBaltic, Airbus ProSky, Civilās Aviācijas Agentūra, Latvijas Gaisa Satiksme (LGS) and Riga International Airport

Summary

The AMBER project aimed to demonstrate the capability of turboprop aircraft to fly tailored Required Navigation Performance – Authorisation Required (RNP-AR) approaches together with Continuous Descent Operations (CDO), in order to shorten arrival tracks and to reduce both noise and associated CO₂ emissions. Two RNP AR approach tracks were designed for Riga International Airport, each of which with several entry points to the airport's TMA. These approaches were designed and tested in a simulator and then approved by Latvia's Civil Aviation Authority (CAA), before being

released for flight trials on regular scheduled flights under Visual Meteorological Conditions (VMC).

Results

The project conducted 124 AMBER approaches, which were measured from a constant distance of 75 nautical miles (NM) around the airport reference point. Flight data of these approaches such as air distance, fuel used, time and distance/time spent in intermediate level-offs were recorded and compared to a set of 260 conventional runway approaches. Results were also validated by comparing data from different sources, like aircraft systems, air traffic control radar records and airport noise monitoring equipment. Pilots and controllers were specially trained in preparation for the flight trials, which were conducted on Bombardier Q400 Next Gen aircraft, featuring the RNP AR capability.

AMBER illustrated the benefits of RNP-AR equipped turboprops as follows:

- A reduction in inbound distances into Riga Airport in the order of 20 NM;
- A corresponding 230 kg reduction in CO₂ emissions per approach by both shortening the approach path horizontally and allowing a CDO from top of descent to touchdown. In comparison, an average 5 NM (1.6 min) cumulative intermediate level-off was registered for conventional approaches;
- A reduction in noise impact of 0.6 decibels (dBA) and successful avoidance of the touristic and noise sensitive area of Jūrmala city on the coastline of the Baltic Sea;
- Operational acceptance by pilots, controllers, flight operations personnel and involved CAA staff with positive feedback regarding the measured results, including increased flight safety standards.

The project enabled the initiation of an approval process for RNP AR approach operations in order to realise savings on a daily basis.

2. CANARIAS – CO₂ and Noise Approach Reduction for International Aviation Sustainability



Partners

Air Berlin, Airbus ProSky, ENAIRE (formerly AENA), Norwegian Air Shuttle, Novair and Thomas Cook Airlines

Summary

The CANARIAS project highlighted the benefits offered by dedicated Area Navigation-Standard Terminal Arrival Route (RNAV STAR) and RNP-AR approaches into runways at Lanzarote (GCRR) and La Palma (GCLA) airports. RNAV-STAR approaches involve an aircraft flying along a specific pre-defined route that comprises markers or waypoints to a destination. RNP-AR approaches are more efficient since RNP-compliant aircraft use their on-board systems to plot an accurate flight plan as supported by live GPS feeds. These types of approach trajectories allow aircraft to fly optimised horizontal and vertical paths, which result in a reduction of both CO₂ emissions and corresponding aircraft noise.

Results

The use of the RNP-AR procedure allowed aircraft to perform CDO based on the optimised top of descent calculated by the on-board flight management system (FMS), shorter tracks optimised to take into account adjacent obstacles, stabilised approaches aligned with the runways and lower minima. Overall, these characteristics increased the safety of daily operations, and reduced the environmental impact of aviation on the community.

The following results were achieved by the project:

- Shortened flight tracks;
- Stable approaches aligned with the runway;
- Accessibility to airports surrounded by challenging terrain;
- Optimised descent profiles;
- A reduction of flight times, fuel burn, CO₂ emissions and noise.

An average of approximately 34-38 NM and 292-313 kg of fuel for La Palma and 14 NM and 100 kg of fuel for Lanzarote were saved.

3. DFlex – Departure Flexibility at Paris-CDG

Partners

Aéroports de Paris, Airbus ProSky, Air France, Delta Airlines, DSNA, Eurocontrol, FedEx and HOP!

Summary

Collaborative Decision Making (CDM) is at the heart of airport operations, meaning all actors (ground handlers, ANSPs, airlines and controllers) are working together to ensure that overall operational schedules are maintained. The DFlex project aimed to incorporate enhanced flexibility measures into the Pre-Departure Sequencing process currently in operation at Paris CDG, by allowing flight reordering based on airline business requirements. The desired outcome was to lower the cost exposures experienced by airlines due to delays and cancellations.

Results

Dflex trialled flight Pre-Departure Sequencing with over 2,000 flights at Paris CDG at different periods of time.

The project successfully tested the flexibility of the flight sequence re-ordering procedure to allow

adjustments to be made to the Target Start-up Approval Times (TSAT), whereby airlines could swap the priority of two flights. A total of 50 flights were involved in this test. Based on the success of this initial phase, it was decided to maintain the functionalities, during the busy summer period in order to demonstrate how the DFlex procedure could efficiently handle disruptive situations. By November 2013, more than 500 flights had benefited from the extended use of this procedure.

A second phase test, running from late 2013 to spring 2014, applied DFlex in two departure features covering 1,500 flights that garnered encouraging results. The first feature, “Ready to depart re-ordering”, allowed one flight priority over all others, while the second feature, “substitution”, allowed airlines to use a previously cancelled departure slot. It was found that procedural redesign would be necessary to ensure that airlines cancel slots early enough to allow others to use that slot.

Overall, the project found that the measures introduced were beneficial to those flights involved without penalising those flights outside of the trial. The Dflex procedure was successfully woven into the fabric of operations at Paris CDG, with other airports encouraged to follow suit.



4. FAIR STREAM – FABEC ANSPs and Airlines in SESAR Trials for Enhanced Arrival Management

Partners

Airbus Pro-Sky, Air France, DFS, DSNA, Eurocontrol, Deutsche Lufthansa AG, SKYGUIDE and SWISS International Air Lines AG Ltd

Summary

The project aimed to enhance flight predictability at busy airports and to reduce the need for stacking aircraft at an airports' TMA. The project demonstrated the use of Target Time of Arrival (TTA) instead of – or complementary to – Calculated Take-off Time (CTOT), and evaluated the impact on flight efficiency (time and fuel), air traffic controller workload and flight crew workload.

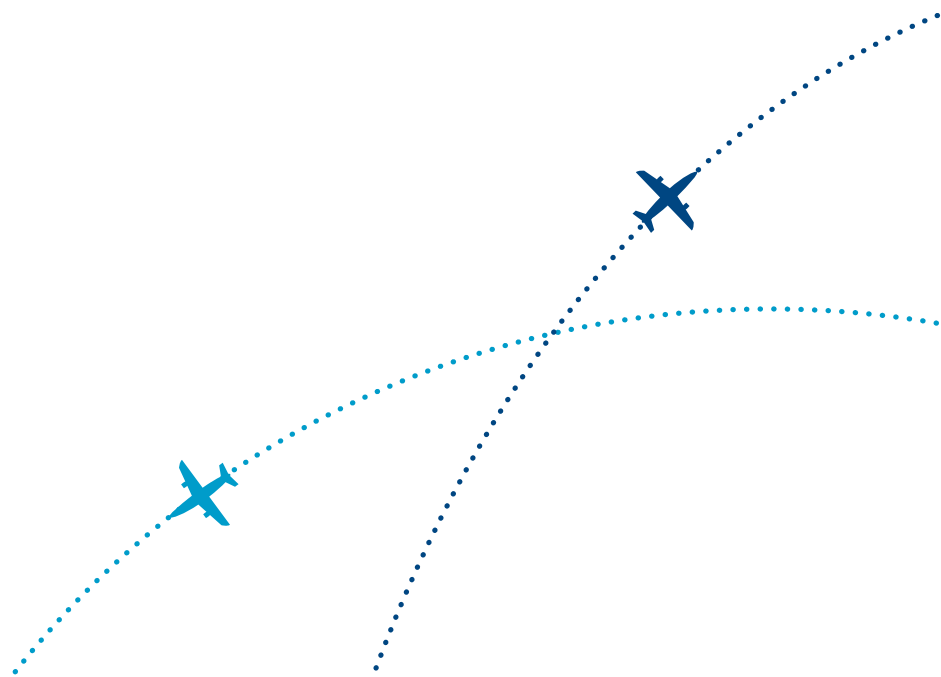
Results

The trials were conducted at three airports (Paris CDG, Zurich and Munich) at which 825 flights were analysed. The project found that the introduction of TTA measures was feasible in the current operational and technical environment, noting that these measures did not result in a significant increase in air traffic controller and flight crew

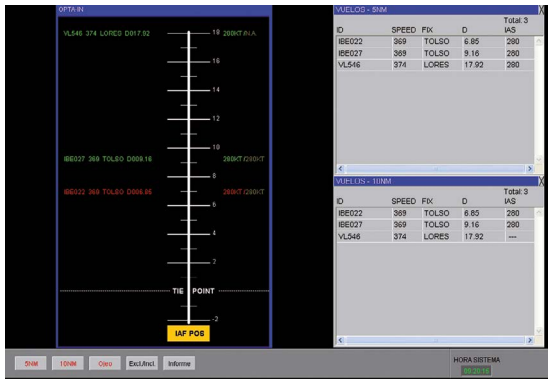


workload. It also showed that flight predictability could be improved through the adherence to TTA and the involvement of all actors, but was influenced by take-off time and unplanned direct routes. With TTA, airlines ultimately have more flexibility in their planning, allowing flights to leave the gate earlier and fly more fuel efficiently.

The work of FAIR STREAM is one step closer to making initial 4D trajectory management a reality, since the project provided all operational actors the opportunity to familiarise themselves with the application of time-based operations with existing ground and on-board equipment.



5. OPTA-IN – Optimised Profile Descent Approaches Implementing Windows



Partners

Air Europa, CRIDA, ENAIRE (formerly AENA), Indra and INECO

Summary

The OPTA-IN project investigated the means of developing fuel efficient flight profiles for a variety of RNP-equipped aircraft within the current airspace density and equipped with air traffic control systems. The project aimed to attain the highest percentage of optimal descents within medium traffic density environments. Air traffic controllers made use of an automated tool to control speed. The tool took into account data from published Speed Reduction Advisory Tables

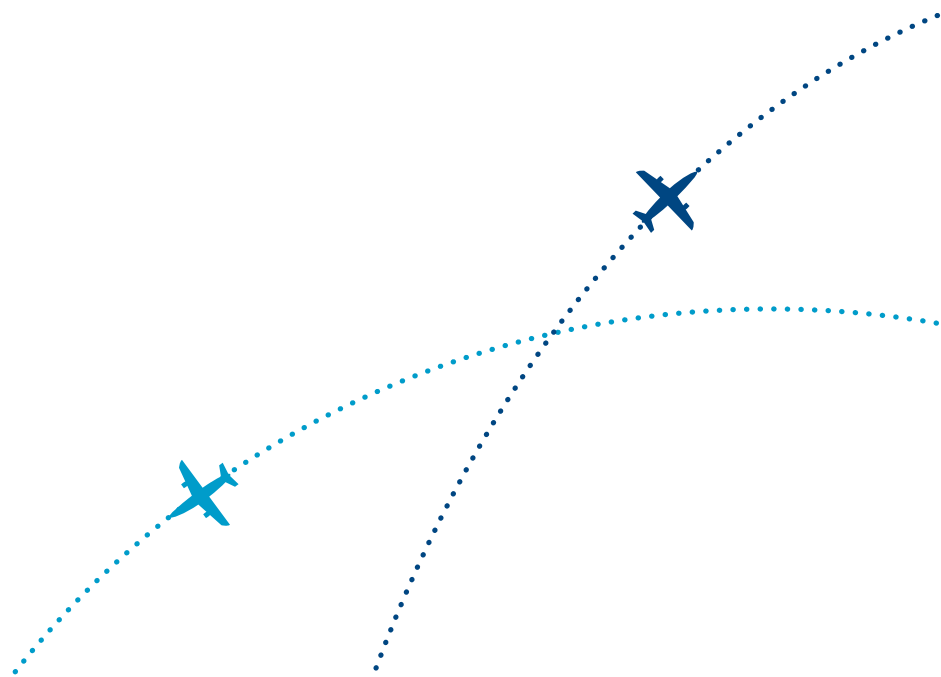
in order to establish ad-hoc optimal CDO patterns for a particular aircraft. The OPTA-IN flights were undertaken at Palma de Mallorca’s largest Airport (TACC), where the OPTA speed control concept had previously been simulated.

Results

A total of 101 flight demonstrations were performed using a number of airframe types, including Embraer ERJ 190s, Airbus A320/1 and Boeing 737/8s. The OPTA-IN project flights highlighted:

- Potential reduction of 7-12% in fuel burn and related CO₂ emissions;
- Possible savings of 600 EUR per 100 aircraft out of the 300 aircraft that fly into the airport daily.
- Possible integration of the support tool into the controller’s working position;
- Possibility to tailor the concept to other operational environments;
- Foreseen application of the concept for the sequencing of three consecutive aircraft.

Finally, the project showed the operational feasibility for allowing optimal profiles to be flown on arrival without requiring an overhaul of the current ATM system. However, it was noted that coordination with the neighbouring Area Control Centre (ACC) is necessary.



6. NEWBRIDGE – Time-based coordination of air traffic movements, bridging technologies (*Ongoing*)



Partners

Airbus Pro-Sky, EANS, EGIS Avia, Estonian Air, LFV, Malmö Aviation AB (TF), NLR, Nova Airlines (Novair), Rockwell Collins France, SAS and Swedavia AB

Summary

The NEWBRIDGE project aims to show the feasibility and cost efficiency of time-based operations, using the maximum possible time horizon available for these operations through reference trajectory-based coordination. It will aim to demonstrate that existing technologies may be applied to achieve the coordination of these

operations and that commercial air transport operations and other type of air operations (such as Remotely Piloted Aircraft) are interoperable through such coordination.

Expected results

The ongoing project involves five exercises including a number of simulated flight trials, which are preparing the various functionalities for seamless implementation. The project aims to achieve improved vertical profiles resulting in reduced fuel burn as a result of the reference trajectory-based coordination.

7. NASCIO – Navigation SESAR Concepts Involving Operators



Partners

Aeroclub Sabadell, BlueSkies, Borajet, BULATSA, CAT Helicopters, DHMI, LPR, ONDA, REGA, IATC Academy, LPS SR, Pildo Consulting SL, Royal Air Maroc and Pyrenees Airlines and UNIZA

Summary

The project aimed to demonstrate the new navigation specifications included in the Performance Based Navigation (PBN) manual for rotorcraft, general, business and regional fixed-wing operators. The project also served to demonstrate the feasibility of integrating Instrument Flying Rules (IFR) based rotorcraft operations at busy airports, including Barcelona El Prat Airport, without interfering with existing fixed wing traffic.

Results

Eight different scenarios were designed and tested by involving operators' fleet equipped with a portable PBN flight validation platform developed by Pildo Labs, known as PLATERO. In total, more than 60 approach and departure operations were performed in coordination with Air Navigation Service Providers (ANSPs) and aviation authorities, demonstrating the significant value that satellite-based navigation technology can provide to rotor and fixed-wing users, which are usually operating at less ground-equipped infrastructures like helipads, heliports and small aerodromes.

The project proved that the newly-introduced navigation specifications included in the PBN manual allow rotor and fixed-wing operators to develop further their actual services upon cost-effective solutions based on satellite navigation technology. It was clear from the trials that the implementation of these innovative operations requires the support and involvement of all stakeholders, and in particular aviation authorities for its final operational approval.

8. REACT Plus – Reduction of Emissions using CDAs and CCDs in TMA



Partners

Budapest Airport, HungaroControl, Pildo Labs and WIZZAIR

Summary

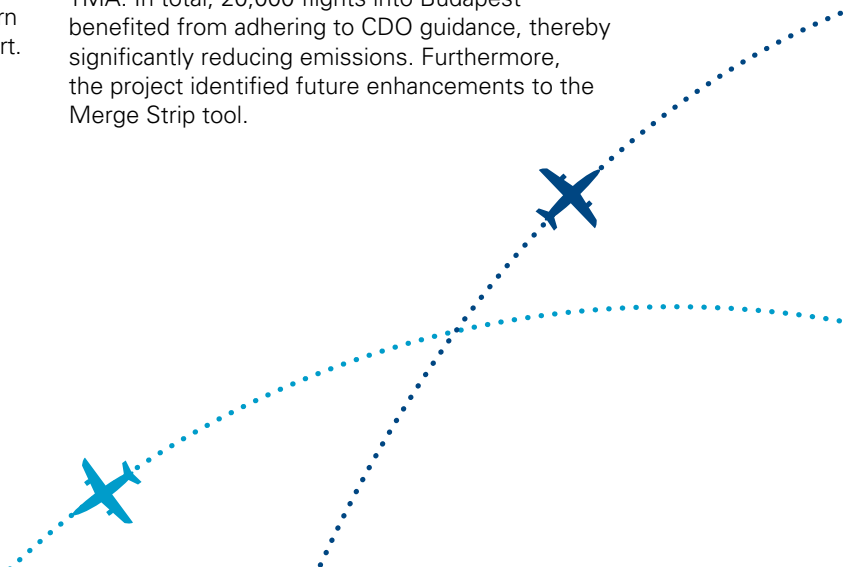
The aim of the REACT-Plus project was to perform CDO and CCO both at and from Budapest Liszt Ferenc International Airport using a new tool – the Merge Strip – which aims to enhance situational awareness and provides Distance-To-Go (DTG) information to pilots. The project measured the extent to which CDO and CCO decreases fuel burn when implemented at the target destination airport.

Results

In total, 474 CDO and 3,639 CCO flights were conducted with the following results:

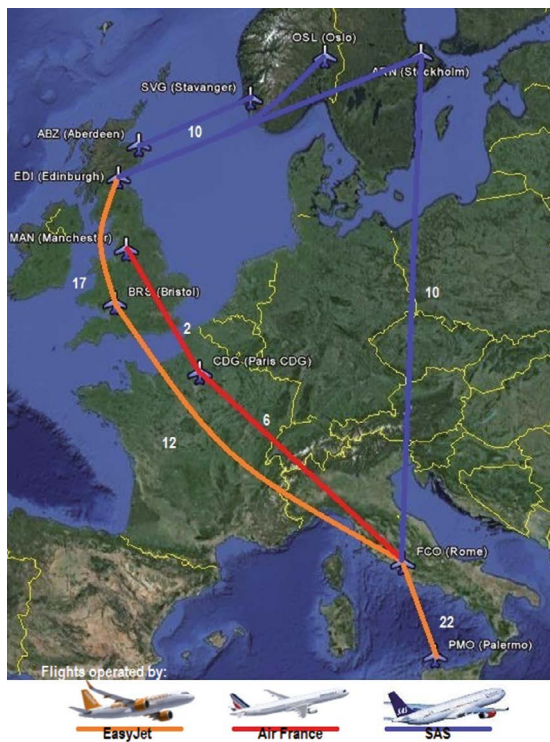
- Conclusive 48-50% savings in fuel consumption during CDO operations;
- A total of 102 kg of fuel was conserved during each CDO-themed flight.

The outcome of the project opened up the possibilities of airlines flying CDO/CCO procedures within the Budapest Liszt Ferenc International TMA. In total, 20,000 flights into Budapest benefited from adhering to CDO guidance, thereby significantly reducing emissions. Furthermore, the project identified future enhancements to the Merge Strip tool.



Oceanic and en-route projects

1. AFD – ATC Full Datalink



Partners

Airbus ProSky, Air France, Boeing, EasyJet Airline Company Limited, ENAV S.P.A., NATS (En Route) plc, SAS, Selex ES SpA and SITA Information Networking Computing

Summary

The AFD project aimed to prove that it is possible to leverage on existing technology investments made by airlines (using modern flight deck equipped aircraft) and ANSPs across Europe that comply with the EU ⁽²⁾ Implementing Rule on data link services. The demonstration project aimed to show how controller-pilot data link communications (CPDLC), as opposed to voice exchanges between pilots and controllers, can increase capacity, reduce radio frequency congestion and increase safety levels within continental airspace.

Results

A total of 80 trials were performed in both Italian and UK airspaces between February and May 2014, showing the operational acceptability of the use of CPDLC applications to replace routine voice. They also confirmed that data link services are relevant to perform air-ground ATC coordination and to deliver benefits to airlines. The system infrastructure used for AFD allowed a detailed analysis of data link performance at the network and radio-frequency level. Preliminary results of the SESAR AFD demonstration activities were provided to EASA and are reflected within their “Report on Technical Issues in the Implementation of Regulation (EC) No 29/2009 (Data link services)”.

⁽²⁾ Commission Regulation (EC) N° 29/2009 of 16 January 2009 laying down requirements on data link services for the single European sky (Text with EEA relevance) <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009R0029>

2. ENGAGE PHASE II – Europe-North America Go ADS-B! for a Greener Environment II

Partners

NAV Canada, NATS (En Route) plc and Air France

Summary

This project built on the success of ENGAGE PHASE I by demonstrating the safety of performing variable aircraft (Mach) speed and flight altitudes over the North Atlantic. With a much broader scope than the 2011 first round of the initiative, ENGAGE II retained the objective of reducing emissions and fuel burn, but with a much wider airspace catchment area, extending both North and South of the original trials. The larger airspace served to encompass a greater number of eligible flights, thus increasing the probability of successfully demonstrating that the procedures are feasible and safe.



Results

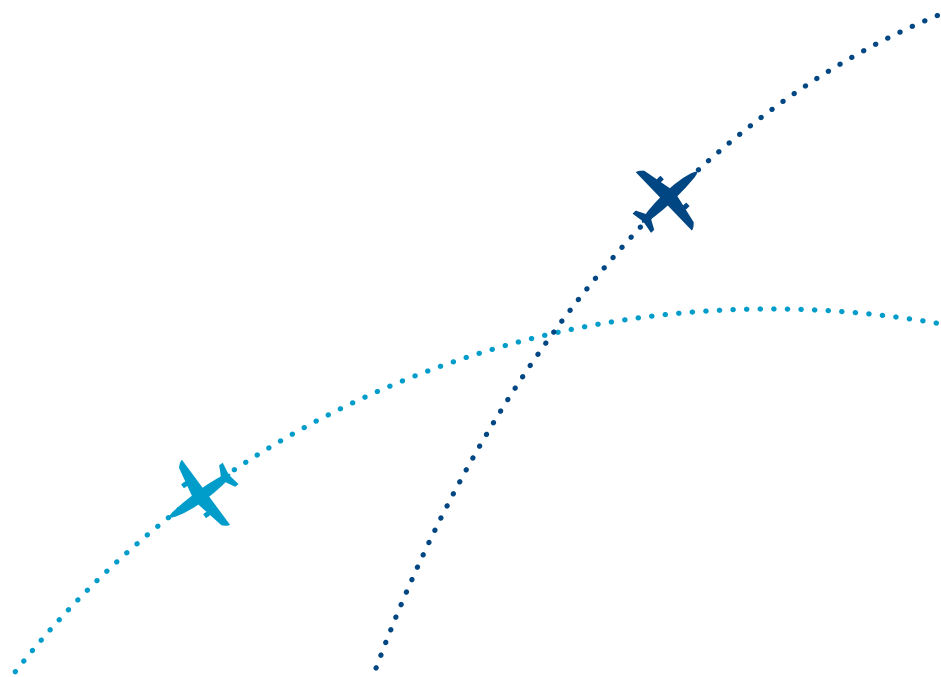
A total of 210 ENGAGE flight trials were conducted by five different airlines between Europe and Canada, out of which 200 contributed relevant data. To comply with safety aspects, a safety survey was completed by trial participants.

Confirming the green credentials of ENGAGE, this extended exercise achieved the same level of fuel and emission reductions as the former initiative, namely:

- 200-400 litres of fuel savings representing an average of 1-2% of fuel conserved;

- Safety levels maintained with no incidents reported by operators.

Having presented the findings to the ICAO North Atlantic System Planning Group (NAT SPG), the next stage of the project was the removal of speed restrictions during oceanic flights in favour of the proven variable Mach speed concept. To date an implementation roadmap has been established with recommendations to the NAT ANSPs for the process for adoption by airspace users.



3. FRAMaK – Free Route Airspace for Maastricht and Karlsruhe



Partners

DFS, Deutsche Lufthansa AG and Eurocontrol MUAC

Summary

FRAMaK aimed to demonstrate that free route capabilities are possible within congested and complex airspaces that cross national borders and ANSP boundaries. The project also aimed to show that these capabilities can have a positive impact in terms of reduced flight times and fuel burn.

Results

466 Cross-Border Direct routing options and 62 Cross-Border User Preferred Routes (UPR) were published for a high-density airspace comprising of the Karlsruhe Upper Airspace Centre (UAC) and Maastricht UAC, thereby creating a large-scale free routing airspace over Belgium, most of Germany, Luxembourg and the Netherlands. Flight Plan and track data of some 17,295 flights were collected in this timeframe with which the following results were obtained:

- For Cross-Border Direct routing operations, the lengths of Flight Plan routes were reduced by 6.8 NM per flight (or -0.6%), while the lengths of actual flown routes were reduced by an average 3.7 NM (0.3%);
- For short haul Cross-Border UPR operations, lengths of flight routes were reduced by 16 NM, corresponding to fuel savings between 6 kg and 87 kg, with an average of 5.5 kg in fuel saving per NM;
- For long haul Cross-Border UPR operations, the lengths of flight routes were reduced by between 12 NM and 25 NM, corresponding to fuel savings between 280 kg and 618 kg, an average of 23.6 kg per NM.

The project showed that UPR allows aircraft operators to determine the most cost-efficient routes, such as those that take advantage of tail wind inducing jet streams and turbulence avoidance. It concluded that further development of the flexible use of airspace is required, while the widespread application of the concept is dependent on having support tools to optimise the trajectory, minimise workloads and mitigate environmental impact.

4. ICATS – Interoperability Cross-Atlantic Trials

Partners

Air Europa Lineas Aereas , CRIDA, ENAIRE (formerly AENA), Indra Sistemas, NAV Portugal and Lockheed Martin UK Limited

Summary

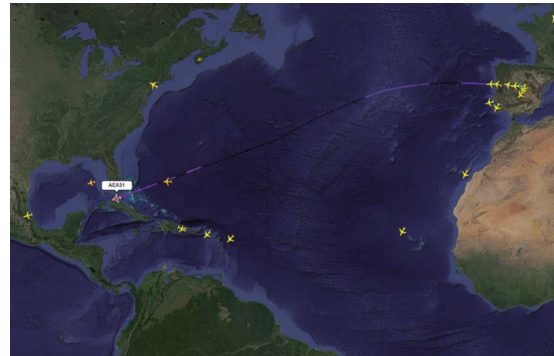
The overall aim of the ICATS project was to demonstrate, via flight trials, that the sharing of flight-related data between airlines and international air traffic control systems – oceanic and domestic – across both sides of the North Atlantic can result in flight efficiencies, as well as environmental, safety and capacity gains.

Results

More than 240 flights were conducted in the northern part of the Atlantic Ocean, connecting the USA and countries making up the Iberian Peninsula (Spain and Portugal). The project included two demonstration exercises supported by a ground infrastructure based on Flight Object (FO) Interoperability technology built on US/EU FIXM/ED-133 concepts and models, complemented by a inter regional Global Flight Object model developed specifically for the project. More than 40 trials were performed (39 Westbound and 2 Eastbound) and more than 200 inbound flights (Eastbound flights) were analysed.

The first trials centred on flight optimisation to deliver the following results:

- A 1.4% fuel burn and emissions reduction, exceeding the 1% prediction;
- A 5% reduction in the rate of trajectory change requests, with pilots and controllers agreeing



on the benefits through using interoperable and compatible systems;

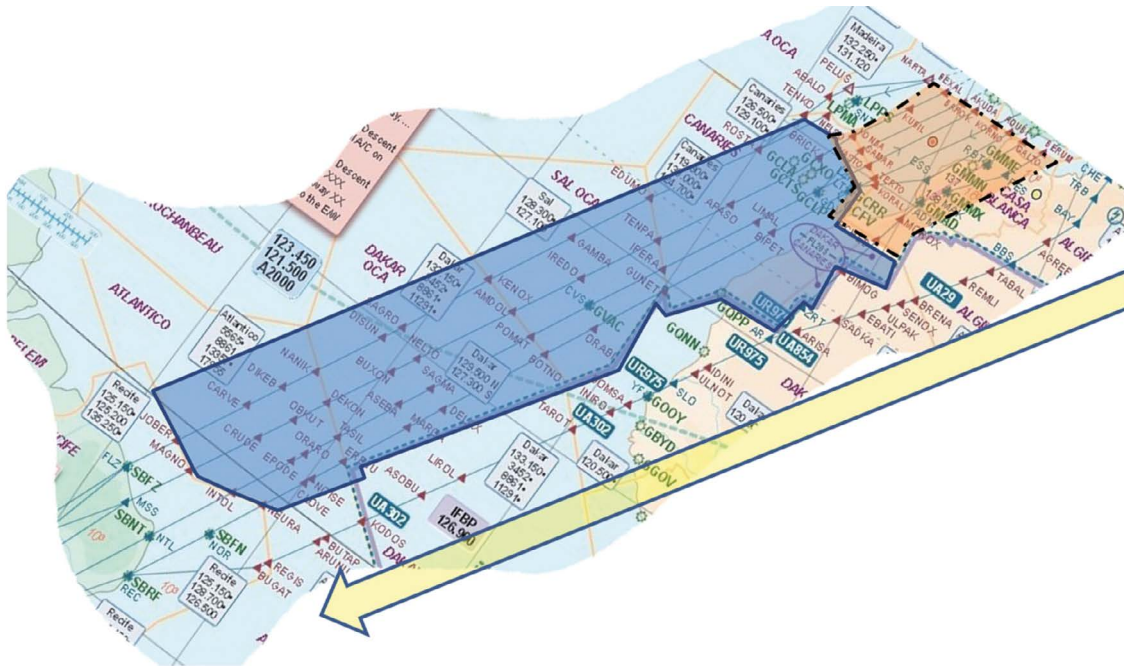
- As reported by controllers, tactical conflicts were dealt with relative efficiency as information was provided to them in advance of the time when the decision-making event would become necessary.

The second set of trials analysed the ICATS data with the following noted outcomes:

- ICATS data accuracy of the sector load calculation and sector overload was improved when compared to the current Flight Information Position system;
- Greater predictability (18 minutes) and accuracy (8 minutes) were also ascertained.

The agreement of the FO interoperability concept between ICAO regions is critical. It was recommended for larger trials to be carried out for further validation and access to better data. The latter would further validate the benefits to airspace users in respect of accuracy and predictability of operations using interoperable FO systems.

5. SATISFIED – SAT Improved use of Flight corridor for Emissions reduction



Partners

Air Europa Lineas Aereas, ANSPs from South Atlantic (SAT) Oceanic, Dakar Oceanic and Atlantico Operational Control Centres (OCC), ENAIRE (formerly AENA), Iberia and INECO

Summary

The project introduced the free routing concept within oceanic corridors. Specifically, the project conducted user-preferred route operations, taking into account prevailing meteorological conditions when deciding the best route that delivers the lowest fuel burn and a marked reduction in associated CO₂ levels.

Measures adopted during the trials included:

- Reduced separation between RNP4 equipped aircraft;
- Optimised oceanic entry and exit transition;
- Oceanic trajectory transition (horizontal, vertical and longitudinal);
- Improved use of meteorological information.

Results

A total of 165 flights were flown, of which 36 were optimised either statically (Statically Optimised

Flight - SOF) or dynamically (Dynamically Optimised Flight - DOF). The former generates a flight profile that considers extreme weather conditions prior to departure with the latter implementing free routing for a truly optimised flight path. The project resulted in the following:

- An average reduction of 500 kg of fuel, amounting to savings between 1% to 2.5% depending on the aircraft;
- Reductions of around 1,578 kg in CO₂ emissions;
- Current flight taxes have a visible influence on the decision-making process of airlines – these taxes are integrated in airlines' flight planning software.

The project concluded by indicating the changes necessary to implement the concept in the EUR-SAM corridor. These include equipping all aircraft with Future Air Navigation Systems (FANS1/A at a minimum) and a wholesale upgrade of ATM systems to ensure a seamless overlap between the different FIRs and allowing for the necessary separation of aircraft.

The project also recommended implementation at airline level. To this end, the project developed an online course for the dissemination of the concept and guidance in the set-up of operations.

6. SMART – Shared Monitoring Alert and Reaction Tracking (*Ongoing*)

Partners

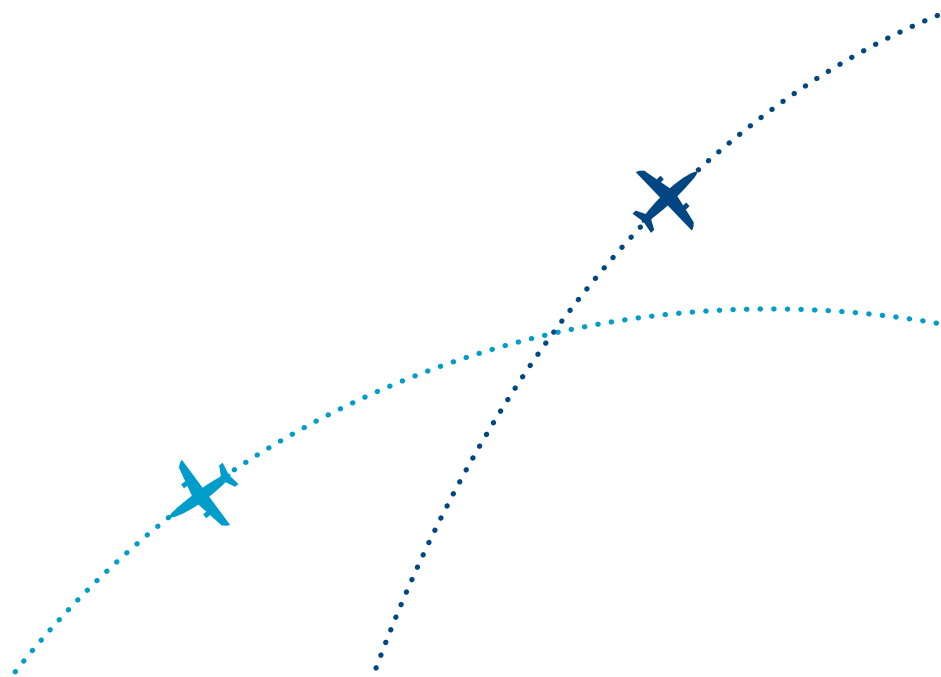
Adacel, Air Europa, Air France, Iberia, INECO, NAV Portugal, Novabase, SATA and TAP Portugal

Summary

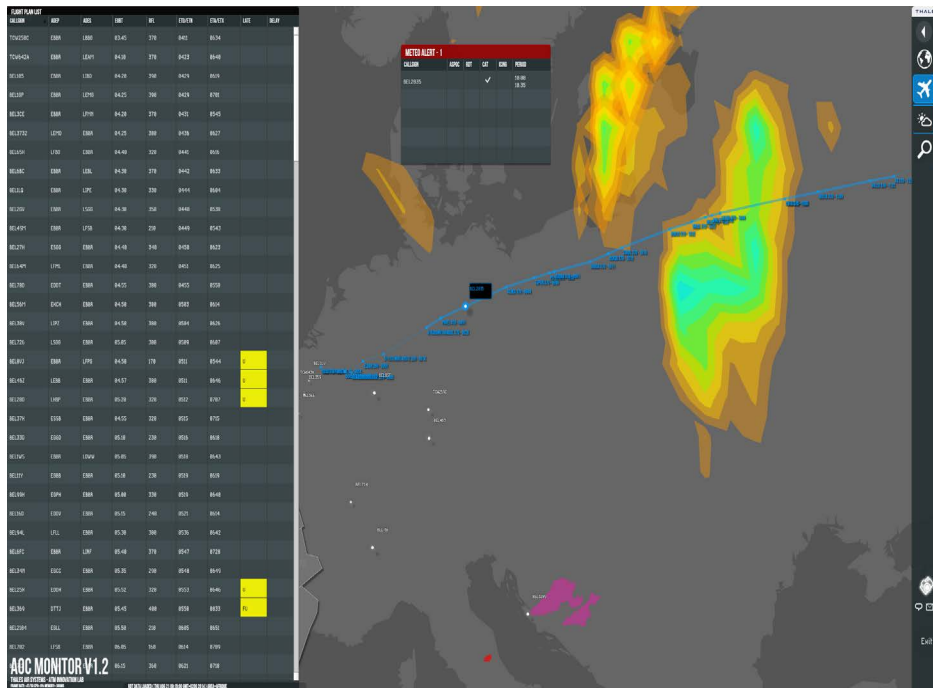
The SMART project aims to share real-time data between airlines, ATM and systems in order to optimise oceanic flights and provide the most cost-efficient routes based on current and prevailing meteorological conditions. Optimisation is triggered when a significant deviation occurs between the meteorological forecast used for the last coordinated flight plan and newly available meteorological information. Optimisation also takes place when a SIGNificant METeoroological Information (SIGMET) is broadcast by a meteorological office that is monitoring a particular airspace.

The key enabler of SMART is a system under development that feeds airline dispatch offices (via internet or email) with information on flights and their current global positioning in terms of the FIR (and times) that could be optimised.

SMART trials have been extended into April 2015, with the expectation that the demonstrations will amount to 250 flights (50 per airline).



7. TOPMET



Partners

Brussels Airlines, DSN, GIE EUMETNET, Thales Air Systems SA and Thales Avionics SA

Summary

TOPMET aimed to test a new set of meteorological services tailored for use by ATM. The tests were designed to highlight the improved accuracy in the monitoring and forecasting of adverse weather conditions.

Results

Over 1,000 flights, primarily flown by Brussels Airlines, were involved as part of evaluating the accuracy of the MET services.

Overall the project resulted in:

- Improved awareness by ATM stakeholders of the new MET services. This involved collecting their operational feedback to better focus the development of such service provisions according to actual needs and priorities;
- Demonstration of the interoperability of the MISC (4DWxCube) between multiple MET providers (NMS) and multiple ATM and aviation clients (Airline ground and air segments,

ANSPs), at different geographical scales (sub-regional – typically over the western EU airspace, or multi-regional – typically over the EU/Atlantic/Africa airspaces);

- Demonstration of the air-ground pre-SWIM operations in a non-safety-critical environment.

A number of key performance indicators (KPI) were established to evaluate the accuracy of MET data in the context of being able to mitigate delays, costs and fuel burn due to adverse weather. The results showed in many instances that the new MET services were able to assist both airlines and air traffic control to minimise delays, cancellation and costs due to the accuracy of forecasts:

- A 79% reduction of MET-related fuel consumption per flight (from 4,700 kg to 1,000 kg);
- A 73% reduction MET-related extra costs per flight (from 3,748 EUR to EUR 1,020 EUR, not taking into account indirect costs);
- A 33% reduction in MET-induced extra flight duration (from 9 to 6 minutes for every four flights).

The project concluded recommending that further enhancements could be made to MET products and procedures for their integration into daily operations.

8. TOPFLIGHT



Partners

Airbus ProSky, Barco Orthogon, Boeing, British Airways PLC, Eurocontrol, ICAO North Atlantic Groups, NATS (En Route) plc and NAV CANADA

Summary

The overall objective of the project was to demonstrate SESAR procedures designed to allow transatlantic flights to follow a trajectory as close as possible to their Reference Business Trajectories (RBT) while remaining de-conflicted and meeting their Arrival Manager (AMAN) sequenced times of arrival. TOPFLIGHT also assessed the use of Cross Border Arrival Manager (XMAN) by extending the Arrival Manager horizon for London Heathrow inbounds to 350NM.

Results

More than 20,000 flights were involved in the trials, divided in two phases: May, June, July 2013 and April 2014. A comprehensive range of SESAR Solutions were tested.

Phase 1 involved 100 transatlantic flights and validated several SESAR Solutions with the optimisation of one flight at a time: (Reduced Engine Taxi, Oceanic Clearance Delivery for aircraft at gate, Continuous Climb Operations, Business Trajectories, Advanced Flexible Use of Airspace, Optimised Oceanic Profiles including Continuous Cruise Climb and Variable Speeds, Continuous Descent Operations) as expected.

The sustainability and feasibility of these SESAR elements was proven during Phase 1:

- 25% of the trial flights achieved full gate-to-gate optimisation by the application of every single concept element. For 70% of the demonstration flights;
- More than 60% of the concepts in place were applied;
- Up to 834 kg fuel was saved in the westbound and 301 kg fuel was saved in the eastbound flights.

Phase 2 included the assessment of 20,000 flights to understand the benefits of extending the horizon of the arrival manager at London-Heathrow to 350NM, crossing the FIR boundaries (Cross Border AMAN – XMAN). The results of Phase 2 include:

- Effective queue management (XMAN trials) can partially tackle ATM system inefficiencies that cause delays;
- 40 kg-150 kg of fuel for each arrival saved through reduced stacking and orbital holding time;
- 168 flight trials validated the accuracy of data in ATM systems required to implement oceanic metering;
- Confirmed the capability for delay absorption for flights en-route to London Heathrow.

The success of the project in demonstrating the feasibility and benefits of the SESAR concept has reinforced commitment regarding the early transition of some of those elements into sustainable operations in complex TMA, high-density en-route and oceanic environments.

9. WE-FREE – Week End Free Route for Environmental Efficiency



routing, conducting en-route optimisations mostly in the lateral dimension with vertical adjustments as a secondary option.

Results

A total of 128 trial flights were conducted as part of weekend operations from Standard Instrument Departure (SID) exit points to Standard Terminal Arrival Routes (STAR) entry points between CDG and nine Italian airport destinations respectively.

Combining all trial flights, the WE FREE routings generated the following savings:

- 925 NM in route lengths;
- 140 minutes in flight time;
- 6.5 tonnes of fuel;
- Daily savings of 20 tonnes of CO₂;
- A fuel reduction of 1% was achieved due to the use of the project's horizontal deviation compared to current horizontal deviations.

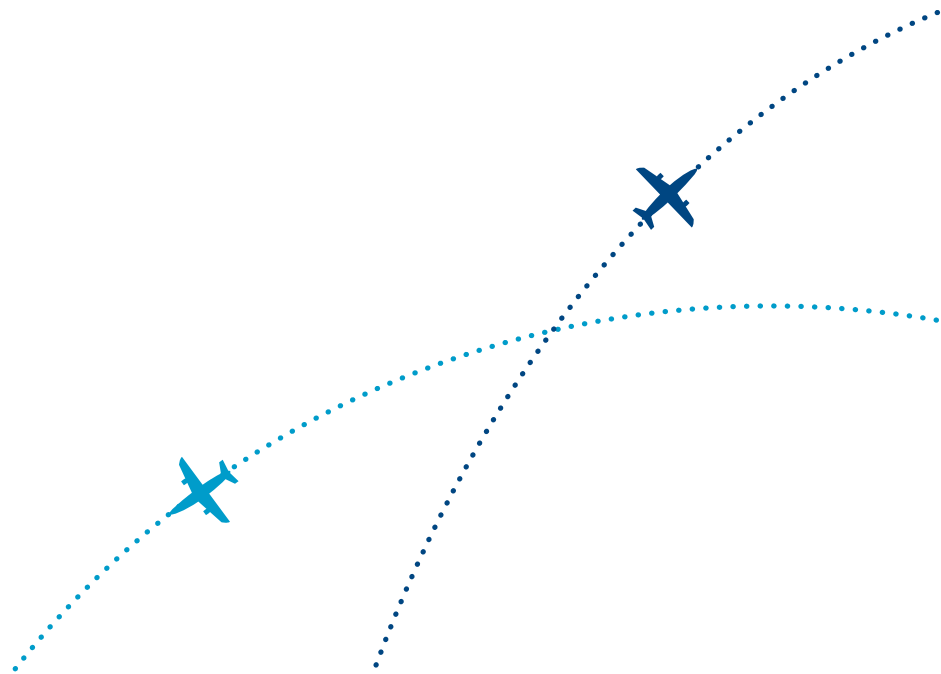
The favorable project outcomes have resulted in more challenging cross-FAB live trials proposal, which is essentially an expanded free routing exercise.

Partners

DSNA, SKYGUIDE, ENAV, Air France, Alitalia and HOP!

Summary

The WE FREE project aimed to demonstrate how the concept of free routing during weekend operations can contribute to reducing emissions in congested airspaces when applied to city pairing routes. The project focused on user preferred



Gate-to-gate Projects

1. MAGGO – Multiple Atlantic Gate to Gate Optimisations (Ongoing)



Partners

Adacel, Nav Portugal, TAP Portugal and SATA

Summary

This MAGGO project aims to facilitate the adoption and implementation of operational improvements that benefit from the latest ATM systems, taking account of automated future air navigation (FAN) requirements. These enhancements are expected to yield

a reduction in emissions as a consequence of lower fuel burn.

As an example, the project will provide evidence of the efficiency of implementing 50NM lateral separation in Santa Maria Oceanic (from 60NM or 1 degree latitude). The project findings will allow demonstrating PBN implementation on the NAT region and the alignment with adjacent airspace as well as to increase airspace efficiency. Commercially flown flight trials will be conducted in 2015, with 100 test flights expected. Results are expected in April 2015.

Conclusions

As part of these latest 18 SESAR Demonstration Activities, more than 30,000 trials were conducted on commercial flights in real-life operational conditions, offering a critical mass of proof for the performance benefits that SESAR Solutions can deliver to the ATM community. Thanks to the successful outcomes of these projects, there is increasing confidence among ATM actors today towards implementing these solutions.

Of course, a holistic view must be taken of the ATM system in order to achieve high performing aviation for Europe. It is therefore reassuring to see that these projects are providing and accelerating the momentum for SESAR members

and partners to perform larger and more complex projects together. In this respect, 15 large-scale projects were launched in 2014 to demonstrate that SESAR solutions are relevant for uptake within a much wider operational environment across Europe. Demonstrations will also be a major focus for the SESAR 2020 strategy, due to be launched in 2016.

By working together on SESAR Demonstration Projects, the European aviation community is proving that the first SESAR solutions for the future ATM system are ready for industrialisation.

Check www.sesarju.eu regularly for updates on SESAR Demonstration activities.



Acronyms

4D	Four-dimensional
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Area Control Centre
ADS-B	Automatic Dependent Surveillance-Broadcast
AIRE	Atlantic Interoperability Initiative to Reduce Emissions
AMAN	Arrival Management
ANSPs	Air Navigation Service Providers
AOC	Airline Operations Centre
ATCO	Air Traffic Controller
ATM	Air Traffic Management
CDA	Continuous Descent Approach/Arrival
CDM	Collaborative Decision Making
CDO	Continuous Descent Operations
CFMU	Central Flow Management Unit
CO₂	Carbon dioxide
CPLDC	Controller-Pilot Data Link Communications
CTOT	Calculated take-off time
DTG	Distance-To-Go
DMAN	Departure Management
FANS	Future Air Navigation System
FIR	Flight Information Region
FMS	Flight Management System
GSNSS	Global Navigation Satellite System
INA	Initial Approach
IFR	Instrument Flying Rules
OTS	Organised Track System
PBN	Performance Based Navigation
RBT	Reference Business Trajectories
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance Authorisation Required
SID	Standard Instrument Departure
STAR	Standard Terminal Arrival Route
TMA	Terminal Manoeuvring Area
TOBT	Target-Off Block time
ToD	Top of Descent
TSAT	Target Start-up Approval Time
TTA	Target Time of Arrival
UPR	User Preferred Routes
XMAN	Cross Border Arrival Manager

About the SESAR Joint Undertaking

A well-functioning and efficient Air Traffic Management (ATM) system is a vital element for the sustainability of global aviation. That is why in 2004, SESAR (Single European Sky Air Traffic Management Research) was set up to modernise and harmonise Europe's ATM system through the definition, development and deployment of innovative technological and operational solutions.

The SESAR Joint Undertaking (SJU) is a public-private partnership, which pools the knowledge and resources of the entire ATM community in order to implement SESAR's Research and Innovation (R&I). Founded by the European Union and Eurocontrol, the SJU currently has 15 industry members: ENAIRE (formerly AENA), Airbus, Alenia Aermacchi, DFS, DSN, ENAV, Frequentis, Honeywell, Indra, NATMIG, NATS (En Route) Limited, NORACON, SEAC, Selex ES and Thales.



Discover more about the SESAR Demonstration Activities

YouTube: www.youtube.com/user/SESAREuropeanUnion

Website: www.sesarju.eu/innovation-solution/demonstrating-sesar



For the latest information, please consult our website:

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Members



Associate Partners



Associate Partners to the SESAR Joint Undertaking

