Super Highway: Development of an Operationally Driven Airspace Traffic Structure for High-Density High-Complexity areas based on the use of Dynamic Airspace and Multi-Layered Planning

Nicolás Suárez
Isdefe
nsuarez@isdefe.es

Abstract

The Super Highway project will define and validate (using a combination of fast-time and human-in-the-loop simulations) a set of Operational Concept Scenarios that fully use OCD principles to arrange the major traffic flows and patterns using pre-defined routes, to ensure that aircraft fly more safely and more frequently along a “Super Highway”. The traffic structure will be within the Single European Sky functional blocks of airspace and will have two essential components: entries/exits onto the super highway (junctions) and lanes.

The study will focus on the assessment of the Workload per aircraft, and of the Situational Awareness for both junctions and lanes. The assessments will address mainly the effect of the new airspace structure on the controllers and be performed on the two elements of the super highways: lanes and junctions.

The proposed Performance Targets address mainly the operational improvements and the user benefits, and then the implementation of technologies. In this manner the proposed objectives reflect the focus of the study: Decrease the Workload per Aircraft; Improve the Situational Awareness; and Ensure On Time Performance.

1. Introduction

The Super Highway project will be partly financed by the European Commission through the 6th Framework Programme. Super Highway focuses on the development of an innovative airspace traffic structure based on the simplification of the route network around the major European traffic flows. The new airspace structure will make full use of the Operational Concept Document [1] principles, and in particular of Layered Planning, System Wide Information management, and Distributed Air and Ground responsibilities, to increase available ATM en-route capacity in the high-density areas. The proposed approach will break from traditional airspace design incorporating into the route design the use of these OCD principles.

To ensure full operational benefits, the project is based on the innovation of the operational framework rather than on the development of new technologies. Emphasis is placed on obtaining the maximum synergies between locally available systems and the overall European framework, to optimise the overall efficiency of the system. Special attention will be placed on guaranteeing the accessibility and equity of the proposed airspace structure.

Through the use of Super Highways, airspace capacity is expected to be improved with respect to the classical sectorised airspace capacity. However, it is clear that if the airport can not accept more capacity than today (for arrivals) or if the terminal area can not feed the Super Highways (for departures), the overall ATM system capacity might not be improved, and having just more traffic in a given part of the airspace (the super highways) would not be useful. Therefore, it should be stressed that the use of Super Highways is a primal part of a transformational solution in which other ATM elements should also change.

2. Technical Approach

The project will elaborate a set of Operational Concept Scenarios that will exploit the OCD principles to arrange the “major” traffic flows and patterns using pre-defined routes. Thus ensuring that aircraft fly more safely and more frequently along the Super Highway. The traffic structure will be located on the Single European Sky functional blocks of airspace (with no constraints coming from national borders) and will have two essential components: the entries / exits into the Super Highway (referred as junctions hereafter) and the routes (called from now on lanes). The Super Highway project will be based on the following design principles:
Airspace boundaries and divisions will not prevent the efficient use of advanced tools (including both air & ground).

An optimum airspace configuration will be developed in combination with other methods for increasing the ATM system capacity.

Flow through the super highways will be based on the Area Control concept.

RNAV will be used whenever practical/feasible.

This structure will be applied in high-density airspace.

The systematic separation of air traffic will be possible.

Economical flight paths will be permitted.

In addition to the OCD, the proposal uses the EUROCONTROL Airspace Strategy [2] principles as guidelines for the development of its structure. It specifically uses the following concepts and improvements described in the strategy document:

- Flight Planning & Information on Flight and Airspace Status.
  - Enhanced Collaborative Decision Making applied to Airspace Management System Wide Information Management (SWIM).

- ATC Sector Design Optimisation.
  - Control on a flow basis.
  - Sectors adapted to particular traffic flows and/or specialised functions.
  - Sectors adapted to variation in traffic flows and/or airspace availability.

- Route Network Optimisation.

The strategy to carry out the project objectives will be based on two major items: the design of operational scenarios, and the assessment and exploitation of these operational scenarios through the use of fast-time and real-time simulations. The Operational Concept Scenarios will be used to identify and describe the operations and activities related to the use of the Super Highway by the relevant actors. The operational scenarios will also support the identification of the tools and technologies needed to implement the Super Highways.

The fast-time and real-time simulations will be used to identify the potential benefits that could be accrued by the Super Highway and also to identify its operability. Since the project will be focused on the determination of the viability of the proposed organisation, the assessments will only address the effect of the new airspace structure on the controllers. The assessment will be performed on the operational concept scenarios in the two main Super Highway elements: lanes and junctions. For the Planner Controller the following aspects will be considered: Conflict Search for future traffic, Planning of entry/exit conditions and Sector Coordination. As for the Executive Controller the following aspects will be considered: planning (as regards conflict solving), actual traffic conflict search, Monitoring (deviations from flight track), implementation of solutions, and hand-over procedures.

The project will focus on the assessment of the Workload per aircraft, and of the Situational Awareness for both the junctions and the lanes. The assessment will be performed on the operational concept scenarios in the two main super-highway elements: lanes and junctions. Since the role of ATCos should be adapted for the use of Super Highways, the operational evaluation will mainly address the effect of the new airspace structure on the controllers. For the Planner Controller the following aspects will be considered: Conflict Search for future traffic, Planning of entry/exit conditions and Sector Coordination. As for the Executive Controller the following aspects will be considered: planning (as regards conflict solving), actual traffic conflict search, Monitoring (deviations from flight track), implementation of solutions, and hand-over procedures.

As a result from the assessment, the Project will include a list of initial requirements for the new support tools that might be necessary.

The following figure summarises the main principles that will be used to develop the operational concept scenarios.
3. Work Package Breakdown

Special care has been given to the Work Breakdown Structure (WBS) and to the content of every work package, in order to insure a maximum consistency and solidity to the project. Every work package has a very clear role (from operational concept scenario to assessments) and clear relationship with the others.

Following the stated technical principles and the development strategy, the project is organised into four work packages: Operational Concept Scenario Elaboration, Benefits Assessment, Development of Conclusions and recommendations and Exploitation and Dissemination. Additionally there will be a project management and coordination work package. This structure is presented in the following figure:
4. Consortium Structure
To carry out the work, a consortium has been created with five of the leading organisations in the area of Air Traffic Management research: Isdefe (as coordinators), Aena, DFS, Eurocontrol Experimental Centre and SENASA. These organisations will use their available skills and expertise to carry out all the technical and management activities to complete the project.

Two major Air Navigation Service Providers (Aena and DFS) provide operational expertise related to the design and implementation of the system. The operational expertise provided by the end user is expected to be obtained through the performance of the workshop and user forum.

Even though there is an adequate representation of the different operational skills needed, the Consortium has felt the need to increase the participation of airlines. Since by nature airlines are difficult to engage of project of this kind, the Consortium has envisioned to use workshops performed at selected project times, to obtain their inputs regarding the operational concept scenarios and the project conclusions.

The required system engineering skills (e.g. system modelling, system assessment) are provided by the following companies:

- System modelling: Isdefe and EUROCONTROL EC.
- System assessment: Aena, DFS, EUROCONTROL EC, SENASA.
- System Validation: Isdefe and EUROCONTROL EC.

It must be noted that the Consortium includes the companies that lead the expertise related to the performance of fast-time and real-time validation experiments (Aena, DFS, EUROCONTROL EC and SENASA).

5. References