SESAR 2020 Solution PJ.06-02
Management of Performance Based Free Routing in Lower Airspace

Krzysztof Banaszek – PJ.06-02 OSED V1 Task Leader
PANSA

April 2018, IRL-2018 Conference (17-18.04.2018)

Founding Members

SESAR 2020
Solution PJ.06-02

SESAR 2020 Solution PJ.06-02 - Basic info:

SESAR· Solution· PJ.06-02 SPR-INTEROP/OSED·for·V1 -·Part·I¤

D3.1.01¤	Public¤
PJ06¤	
Grant:¤	734129¤
Call:¤	H2020-SESAR-2015-2¤
Topic:¤	Trajectory·based·Free·Routing¤
Consortium·coordinator:¤	B4¤
Edition·date:·¤	22·December·2017·¤
Edition:¤	5¤

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

The Free Routing concept is a transversal operational concept that affects many ATM activities at regional, sub-regional and local level.

Free Routing is the ability of an Airspace User to plan/re-plan route according to the user-defined segments, i.e. segments of great circle connecting any combination of two user-defined or published waypoints.

The Solution PJ.06-02 is contributing to the improvement of air traffic management at local level to enable Free Routing in high complexity cross-border environments and Management of Performance Based Free Routing in lower airspace sees the application of FRA for airspace users beyond the PCP expectations (below FL310), improving predictability, efficiency and flexibility for a wider range of different airspace users.

SPR-INTEROP / OSED document is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734129 under European Union's Horizon 2020 research and innovation programme.

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

In order to achieve the aim of the solution, the objectives will be focused on the following aspects:

- Creation and validation (FTS and PRTS) of procedures to be applied by ANSP and Airspace Users.
- CNS performance aspect (cyber-security) will be validated with main focus on the assessment of the resilience of Free Route operations and the impact that data integrity issues may have on human performance (ATCOs) and safety in Free Route environment.

The Solution PJ.06-02 takes as input previous Free Route Solutions:

- **Solution #32**: Free Route through the use of Direct Routing for flights both in cruise and vertically evolving for cross ACC/FIR borders and in high complexity environments
- **Solution #33**: Free Route through Free Routing for Flights both in cruise and vertically evolving for cross ACC/FIR borders and within permanently low to medium complexity environments

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

FRA in SESAR

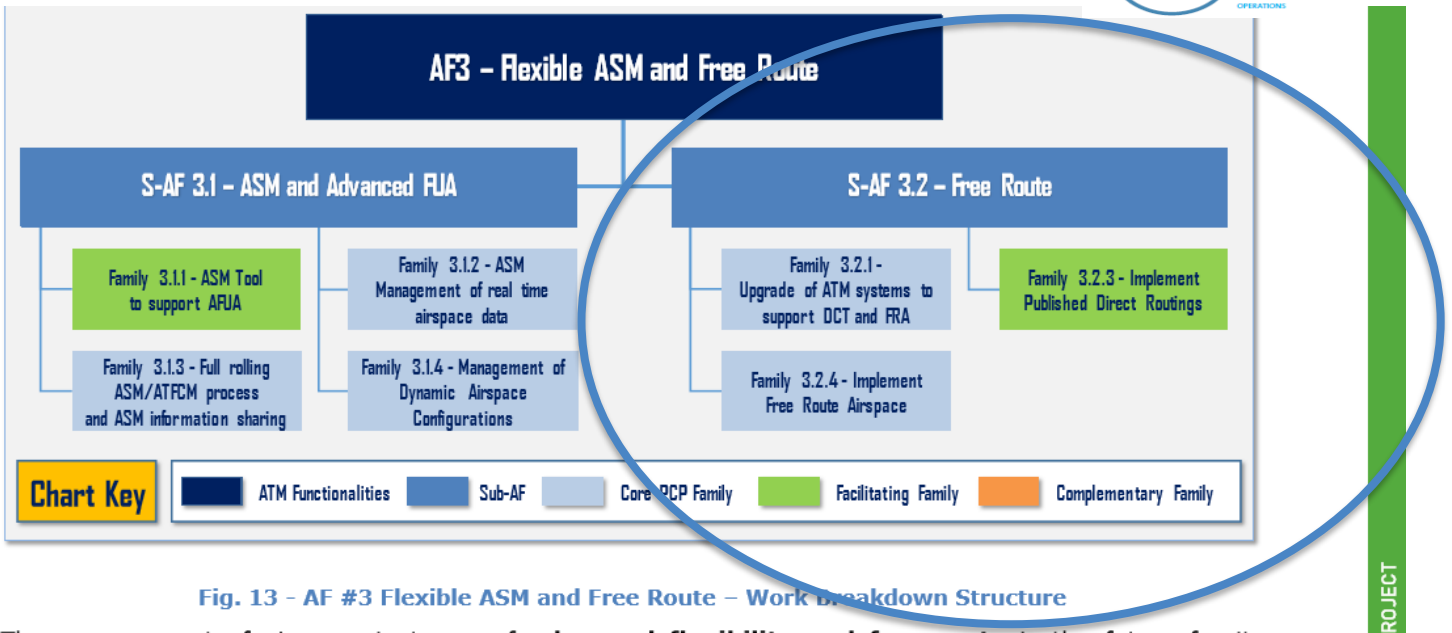


Fig. 13 - AF #3 Flexible ASM and Free Route – Work Breakdown Structure

The management of airspace in terms of **advanced flexibility and free route** is the future for its optimization. The main aims of ATM Functionality #3 are to produce **benefits to the environment**, in terms of **emissions reduction**, as well as to the Airspace Users, with respect to the desired trajectories and with due consideration of the impact on airspace capacity. These objectives may be achieved by combining the following operations:

- Implementation of **ASM management systems, tools, airspace structure, and procedure** that support an advanced **Flexible Use of Airspace**. The aim is to ease, to **facilitate segregations and reservations of portions of airspace when required for exclusive usage**, avoiding, as much as possible, to hamper the military mission effectiveness and providing, at the same time, minimum impact on other airspace users.

- Implementation of **harmonised DCTs and Free Route Airspace throughout Europe**, with necessary support by system upgrades and tools. This shall enable flights to as far as possible to fly their **preferred route without the typical constraints of fixed route network** and rigid airspace structure.

THE PROJECT VIEW OF THE PILOT COMMON PROJECT

Source: Document SESAR-Deployment-Programme-edition-2017 (https://www.sesardeploymentmanager.eu/publications/deployment-programme/)

SESAR Solution lifecycle

The SESAR Solution lifecycle includes five Maturity Gates, these are decision points assessing achieved results and authorising continuation of development and validation activities along the lifecycle. Each Gate is based on a set of success criteria.

The following figure provides an overview of the SESAR Solution lifecycle, its phases and Gates.

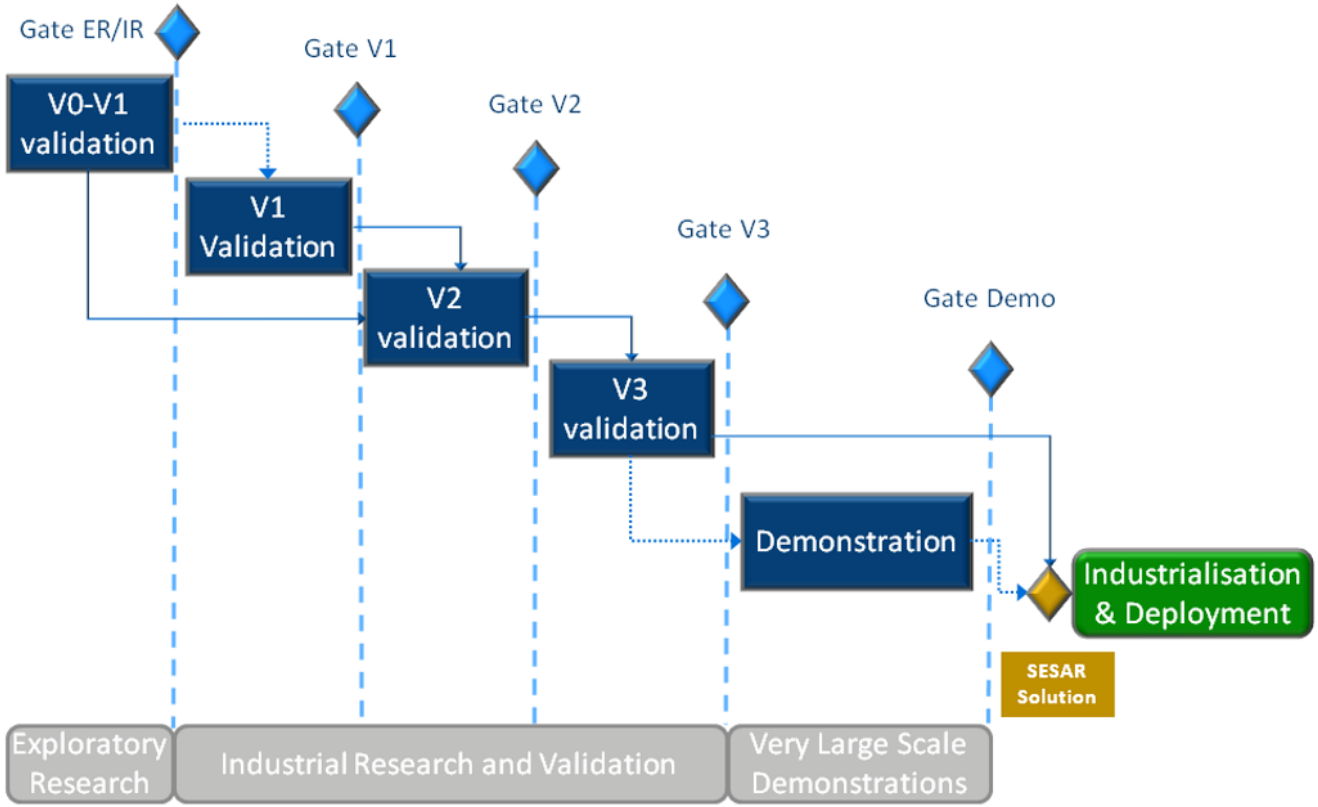


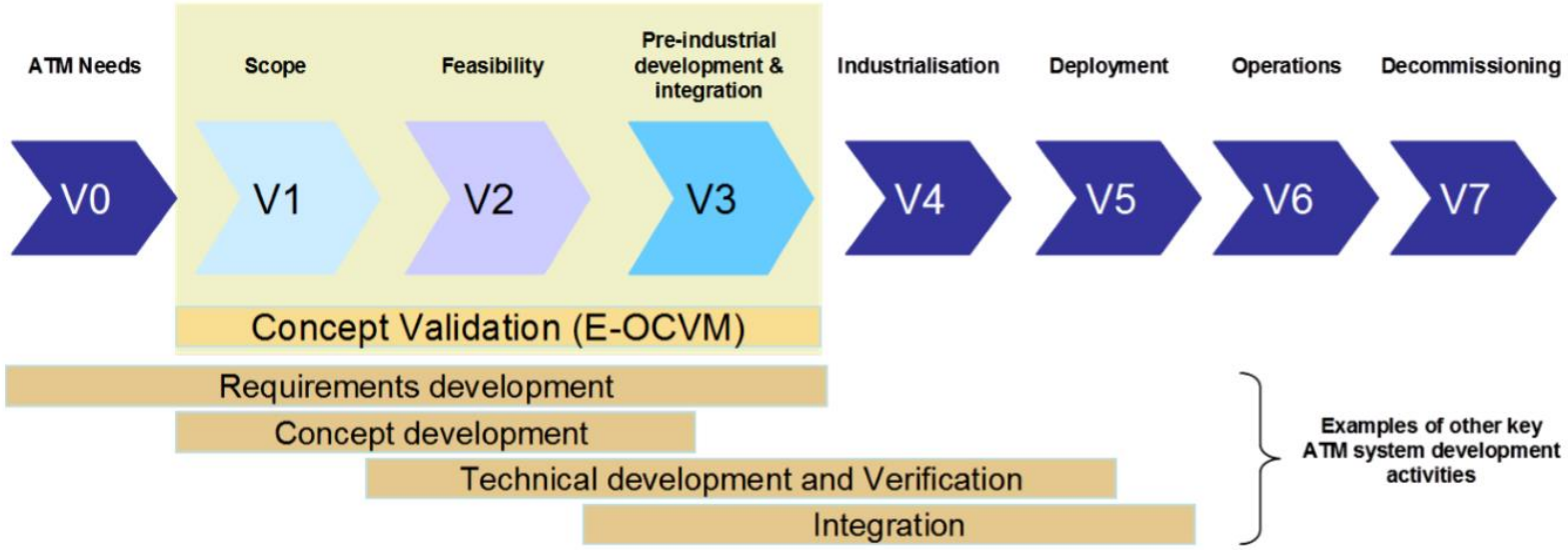
Figure 8 Gates and phases of SESAR Solution life cycle

Source: Document Introduction to the SESAR 2020 Programme Execution (30th April 2015 Edition 01.00.00)

SESAR 2020 Multi-Annual WP

Research Maturity

Regulation 409/2013 calls for the maturity of ATM functionalities to be demonstrated, inter alia, on the basis of the results of validation carried out by the SESAR Joint Undertaking, the status of standardisation and certification processes and an assessment of their interoperability, also in relation to the ICAO Global Air Navigation Plan and relevant ICAO material. Today the SJU has the established principle of managing research maturity using the European Operational Concept Validation Methodology (E-OCVM) and includes gate reviews etc. described in the current Programme Management Plan. Shown in the diagram below (repeated from the official publication) are the maturity phases and the scope of E-OCVM.



Source: Document SESAR 2020 Multi-annual Work Programme (01 July 2015 Edition 1.0)

SESAR 2020 Solution PJ.06-02

Expected outcome and benefits

PJ.06-02 approach will ease the flight preparation for segment of airspace users mentioned above. To minimize fuel consumption and flight time between departure and landing sites direct is taken as mandatory for planning purposes, at least between TMAs exit and entry points.

The effort of route finding should be moved from commander to the planning system, that utilizes information from AUPs and other sources and, having aircraft performance data, solves several alternative route proposals within direct is desirable most. The expected outcomes and benefits are:

- Improved predictability and efficiency for a wide range of different airspace users, therefore improved Access and Equity including for BA/GA and rotorcrafts.
- Lower fuel consumption and increased flight efficiency due to the flight routes being optimised for weather conditions, aircraft performance and overall flight length.
- Safety maintained or improved.

It is expected that proposed Free Routing concept in solution PJ.06-02 will not decrease safety levels. In that prospect, the target remains to mitigate the potential negative impact resulting from more flexible aircraft operations not structured by a fixed ATS Route Network by appropriate layered ATM services adapted to Free Routing operations.

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

Network Operations - Network Management Role and Responsibilities

The Network Vision for 2020/21 is to achieve predictability, punctuality, safety and service continuity. This will be achieved by the following:

- **Free Route Airspace - fully deployed in the upper En-Route airspace. With the possibility to extend further to a level as close as possible to the TMA in lower airspace**
- Efficient access to airports - high density segregated departure and arrival routes requiring PBN capabilities
- Advanced flexible use of airspace - unused airspace will be made available to either civil or military users
- Network operations (e.g. Target Time Over - TTO) are integrated with local/FAB ops (e.g. AMAN/DMAN) through cooperative traffic management
- Network Safety is addressed with a focus on human aspects
- SWIM enables the sharing of dynamic ATM information to support the European ATM Network.

As part of its general role and responsibilities described above, the Network Manager will support the combined operation of Flexible Airspace Management and Free Routing taking into account operational performance requirements addressing both flight efficiency and capacity.

Network Manager will also participate to the evolution of ATFCM from airspace to a trajectory based system, through a Network collaborative management process and towards a Cooperative Traffic Management environment, in order to support efficient Network management in Free Routing environment.

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

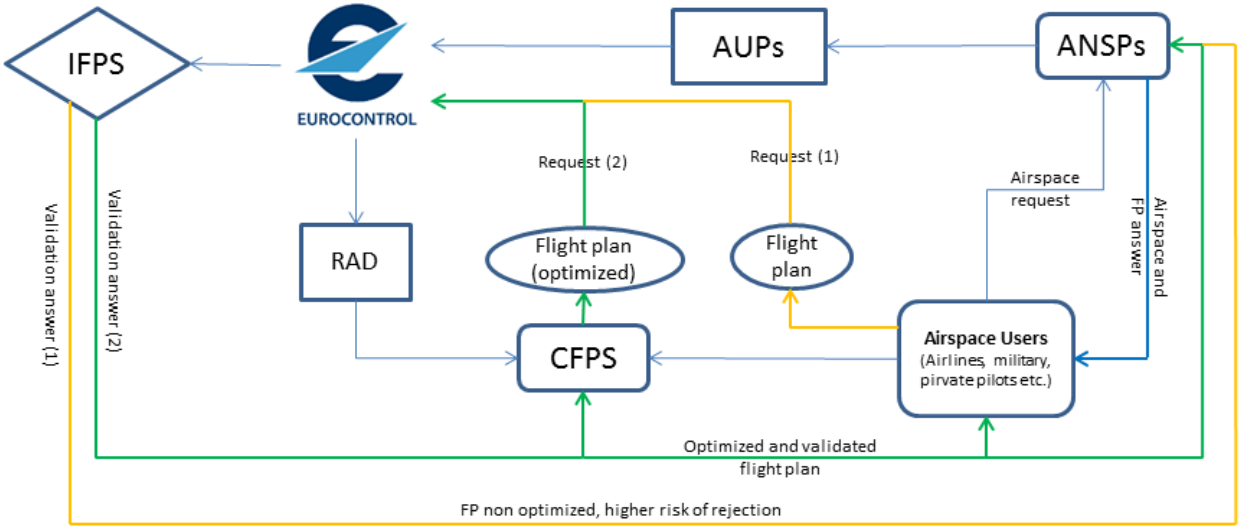
SESAR 2020 Solution PJ.06-02

Flight planning algorithms for airspace users - Contemporary flight planning and execution proces (The presented situation).

Today each flight which is going to take place in the controlled airspace and each IFR flight, regardless of type of airspace should be preceded by filling a flight plan. This message contains all relevant data regarding performance of the aircraft and the planned route from departure to destination in terms of position, time and fuel consumption. The number of operations within airspace and different types of airspace users as well as capabilities of air traffic managers imply the rules the airspace is organised with.

Flight planning information flow

Two ways of request: direct (1) or via CFPS (2)



Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

New SESAR Operating Method

Extending FRA below FL310 will introduce significant change to the design, management and operation of the Network within ECAC. The airspace below FL 310 contains a more complex mix of Airspace Users and flight phases than the upper airspace where more flights are in level flight. Below FL 310, altering the structured network of routes and associated rules that has ensured the safe and efficient flow of traffic arriving and departing from airports in Europe for generations, will require substantial change to all actors and systems engaged in Network Operations.

Change to ATM (including airspace design, ASM and ATFCM) civil and military ATC systems, controller support tools, ATCO procedures and working methods, Airspace users and the CFSPs will occur. Inevitably, adapting to a new environment of FRA outside Terminal areas below FL 310 will incur financial cost for most users. However significant benefit is expected to predictability, flight efficiency and the environment.

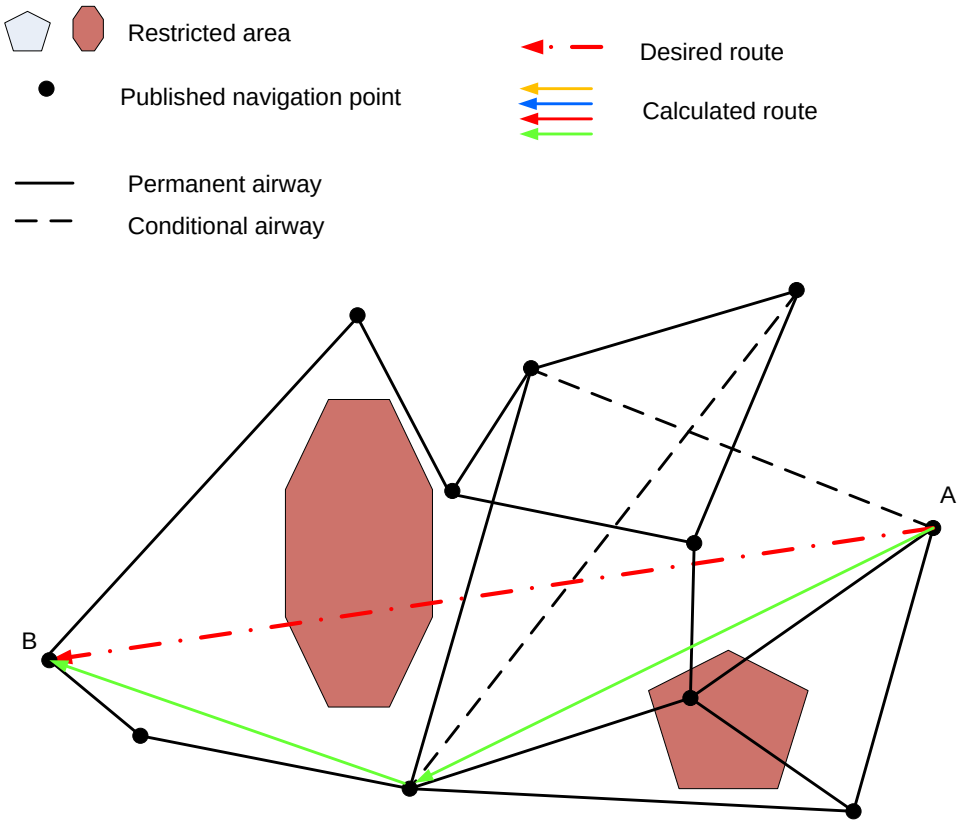
Below FL 310, FRA will be extended to all airspace down to a defined Flight Level (within PJ06.02 this will be FL 95) excluding Terminal Airspace within which a pre-determined structure of arrival and departure routes will still be required to expeditiously handle increasing numbers of arrival and departure flights.

PJ06-02 works on the feasibility to extend FRA below FL305, focusing on ATCO working methods and will provide a solution to support flight planning in FRA for small aircraft operators / General Aviation (GA).

Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

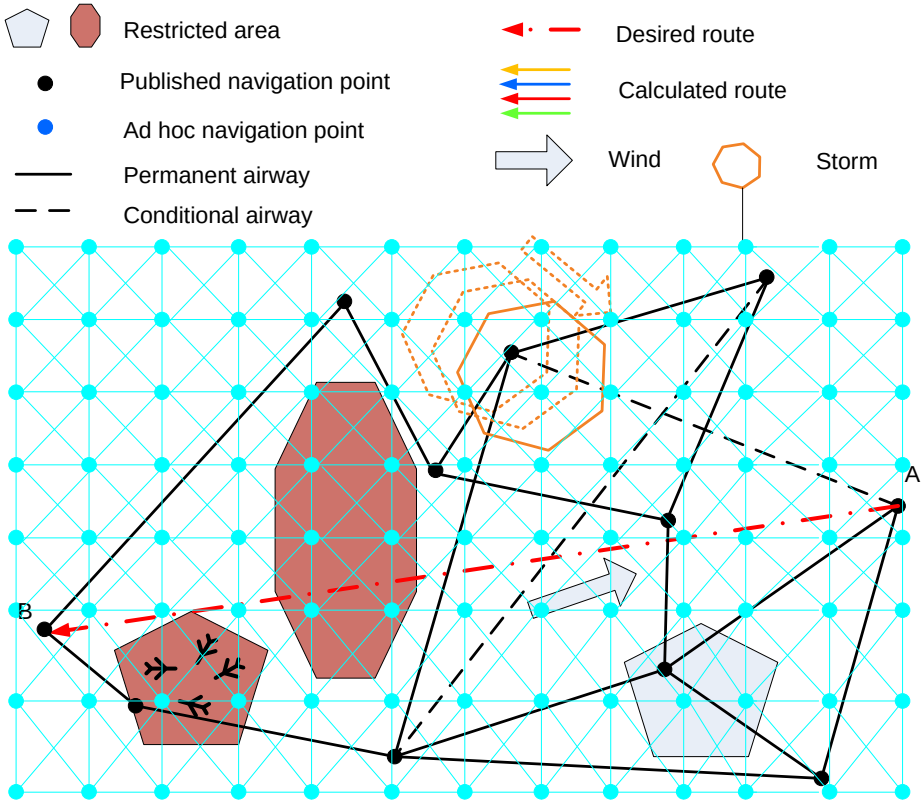
Free Route Airspace (FRA) **model** extends the way the fights may be planned. A segment of the route can be defined between any of given navigation points. This multiplies the amount of possible flight routes, as some of them do not follow the predefined airways. Figure 3 shows a new flight route found within a given airspace model, where Free Route concept is incorporated. Two "shortcuts" between a given set of navigation points has been found, and the flight route has been shortened.

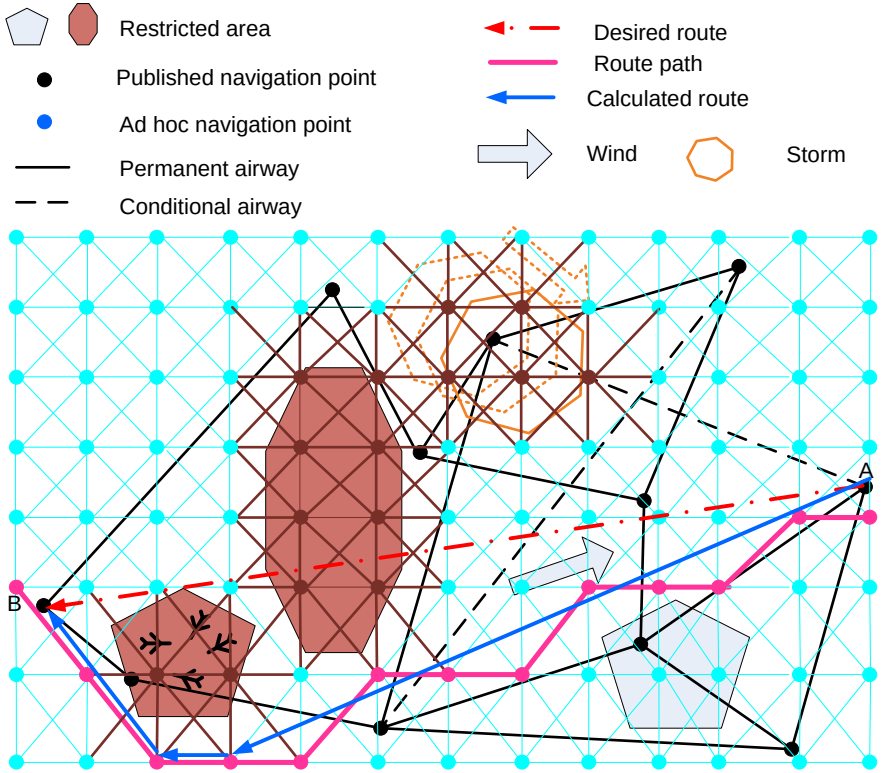


Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

Airspace model chosen for optimized flight planning algorithms development will "cover" all the space by regular graph, where only neighbouring nodes are connected by an edges. Figure 9 includes an example shape of the new graph modelling the airspace. The nodes positions and density will be a subject of research.

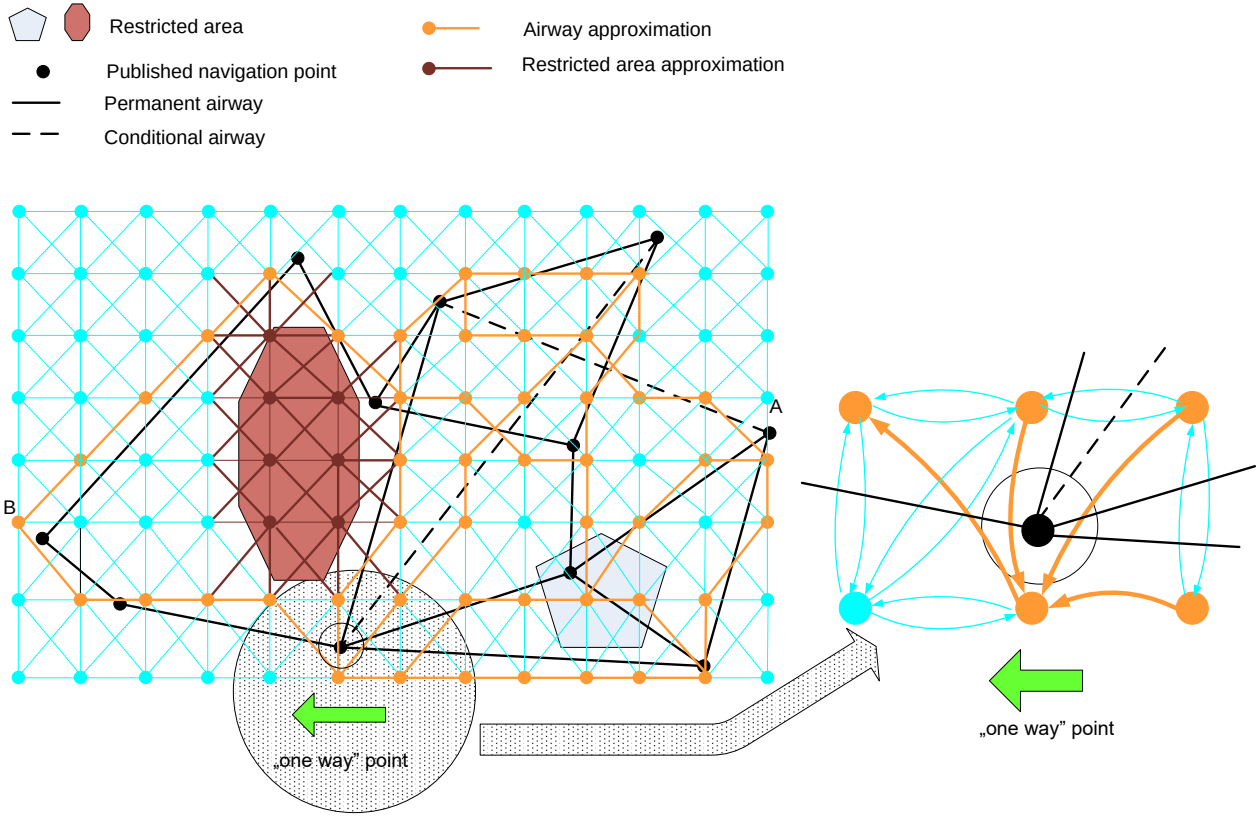




Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 Solution PJ.06-02

The new airspace model assures also a kind of "backward compatibility" to the previous airspace representation. For example, the "Free Route" flight paths finding can be transferred into "airways flight planning" by elimination of the next set of nodes and edges from the graph. Figure below shows the possibility of reduction the model into an approximation of the "old" airways. Similarly, the new model is able to utilise the restrictions idea.



Source: Document PJ06-02 SPR INTEROP OSED V1 (02.2018)

SESAR 2020 and PJ.06-02 Summary

SESAR 2020 PJ.06 TRAJECTORY-BASED FREE ROUTING

Project partners will validate both the benefit to airspace users and the impact on ATM of the extension of free routing (FRA) into complex airspace and lower vertical limits through modelling and real-time simulations. The results will seek to provide evidence that FRA can be implemented, cost effectively, in all the Single European Sky airspace.

http://www.pansa.pl/?menu_lewe=sesar2020&lang=_eng&opis=sesar_pj06_tobefree

SESAR 2020

The SESAR (Single European Sky ATM Research) is the technological pillar of the Single European Sky. Its aim is to develop a modern air traffic management system, that can handle the permanent growing volume of air operations while improving safety indicators, and reduce costs. The use of modern technologies and procedures will also help to reduce the negative impact of aviation on the environment.

The aim of the SESAR Programme is to move from the fragmentation of air traffic management in Europe to synchronize the activities of all those involved in the process.

http://www.pansa.pl/?menu_lewe=sesar2020&lang=_eng&opis=sesar_info

SESAR 2020 PJ.06 ToBeFree

Project Partners:



Project PJ.06 ToBeFree has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 734129.

SESAR 2020

Solution PJ.06-02 – Trajectory based Free Routing

Thank you very much for your attention!

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

Founding Members

The opinions expressed herein reflect the author's view only.
Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.