



Agenda Item2: *Air traffic management (ATM)*

SATISFIED

(Presented by SATMA)

SUMMARY

This information paper contains the main results of the SATISFIED (**SAT** Improved uSe of Flight corrdIdor for Emissions reDuction) project.

1. INTRODUCTION

A flexible route network framework would allow airlines to make full use of the information on influencing prevailing upper wind conditions and updated payload, to thus reduce fuel burn and CO₂.

The objective of the **SATISFIED** (SAT Improved uSe of Flight corrdIdor for Emissions reduction) project has been to demonstrate that further improvement in en-route aircraft performance is possible through the execution of flexible optimized oceanic route trials inside the EUR-SAM corridor. Particularly, flight demonstrations validating the solutions for CO₂ emissions reduction were performed in the oceanic domain over the South Atlantic region, covering the following Oceanic centers: CANARIAS, SAL, DAKAR and ATLANTICO.

The final SATISFIED report will be available on SJU web page: <http://www.sesarju.eu/innovation-solution/demonstrating-sesar/aire>.

2. BACKGROUND

Past projects as Iflex and the continuing AIRE Framework have shown significant savings in fuel consumption and emissions when flexible routes are allowed in OCEANIC control areas (as in the NAT region), without increasing the workload of the operators (ANSPs and Crew).

Currently in the EUR-SAM corridor a very limited number of random routes are available to improve the routes for very long haul flights (i.e. Santiago de Chile). However, fixed airways are used which do not allow the optimization of the flight profile as prompted by modern flight plan software and aircraft.

In this line, during the SAT17 and SAT18 meetings, Spain introduced the AIRE strategic partnership to reduce emissions in the EUR/SAM Corridor in order to improve energy efficiency through the development and the implementation of environmental friendly procedures: the Satisfied Project.

3. RELEVANT FEATURES OF SATISFIED PROJECT

3.1 SCOPE

SATISFIED was based on the aircraft following their preferred track without the constraints of the fixed airways passing through of four ACCs: Canarias, SAL, DAKAR and ATLANTICO.

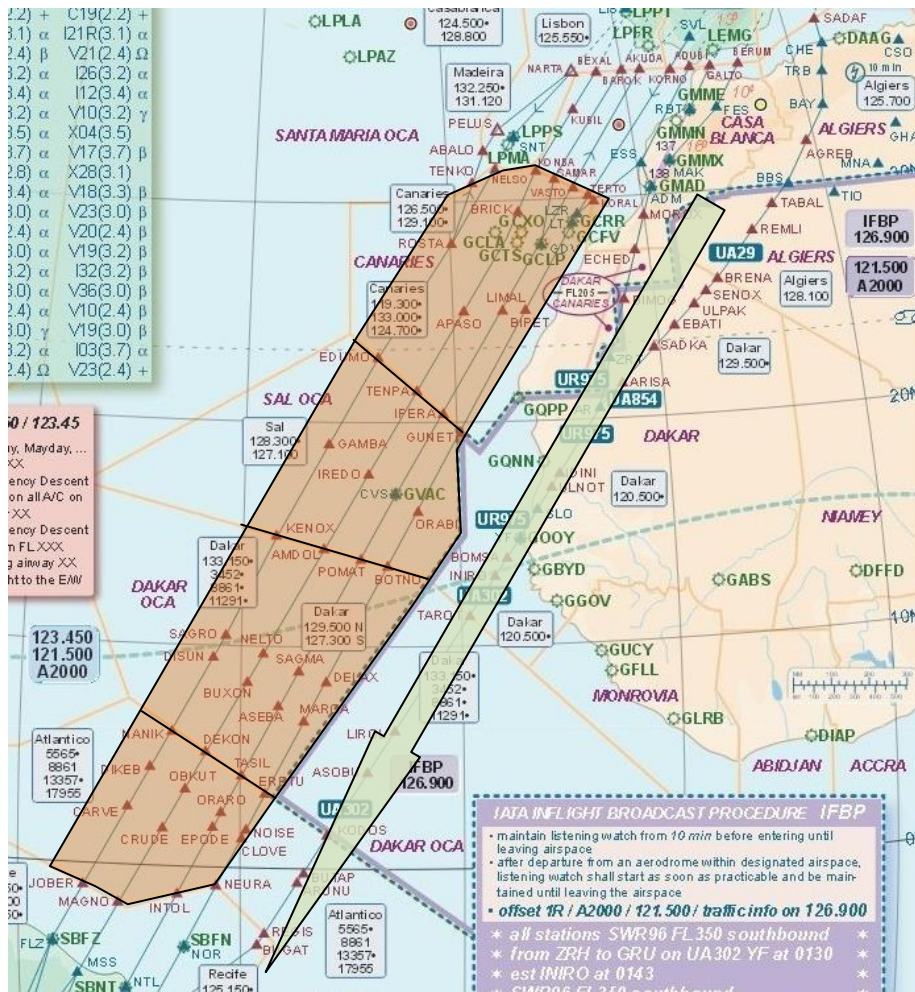


Figure 1: Area of Interest

In order to guarantee at least a minimum of 50 flight demonstrations, number required by SJU, it was defined a period for the performance of the flight trials: between March 2013 and April 2014. Likewise, the transoceanic flights were exclusively performed by member of consortium's aircraft connecting Europe to South America (AirEuropa and Iberia).

Only South-West flow, from Europe to South America, was considered in these demonstration trials. The rest of flows were discarded due to both Canarias ACC was exclusively the responsible to coordinate the trials with the rest of stakeholders (airlines and of ACCs) as well as that involved AOC's staff was located in Spain.

3.2 PREMISE TO THE SATISFIED PROCEDURE (AIRLINES)

Any SATISFIED flight complied with the following:

- The flight plan was uniquely identified as a SATISFIED test flight adding to field 18 the following: **“SATISFIED STANDARD”**.
- One flight per day (to keep the ATC workload) was conducted as is shown in the table below:

ORIGEN	Destination	DAY	Period	Airline	Aircraft	Max. nº Flights
MAD (LEMD)	EZE (SAEZ) GIG (SBGL) GRU (SBGR)	Tuesday Wednesday	-Daytime	IBERIA	A340-300/600	1 X day
	SSA (SBSV)	Tuesday ¹ Thursday	Daytime	Air Europa	A330-300	1 X day

Table 1 Candidate flights

- Aircraft will be FANS1/A equipped and certified, as well as the crew certified in the use of CPDLC/ADS-C.
- Exceptionally these flights had to **Log-On to CANARIAS 1 (one) hour before the entrance to the FIR identifying themselves as “SATISFIED” flight**, in order to have direct communication in case of a setback in the process.
- The demonstration flights by AirEuropa took place between March 2013 and April 2014.
- The demonstration flights by Iberia took place between the 7th of May 2013 and April 2014.
- *Any flight planned through route UA-302 or Santa Maria was excluded from the trials due to Canarias ACC cannot coordinate them.*

In order to reduce the workload and coordination, it was applied a unique and independent procedure for airline and/or destination.

3.3 INTERNAL COORDINATION (ASNPs)

The SATISFIED working group elaborated a technical note in order to describe:

- The different tasks together with their responsibilities;
- Coordination processes among the different participants;
- The preliminary risks and mitigating solutions which have been identified for the performance of the SATISFIED flight trials.

This technical note was agreed by involved stakeholders: ANSPs and Airlines and it allowed to have a safety and optimized operation in EUR-SAM Corridor during the trials period.

5. SATISFIED RESULTS

A total of planned **165** flights were flown of which 36 were optimized either statically (Statically Optimized Flight - SOF) or dynamically (Dynamically Optimized Flight - DOF). Around 40% of the flights were found to choose another route which would partially or not at all cross the EUR-SAM Corridor (see Figure 3:).

	Iberia	AirEuropa
NOT Optimised	44	85
Dynamically Optimised	5	7
Statically Optimised	20	4
Total	69	96
Total planned flights	165	
Total optimised flights	36	

Table 2 Results of the IBERIA and AirEuropa campaign

Although there were a small number of Optimized flights captured, the results have partially helped fulfill the main aim of the project: reduction in emissions and fuel burn. The environmental operational assessment performed has shown potential reductions in fuel burn and emissions of around 2-3% depending on the airline flying (and the fleet).

Sadly the reduction is only indication of a trend and not a solid statistical value due to the small number of flights actually performing the SATISFIED procedure. It is in fact more likely that the reduction is due to SOF, which establishes the update of the first flight plan to the actual values coming from the a/c's load sheet. This value was later used by the environmental impact assessment (EIA) to calculate its indicators and as a feed in for the economic analysis.

In fact, the environmental impact assessment applied to a SATISFIED Progressive implementation scenario (evolution of traffic, fleet capabilities, etc.) estimated:

- That the application of the SATISFIED process could save the equivalent of 1.8% in distance for each flight.
- That about 1.85 tones of CO₂ could be saved on a per-flight basis with the introduction of the SATISFIED process.
- That the progressive implementation of the SATISFIED process would save airlines 155 million Euros* during the next fifteen years.
- Based on a forecast of 325,459 Optimized flights during the next 15 years, the economic savings are translated to 477€ saved per flight.

* Assuming current - 2014 -kerosene prices of 750€/t and expected MBM offsetting costs and 20€/t of CO₂. The fuel price forecast is quite uncertain, and it is out of the scope of this study to focus on that detail. Given the proposed costs, 8% of the savings would be due to environmental Market Based Measures (MBM) for CO₂ emissions. Further savings can be expected in the future if other pollutants such as NOx are included in the MBM programme.

On the other hand it was fundamental for the free route concept since it highlighted, for these types of procedures, that there are constraints inherent in the EUR-SAM airspace and the possibilities for the implementation of improvements in the same line. In particular from the operational side what was found was that:

- That all the candidate flights were accepted by the EUR-SAM OCCs involved, showing the high degree of coordination between them;
- The restrictions, imposed by neighboring fixed ATS route network environment, have not given the flexibility required for the flight planning systems to deliver the sought improvement. Meaning that the current environment (with different level of maturity in systems and in traffic equipment) does not allow implementing the free routing concept to all flights;
- That existing AOC flight planning systems are not ready to optimize only part of the total trajectory, since the objective is the optimization of the whole origin/destination route;
- In many cases the flight plan (main tool of the airline) could not improve the route based on the conditions and change in parameters offered.

Finally, the project has delivered the first results of trying to deploy the free route concept to the EUR-SAM corridor. Even though the data collected is not enough to validate through these flights what was proved beneficial in theory and in other demonstration campaigns (DORIS, AIRE, etc..), it has shun more light on the critical changes needed for the deployment of the free route concept through these 4 Oceanic Control Areas.

It has also clearly shown the commitment/preparedness of all the operational actors and the maturity of the systems to the task.

6. SATISFIED RECOMMENDATIONS

Based on the results and experiences during the trials, a set of aspects should be taken into account when the implementation of the operational concept tested in SATISFIED is going to be put into service. The fact of having such an heterogeneous mix of fleet equipage, makes the implementation of the SATISFIED operational concept difficult. Currently some traffic can be correctly monitored through ADS-C and information/communication can be interchanged through CPDLC, but this is not universally possible, hence safety issues could arise due to the uncertainty relative to the traffic's position while sharing the same airspace.

Finally the first prerequisite would be to have all the aircraft crossing the EUR-SAM corridor, *between certain flight levels*, conveniently equipped with ADS-C and CPDLC (FANS1A).

- The EUR/SAM corridor must develop a transition/modernization plan which allows adequately equipped aircraft (e.g.: FANS1/A) to take advantage of their systems by allowing reduced separation and optimum performance, while maintaining as far as possible compatibility with the rest of the traffic operations crossing the EUR/SAM corridor ("worse equipped aircraft"). At the same time, the surrounding ATS airways' network, defining the EUR/SAM corridor, should be reviewed and updated to guarantee the continuation of the optimized trajectory.

In an environment where all the traffic would be at least FANS1A or better equipped the implementation of new functionalities in the ATC system like MTCD could be considered, which would easily provide for an enhanced, adequate,, efficient and safe ATS service.

- To encourage operators to take the necessary steps to obtain new approvals for suitably equipped aircrafts in their fleets which would be aligned with the above mentioned modernization plan and international requirements.

Once the new airspace concept is implemented, the AOC could plan strategically, the free route rather than tactically, the flight plan in accordance with the new operational circumstances. Likewise, higher automation in the flight planning systems may significantly decrease the AOC workload and coordination.

In accordance with the expected ATM flexibility, internally the airlines must consider the tactical decisions made by the Captain concerning the balance of the different flight parameters (optimum time, minimum fuel consumption and total cost).

- A further validation campaign could be envisaged, based on the legacy left by SATISFIED, when all the issues/requirements that have come afloat from the SATISFIED project are solved.
- Given the proposed costs, 8% of the savings would be in the future due to environmental Market Based Measures (MBM) for CO₂ emissions. Further savings thus can be expected if other pollutants such as NO_x (critical in the cruise level) are included in the MBM programme.

7. ACTIONS BY THE MEETING

The SAT19 Meeting is invited to:

- a) Take note of the information provided in this information paper;
- b) To disseminate the achieve results;
- c) Take into account the obtained results and suggested recommendations.